

ESEE  2025

27th European Seminar on Extension & Education
*Inclusivity and transformations of agricultural
extension and education*

Vila Real, Portugal, June 30 – July 4, 2025



BOOK OF ABSTRACTS

2025

27th European Seminar on Extension & Education *Inclusivity and transformations of agricultural extension and education*

The conference was organised in Vila Real, Portugal, June 30 - July 4, 2025

More information

<https://www.esee2025.utad.pt/>

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Book of Abstracts**

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Theme and Topics

Central Theme

“Inclusivity and transformations of agricultural extension and education”

International organisations (such as the FAO and OECD), alongside European agricultural policies, are currently focused on promoting sustainability-oriented innovation processes aimed at triggering and advancing transformative transitions of the agrifood system towards sustainability, resilience, integrative health, inclusiveness, and fairness. Agricultural Knowledge and Innovation Systems (AKIS) at various levels – ranging from farm to value chains and regions – together with agricultural education, rural extension, and farm advisory subsystems, play a crucial role in facilitating these desired transformations. Education and extension are not only major drivers but also key players in co-producing innovative and customised knowledge and skills with farmers and farming communities, ensuring the inclusiveness of sustainability-oriented transformative transitions.

Education and extension are undergoing significant transformations, including the pluralistic landscape of advice providers involved in sustainability-oriented transitions, the need to keeping in pace with new processes and organisational models driven by sustainability transitions, alongside an increasingly heterogeneous farming community and an evolving AKIS. The digitalisation of knowledge and advisory services, particularly AI (artificial intelligence), is a major ongoing transformation, presenting substantial inclusiveness challenges. These challenges risk exacerbating already complex issues of social inclusion and the health and wellbeing of farmers and communities, as well as agricultural education and extension communities.

The ESEE2025 conference aimed to explore concepts, frameworks, methods, tools, and empirical evidence related to these transformative transitions of the agrifood system, from the perspective of agricultural extension and education. This included examining its own transformation and assessing the extent of its inclusivity.

The five key topics of the conference were:

- TOPIC 1 – AKIS approaches and policies: from concepts to action and impact
- TOPIC 2 – Collective learning, innovation processes and capacity building: new tools and methodologies
- TOPIC 3 – AI and digitalisation of advisory services and education
- TOPIC 4 – Education, advisory services and the wider AKIS’s contribution to social inclusion and the health and wellbeing of farmers and communities
- TOPIC 5 – How education and advice drive agrifood systems transformations

Committees

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- Alex Koutsouris, Agricultural University of Athens – Greece
- Andrea Knierim, University of Hohenheim – Germany
- Artur Cristóvão, University of Trás-os-Montes e Alto Douro – Portugal
- Ataharul Chowdhury, University of Guelph – Canada
- David Rose, Harper Adams University – UK
- Esmail Karamidehkordi, Tarbiat Modares University – Iran
- Fernando Landini, National Scientific and Technical Research Council; University of La Cuenca del Plata, Argentina – Argentina
- Hanna Tamsalu, Centre of Estonian Rural Research and Knowledge, METK – Estonia
- Hycenth Tim Ndah, University of Hohenheim – Germany
- Jorie Knook, Lincoln University – New Zealand
- Laurens Klerkx, University of Talca – Chile; Wageningen University - Netherlands
- Lisa Blix Germundsson, SLU Competence Center for Advisory Services – Sweden
- Livia Madureira, University of Trás-os-Montes and Alto Douro – Portugal, president of the international scientific committee of the 27th ESEE
- Maria do Mar Perez, University of Santiago Compostela – Spain
- Mark Moore, Teagasc – Ireland
- Micheline Marie-Sainte, ENSFEA – France
- Otavio Balsadi, EMBRAPA – Brazil
- Patricia Fry, Bern University of Applied Sciences – Switzerland
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- Peter Paree, ZLTO – Netherlands
- Pierre Labarthe, INRAE – France
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- Artur Cristóvão, UTAD, CETRAD
- Carlos Fonseca, UTAD CETRAD
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- Manuel Tibério, UTAD, CETRAD
- Marco Silva, UTAD, CETRAD
- Octávio Sacramento, UTAD, CETRAD
- Pedro G. Silva, UTAD, CETRAD
- Rogério Bessa, UTAD, CETRAD

Conference Topics

Topic 1 – AKIS approaches and policies: from concepts to action and impact

Convenors: Esmail Karamidehkordi; Fernando Landini; Simona Cristiano

The AKIS approach plays a vital role in fostering and navigating rural transitions by creating an enabling environment for knowledge exchange and co-creation among farmers, researchers, policymakers, and other stakeholders, guided by multi-actor, multi-sectoral, and multi-level perspectives. This empowers rural communities by combining local knowledge with scientific advancements and integrating technological innovations with social dimensions, enabling them to address complex challenges and foster sustainable, socially inclusive, and locally relevant rural and agrifood transformations.

- How long Strategies, research, institutions, and policies for strengthening AKIS are set to support navigating rural and agrifood transitions and co-constructing liveable futures? Contributions focus on how strategies, policies, governance structures, and institutional arrangements embed mission-oriented, systems-based, multi-sectoral, multi-actor, and multi-level perspectives and enable responsiveness, adaptation, and transition towards more sustainable agri-food and socio-ecological systems in rural areas, by ensuring inclusiveness and responsiveness to local contexts and needs.
- How multi-sectoral, multi-actor, and multi-level perspectives are influencing the organization of roles and functions of the different actors and their interactions with rural and the agrifood systems? Contributions aim at identifying the diversity of the key actors and how these, at different levels of the AKIS, are influencing their functioning towards more sustainable agri-food and socio-ecological systems in rural areas.
- How long does AKIS functioning, through knowledge flows and innovation processes, enable fostering and navigating rural and the agrifood transitions towards more sustainable agri-food and socio-ecological systems in rural areas? Contributions focus on identifying the types, approaches, and tools of knowledge flows characterizing AKIS, along with their conditionalities, models, and effectiveness in fostering user-centered co-creation processes. This includes exploring how these processes combine, by which methods and tools, scientific, technical and tacit knowledge to address practical challenges and problems of the AKIS. Moreover, interconnections between AKIS within and across countries, especially between the global North and South, are investigated to explore how they are due to strengthen the functioning of the AKIS in view of more effective and resilient agricultural systems globally. Macro and micro level system failures, weaknesses and strengths of AKIS are also explored within this topic.
- How long the system capacities within the AKIS support navigating transitions of agri-food and socio-ecological systems in rural areas: Contributions explore frameworks, methods, and tools to define and assess system capacities that foster transformational pathways towards more sustainable agri-food systems, including the assessment of needs and the alignment with capacity-building offerings.

- How long does the long the AKIS approach address the barriers, challenges and incentives to engage in transitions of rural and agrifood systems? Contributions identify the challenges and barriers faced by multiple actors, particularly farmers, advisors, and researchers, in truly engaging in inclusive, collaborative, multi-actor, and multi-stakeholder knowledge flows and innovations for more sustainable agri-food and liveable rural systems.
- How Monitoring, Evaluation, and Learning frameworks and practices on AKIS can help tracking and navigating rural transitions? Contributions focus on methods for tracking and evaluating the structural, functional, and transformative aspects of systemic change within AKIS, including learning pathways. This also includes the evaluation of supporting strategies of AKIS, innovation processes, and their effects in terms of fostering sustainable agrifood transitions. Additionally, the assessment of the performance of AKIS actors, including advisory and innovation support services, as well as research impact pathway frameworks, is part of this topic.

Topic 2 – Collective learning, innovation processes and capacity building: new tools and methodologies

Convenors: Alexandros Koutsouris; Hycenth Tim Ndah; Patrizia Proietti

The objective relating to this theme is to explore concepts, theories, methods, tools and practices focusing on learning processes and capacity development in the context of sustainability-oriented innovation processes in agriculture, agri-food and rural development, as well as on the results of relevant projects, programmes or courses in different socio-cultural, economic and institutional contexts. Besides the global North, contributions from projects and research activities linked with the global South, or from North-South collaborative initiatives are very welcomed. Abstracts are invited to address a range of topics, which include, but are not limited to:

- Methods, tools and practices supporting learning aiming at systemic, transformative and multi-stakeholder (multi-actor and/or transdisciplinary) processes such as networks/ platforms, social learning, interactive innovation, Living Labs (LLs), EIP OGs, etc.
- Experiences of education and training pathways enhancing systemic changes.
- Extension/Advisory/ innovation support services (ISS) (incl. new service functions, business models, new skills and advisors' training).
- Facilitation of new knowledge, skills and attitudes (or capacity development) aiming at systemic change/ transition to sustainability.
- Co-design, co-creation methods and tools for farming and food systems (citizens'/farmers' science, participatory modelling).
- New monitoring/assessment/evaluative approaches, methods and tools to support the analysis of learning pathways, organizational capacities for supporting and accompanying innovations, and capacity development aiming at systemic change.

Topic 3 – AI and digitalisation of advisory services and education

Convenors: Ataharul Chowdhury; Pierre Labarthe

Digitalisation has been a topic for the ESEE conference since 2017 and the 23rd edition organised in Chania (Greece). This question is renewed by the fast uptake of certain

technologies (e.g. social media), changes in access to certain technologies (e.g. the Copernicus program in Europe that provides open access to satellite images), the revolution of Artificial Intelligence (AI) and new legislations and changing power balance (e.g. EU Data Act and Data Governance Act). Hence, there is still a need to produce knowledge about how these diverse technologies and associated regulation actually transform the actors, practices and organisations of advice and education. Abstracts are invited to address a range of topics, which include, but are not limited to:

- Artificial Intelligence: are there already examples of extension services designed or maintained thanks to AI? Who are the actors proposing such services? How can advisors interact with these technologies in their everyday work with advisors? What can we anticipate about social shaping of AI and its adoption by agricultural advisory service providers?
- Misinformation and directionality: with AI and social media comes the risk that “fake news” are disseminated in the farming community. How can advisors reinforce themselves and fight against this risk? How can we enhance trust in advice in the digital age? How can advisor deal with negative and/or toxic behaviour online? More globally, with digitalisation emerges the need to revisit the question of education and extension directionality: does digitalisation create new dependencies on agricultural industry or can it also serve alternative models valorising practical knowledge, with new advice and education models and practices?
- Labour and collective organisation: labour organisation becomes more and more complex in the agricultural sector. Can advisors use digital technologies to support, communication and decision making in complex agricultural holdings? Can advisors influence that digitization is enhancing farmers’ and employees’ insights, instead of introducing new dependencies on tech providers.
- Platforms and tools: how do the emergence of platforms that facilitate peer-to-peer exchanges between farmers impact the role of advisors. Can they move from exchange to knowledge co-creation towards knowledge certification? can we showcase examples of education and advisory digital tools that actually support sustainability?
- Data governance: which role of advice and education in supporting the management and governance of data? What are the emerging advisory business models associated with agricultural data? What initiatives can be taken to enable teachers and advisors to support farmers in safe and effective data management?
- Digital divide in rural areas and use of technologies: can we highlight successful individual/community/public initiatives to include remote communities?

Topic 4 – Education, advisory services and the wider AKIS’s contribution to social inclusion and the health and wellbeing of farmers and communities

Convenors: David Rose; Jorie Knook; Mark Moore; Tomas Russell

Individuals working and/or living on farm are subject to numerous internal and external stressors, such as environmental pressures, isolation, inclusion and health and safety. The burden of these stressors can be overwhelming and have significant impacts of the individual and the farm business. The aim of this topic is to explore how education and extension can support the mental health and wellbeing of agricultural students, farmers, farm families, workers, and other stakeholders within rural communities. Abstracts are invited to address a range of topics, which include, but are not limited to:

- How can extension and education promote and encourage resilience among agricultural students, farmers, workers, and farming families, as well as extension, education and other professionals engaged with farmers?
- In many countries the farming population is aging, many farmers live alone...how can related issues be addressed by extension professionals, is there a role for education?
- Do extension and education workers have the skills to promote farmer, worker, and family wellbeing, health and safety? Is this their role and does this responsibility place an additional burden on them? If so, how can they be supported in this function, also to look after their own mental health? What responsibility do agricultural extension workers have, if any in relation to difficult issues such as suicide? Are there potential downsides of asking non-medical experts to support mental health, rather than supporting the professionalisation of mental health provision in agriculture? What are the barriers to providing greater access to professional mental health support for farming families? How do we adequately train our professionals?
- How can extension and education structures and processes support the wellbeing of people such as migrant workers, different genders, indigenous peoples, those with mental/physical challenges etc.
- Rural communities still suffer disproportionate levels of workplace injury what new initiatives, models and processes are working well?
- How can agricultural education and extension training curricula and processes address wellbeing issues better?

Topic 5 – How education and advice drive agrifood systems transformations

Convenors: Artur Cristóvão; Hanna Tamsalu; Livia Madureira

The pressure of the agrifood system on the planet's resources, the environmental footprint of food and its impact on the climate, food waste, hunger and malnutrition, and human health problems linked to food and nutrition are undeniable today. Addressing these requires transforming agrifood systems worldwide to become more sustainable, resilient, and health-promoting, while also ensuring fair income distribution across value chains, revitalising rural areas, and securing the food security of rural households in the Global South. The primary aim of this topic is to explore how agricultural education and rural extension are driving the transformation of agrifood systems in these directions. This includes considerations at multiple levels – farm, landscape, and regions – while accounting for the diversity of ongoing transition pathways. These pathways include, but are not limited to, sustainable farm systems, agroecology, the One Health approach, regenerative agriculture, and circular agriculture and agrifood economies. Abstracts are invited to address a range of topics, which include, but are not limited to:

- Strategies, approaches, and practices employed by educators and rural extensionists to develop, co-create, and update knowledge and skills, enabling them to provide customised advice at the farm level to an increasingly heterogeneous farming community. This includes frontrunners, farmers leading transition pathways, as well as mainstream farmers who are struggling to engage with the innovations and changes demanded by society and policy in the context of sustainability transitions.
- How agricultural educators and rural extensionists navigate the increasingly pluralistic advisory landscape, which encompasses a growing number of actors providing formal and informal farm advice, including peer-to-peer farmer networks, farmer suppliers

and clients, researchers, non-farm-oriented NGOs, and specialists, ordinary citizens, among others.

- What new approaches are being adopted by agricultural vocational education, advisory training entities, and advisory services to equip rural extensionists and farm advisors with the knowledge and skills needed to anticipate and support farmers in pursuing multiple sustainability transition pathways at different levels, including the farm, value chain, the territorial or landscape levels, and at the wider AKIS level? This includes responding to multiple challenges such as the effects of climate change, structural labour shortages, new technologies, legislative demands, market and consumer volatility, and societal and local community pressures on farmers.
- How are agricultural vocational education, advisory training entities, and advisory services addressing divergent values and political orientations to mitigate potential advisor bias arising from partiality and a lack of neutrality when providing advice to an increasingly heterogeneous farming community pursuing multiple sustainability transition pathways?
- What policies, strategies, approaches, and practices are being adopted by agricultural knowledge and advisory services (AKIS) at a wider level, as well as by rural extensionists and farm advisors, to address exclusion and unequal access to knowledge and innovation, particularly for hard-to-reach farmers? Additionally, how are they addressing social, organisational, and marketing innovations that involve multiple dimensions beyond the conventional range of technical-agronomic skills of advisors?

Organisation and Support



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Boticas e Montalegre



Programme Overview

Hours (GMT+1, London time)	30th June	1st July	2nd July	3rd July	4th July*
08:00 - 08:30		Registration	Registration	Registration	
08:30 - 09:00					
09:00 - 09:30		Plenary Session 1		Plenary Session 2	
09:30 - 10:00					
10:00 - 10:30		Coffee Break		Coffee Break	Training Workshop
10:30 - 11:00					
11:00 - 11:30		Parallel Sessions 1		Parallel Sessions 5	
11:30 - 12:00					
12:00 - 12:30					
12:30 - 13:00		Lunch	Field Trips	Lunch	Lunch
13:00 - 13:30					
13:30 - 14:00					
14:00 - 14:30		Parallel Sessions 2		Plenary Session 3	Training Workshop
14:30 - 15:00	Registration				
15:00 - 15:30		Coffee Break		Coffee Break	
15:30 - 16:00					
16:00 - 16:30		Parallel Sessions 3		Parallel Sessions 6	
16:30 - 17:00					
17:00 - 17:30	Opening Ceremony	Parallel Sessions 4		Closing Session	
17:30 - 18:00					
18:00 - 18:30					
18:30 - 19:00	Welcome Reception	Business Meeting: Planning ESEE27			
19:00 - 19:30					
19:30 - 20:00			Gala Dinner		
20:00 - 20:30					
20:30 - 21:00					
21:00 - 21:30					
21:30 - 22:00					

Day by day programme

Monday, 30 June 2025

Opening Ceremony

17:00-18:30 – Monday, 30 June 2025

Laboratory Complex B.01

Online streaming: <https://utadtv.utad.pt/live/>

Awarding of the Prémios Crédito Agrícola (CCAM TMAD)

Short video presentation of each of the 6 awarded PhD thesis (Agrarian Sciences, Business & Economics and Regional Development) and 4 awarded MSc thesis (Agrarian Sciences, Business & Economics).



Emídio Gomes
Rector of the UTAD



João Lopes de Moura Seixas
Chairman of the Board of
Directors of the CAM-TMAD

ESEE 2025 Opening Session

Welcome Reception

18:30-20:30 – Monday, 30 June 2025

Largo das Pedrinhas



Emídio Gomes
Rector of the UTAD



Livia Madureira
Chair of ESEE2025



Carla S. Marques
CETRAD Vice-Director

Tuesday, 1st July 2025

Opening Plenary Session

9:00-10:30 – Tuesday, 1st July 2025

Laboratory Complex B.01

Auditório de Geociências (Geosciences Auditorium)

Online streaming: <https://utadtv.utad.pt/live/>

Chair:



Alexandros Koutsouris (Head of the Lab of Agricultural Extension, Agricultural Systems & Rural Sociology, Dept. of Agricultural Economics and Rural Development, Agricultural University of Athens; Greece).

Guest Speakers:



Inge Van Oost (Former Policy Officer AKIS coordination & CAP networks; currently Active Senior Expert; European Commission DG AGRI Unit D.1 – Rural Areas and Networks; Belgium).



Krista Mikkonen (ProAgria; Project manager off ATTRACTISS Optimising knowledge exchange systems for sustainable and circular agriculture and forestry; Finland).



Simona Cristiano (Senior research at the CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Council for Agricultural Research and Economics; Research Center for Agricultural Policies and Bioeconomy; Italy).

11:00-12:30 - Tuesday, 1st July 2025

TOPIC 1 – AKIS approaches and policies: from concepts to action and impact

Convenors: Esmail Karamidehkordi; Fernando Landini; Simona Cristiano

Session 1A – Laboratory complex B.01

AGROECOLOGY AND SUSTAINABILITY IN AGRICULTURAL TRANSFORMATION

- *Agroecological transitions and Agricultural Knowledge and Innovation Systems in Europe: theoretical, methodological and practical insights*
Tanya Zerbian
- *Identification of Challenges and Opportunities for adopting Climate Mitigation Actions on Dairy Farms in Ireland*
Niamh Dunphy; Seamus Kearney; Sinéad Flannery
- *Advancing Agroecological Innovations in Sub-Saharan Africa: Agricultural Knowledge and Innovation Systems in Angola with Perspectives from Zambia*
Jose Rosario; Carlos Marques; Hycenth Ndah; Livia Madureira
- *Aligning incentives for innovation and environmental sustainability. A framework for sustainable productivity growth in agriculture*
Mercedes Campi
- *Identifying innovations and knowledge systems in agroecological transitions*
Fabíola Polita; **Ana Filipa Fonseca**; Livia Madureira

TOPIC 2 – Collective learning, innovation processes and capacity building: new tools and methodologies

Convenors: Alexandros Koutsouris; Hycenth Tim Ndah; Patrizia Proietti

Session 1B – Laboratory complex B.02

ADVISORS' EDUCATION-TRAINING

- *Rethinking advisory capacities and roles: Fostering learning and change for Climate Smart Farming*
Jorieke Potters; Ellen Bulten; Kevin Collins; Martin Javornický; Kevin Heanue
- *Learning About Crossing the Lines: The WELL-E Approach to Capacity Development*
Helen Hambly; **Elsa Vasseur**
- *Designing interactive summer school training: Insights from i2connect trainers*
Eleni Zarokosta; Sangeun Bae; Maria Gerster-Bentaya; Andrea Knierim; Alex Koutsouris
- *The use of official tools in university education for the practice of rural extension: An educational experience with the National Registry of Family Farming (ReNAF)*
Analía Oviedo; Fernando Frisicaro Olsece

- *Asynchronous collaborative student engagement to foster development of Communication and Innovation skills at third level*
Kathleenf Lonergan Erickson; Kieran Meade

TOPIC 3 – AI and digitalisation of advisory services and education

Convenors: Ataharul Chowdhury; Pierre Labarthe

Session 1C – Laboratory complex Room 1.04

DEMO AND TEST OF LLM & AI FOR LLL AND EXTENSION

- *Proof of Concept: Leveraging Large Language Models for Qualitative Analysis of Participant Feedback*
Andrew B. Crocker; Marcelo Schmidt; Juan D. Tejada; Howard Rodriguez-Mori; Rachel A. Brauner; Gary Wingenbach
- *The Emergence of AgML's CY-Bench: An AI Platform to Enhance Engagement, Empowerment, and Partnerships*
Robert Strong; Ioannis Athanasiadis; AgML Community
- *ExtensionBot's AI Impacts on Extension and Advisory Services*
Robert Strong; Bruce Herbert; Mahendra Bhandari; Juan Landivar-Bowles; Luis Tedeschi; Karun Kaniyamattam; Seth Murray
- *Semantic precision in agricultural advisory: Human-in-the-loop frameworks for enhancing RAG-tuned LLMs in smallholder contexts*
Andrea Gardeazabal

TOPIC 4 – Education, advisory services and the wider AKIS's contribution to social inclusion and the health and wellbeing of farmers and communities

Convenors: David Rose; Jorie Knook; Mark Moore; Tomas Russell

Session 1D – Laboratory complex Room 1.13

GENDER, EXTENSION AND RESILIENCE

- *Gender Realization and Women's Inclusion in Citrus Value Chains for Livelihood: A Case of Citrus Industry in Pakistan*
Ejaz Ashraf; Muhammad Ahsan; Saira Akhtar; Gomathy Palaniappan
- *The Power of Workforce Resilience and Cooperative Extension*
Rachel Brauner; Andrew B. Crocker; Lakshmi Mahadevan; Christopher Plein; Gary Wingenbach
- *Does Climate Adaptation Improve Food Security and Household Well-being? The Critical Role of Information and Misinformation in Shaping Adaptation and Resilience*
Nasir Khan; Ataharul Chowdhury
- *Building Capacity for Mental Health Education in Rural Texas: Qualitative Insights from a Mental Health First Aid Grant Program*
Lakshmi Mahadevan; Rachel Brauner

TOPIC 5 – How education and advice drive agrifood systems transformations

Convenors: *Artur Cristóvão; Hanna Tamsalu; Livia Madureira*

Session 1E – Laboratory complex Room 1.14

FARMING ADVISORY & RURAL EXTENSION: SUPPORTING NEW TRENDS IN AGRICULTURE

- *The Evolving Media Spotlight on Agriculture and its Influence on Farm Advisory Services. Trends and transformations in Irish newspapers since 1970*
Claire McCormack
 - *Supporting the implementation of an “alternative” agricultural project in the Basque Country, the role of agricultural education*
Micheline Marie-Sainte; Josiane Babe; Mikael Akimowicz
 - *How Do Advisory Services Translate into Improved Performance and Impact of Short Food Supply Chains? An Analysis of “Golden Cases” identified in the COREnet project*
Lisa Blix Germundsson; Rafal Serafin; Jan Willem van der Schans; Aine Macken-Walsh; Yuna Chiffolleau
 - *A new dynamics in extension privatisation: exploring “linked suppliers” in Australia and Europe*
Pierre Labarthe
 - *The ‘good farmer’ and nature conservation through the eyes of agricultural advisors: Insights from Slovenia*
Ana Novak; Tanja Šumrada
-

14:00-15:30 - Tuesday, 1st July 2025

TOPIC 1 – AKIS approaches and policies: from concepts to action and impact

Convenors: *Esmail Karamidehkordi; Fernando Landini; Simona Cristiano*

Session 2A – Laboratory complex B.01

PUBLIC POLICIES AND INSTITUTIONAL FRAMEWORKS FOR AGRI-FOOD INNOVATION

- *Role of agricultural experiment stations in AKIS: How could the Brandenburg’s (Germany) agricultural experiment stations be well set up for the undergoing agriculture transformations?*
Sabrina Scholz; Ralf Bloch
- *Identification of barriers and oportunities for developing policies to foster innovation in the agri-food sector of the Madrid region: a study based on the AKIS approach*
Adrián García; José Luis Cruz; Mario González Azcárate; **José Flomesta**
- *The WELL-E Initiative: Inclusive Innovation to deliver data-driven solutions with and for the Canadian Dairy Industry*
Elsa Vasseur

-
- *Future-proof guiding framework: how to translate foresight into impact?*
Zofia Krystyna Mroczek; **Nevena Alexandrova-Stefanova**
 - *Living Labs in Agroecological Transition: Bridging Academia, Agricultural Extension, and Practical Implementation*
Monica Dantas; Lívia Madureira; Carla Ferreira; Mário dos Santos

TOPIC 2 – Collective learning, innovation processes and capacity building: new tools and methodologies

Convenors: Alexandros Koutsouris; Hycenth Tim Ndah; Patrizia Proietti

Session 2B – Laboratory complex B.02

NETWORKS – MAA

- *Role of social network for the diffusion of Climate Smart Agricultural technologies in Bangladesh*
Md Rezaul Karim; Andreas Thiel; Md Aminur Rahman
- *The functioning and potential of European online Advisory Networks: the case of short food supply chain advisors*
Fedele Colantuono; Lisa Blix Germundsson
- *Facilitating exchange and co-creation of knowledge relating to sustainable calf management in the UK: the multi-actor Calf Action Network*
Laura Palczynski
- *A Dynamic Action Plan for the monitoring of a National Network in a European demonstration project of climate-smart farming practices (Climate Farm Demo)*
Audrey Miserez; Laure Triste; András Ver
- *Collaborative processes as strategies for social innovation in a mountain context*
Sara Simões; Joana Nogueira; Carla Marques; Hermínia Gonçalves

TOPIC 3 – AI and digitalisation of advisory services and education

Convenors: Ataharul Chowdhury; Pierre Labarthe

Session 2C – Laboratory complex Room 1.04

CRITICAL THINKING ON AI AND EXTENSION

- *Large Language Models (LLMs) in Agriculture: Opportunities and Challenges in Agricultural Extension Services (EAS)*
Uduak Edet; Ataharul Chowdhury
- *From Access to Agency: Evaluating (Dis)Affordances in Farmer-Led Digital Extension Design and Delivery*
Eliot Jones-Garcia; Kristin Davis; Laurens Klerkx
- *Bridging the data-action gap: potential opportunities and risks for generative AI language models in communicating data insights to poultry farms*

Laura Palczynski; **Holly Vickery**; David Rose

- *Farmers' data sovereignty in the age of generative AI: implications for agricultural education and extension*
Katarzyna Kosior

TOPIC 4 – Education, advisory services and the wider AKIS's contribution to social inclusion and the health and wellbeing of farmers and communities

Convenors: David Rose; Jorie Knook; Mark Moore; Tomas Russell

Session 2D – Laboratory complex Room 1.13

YOUNG FARMER MENTAL HEALTH AND TRUSTED SPEAKERS

- *The role of farm advisory services in boosting resilience of young farmers*
Giuseppe La Rocca; Annalisa Marigliani; Evangelos Lioutas; Chrysanthi Charatsari; Marcello De Rosa
- *Mental wellbeing education in agricultural universities and colleges: understanding provision, student needs, and the potential role for peer-led initiatives*
Tom York; **David Rose**
- *Mental Health and Wellbeing Education in Tertiary Institutions: Exploring Areas for Development*
Jorie Knook; Nicky Stanley-Clarke; Amanda Hay; Sinead Flannery; Kendra Janssen; **David Rose**
- *Trusted voices in farming: Identifying who farmers deem credible mental health speakers*
Paul Nangle; Ella Joyce; **Tomas Russell**; Louise McHugh; Alison Stapleton

TOPIC 5 – How education and advice drive agrifood systems transformations

Convenors: Artur Cristóvão; Hanna Tamsalu; Livia Madureira

Session 2E – Laboratory complex Room 1.14

KNOWLEDGE & ADVICE FOR SUSTAINABLE TRANSITIONS IN AGRICULTURE AND AGRIFOOD SYSTEM

- *Sources of Information on Organic Agriculture and Good Agricultural Practices of Citrus Producers in Muğla Province of Türkiye*
Tayfun Çukur; Halil İbrahim Yalçın; Figen Çukur
- *Empowering Sustainable Winemaking: The Role of Education in Efficient Water and Energy Management*
Maria Rita Teixeira; Cristina Matos; António Valente; José Baptista; Ana Brigasá
- *Bridging Knowledge and Agriculture: A Socioeconomic Framework for Assessing Agroecological Transitions in Agri-Food Systems*
Carla Ferreira; Livia Madureira; Mónica Dantas; Sofia Neto

-
- *Adoption of Pheromone Trap for Eco-friendly Vegetables Cultivation*
Md Rezaul Karim; Mohammad Anamul Haque; Md Juwel Rana; Jahan Bin Reza; Mahfujur Rahman
-

15:45-17:15 - Tuesday, 1st July 2025

TOPIC 1 – AKIS approaches and policies: from concepts to action and impact
Convenors: Esmail Karamidehkordi; Fernando Landini; Simona Cristiano

Session 3A – Laboratory complex B.01

INTERACTIONS, NETWORKS, AND KNOWLEDGE DYNAMICS WITHIN AKIS

- *Strengthening innovation processes through AKIS approach: Farmers perspectives*
Samir Sayadi Gmada; Adriana Bertuglia; José Luis Cruz Macein
- *Theoretical typology of linkages among research, extension and farmers: A call for a pragmatic approach*
Fernando Landini; Santiago Conti; Ana Villalba
- *Reflecting on a 6-year transition towards systems thinking in a multi-level, pluralistic and heterogenous AKIS – insights for practice*
Sarah Hood; Zarmeen Hassen; Cherry Emerick; Sean Kenny
- *Do public policies support knowledge networks? A qualitative analysis of an Italian case*
Eleonora Caruso; Giuseppina Olivieri; Rossella Ugati; Ferdinando Gandolfi; Teresa Del Giudice; Alessandro Sapio; Concetta Menna
- *Sharing knowledge with farmers: researcher's role in remote areas of Europe*
Teresa Pinto-Correia; Elisa Marraccini and Lucia Piani

TOPIC 2 – Collective learning, innovation processes and capacity building: new tools and methodologies

Convenors: Alexandros Koutsouris; Hycenth Tim Ndah; Patrizia Proietti

Session 3B – Laboratory complex B.02

AKIS ACTORS

- *Innovating in policy space: Innovation Policy Labs making policies more impactful*
Zofia Krystyna Mroczek; Nevena Alexandrova-Stefanova; Manuela Bucciarelli
- *Engaging AKIS actors in shared learning with researchers: The Re-Livestock Project*
Karen McGrath; Jim Kinsella

-
- *Bridging the communication gap between Irish farmers and policy makers to support engagement in sustainable agriculture practices*
Conor McCloskey; Padraig Lacey; Sean Boyle; Tomas Russell; **Louise McHugh**; Nigel Vahey
 - *Learning from collaboration in agricultural innovation systems: changing capabilities, opportunities, and motivation*
Marlene Roefs; Scott Drimie
 - *Enhancing Agricultural Advisory Services Through Impact Assessments: Lessons from the CARE r4d Project in West Africa*
Fernando Sousa

TOPIC 3 – AI and digitalisation of advisory services and education

Convenors: Ataharul Chowdhury; Pierre Labarthe

Session 3C – Laboratory complex Room 1.04

FARMERS AND ADVISORS FACING DIGITAL: TRANSPARENCY, ACCESS, GOVERNANCE, MISINFORMATION...

- *Beyond the screen: The real-world consequences of anti-social behavior and online toxicity in agricultural knowledge sharing on social media*
Khondokar Kabir; Saifur Rahman; Mohammad Maruf Hasan; Ataharul Chowdhury; Andrea Knierim
- *What affects farmers' intention to learn about sustainability in online settings? An application of the extended theory of planned behaviour in Slovenia*
Ana Novak; Živa Alif; Luka Juvančič; Tanja Šumrada
- *Digital Insights into Greenwashing: analyzing social media discourse with AI Tools*
Cibele Souza
- *How are digital platforms hybridizing agricultural advisory systems? The case of Agroconsultas Online in Argentina*
Jeremias Lachman; Federico Bert; Laurens Klerkx
- *Advancing Dairy Extension: A Digital Living Laboratory Approach to Knowledge Mobilization in the Canadian Dairy Sector*
Steven Roche; **Elsa Vasseur**

TOPIC 4 – Education, advisory services and the wider AKIS's contribution to social inclusion and the health and wellbeing of farmers and communities

Convenors: David Rose; Jorie Knook; Mark Moore; Tomas Russell

Session 3D – Laboratory complex Room 1.13

HELP-SEEKING AND 'ACCIDENTAL COUNSELLORS'

- *Farmer Mental Health Help Seeking: Developing Knowledge for Policy and Extension Use*
Siobhán O'Connor; Sinéad O'Keeffe; **Hannah Casey**; Sandra Malone; Joseph Firnhaber; John McNamara; Annie O'Connor; Anna Donnla O'Hagan
- *'Accidental counsellor' or 'accidental confidant': exploring the role of land agents, agronomists, and contractors in supporting farmer mental wellbeing*
David Rose; **Laura Palczynski**; Kreseda Smith; Jenny Howse
- *Building on Solid Foundations: Reflecting on the key learnings from the 'On Feirm Ground' training model and the implications for mental health promotion targeting farmers.*
Barbara Moore; Noel Richardson; Tomás Russell; Louise McHugh; Deirdre O'Connor; Alison Stapleton
- *Trusted voices in farming: Identifying who farmers deem credible mental health speakers*
Paul Nangle; Ella Joyce; **Tomas Russell**; Louise McHugh; Alison Stapleton

TOPIC 5 – How education and advice drive agrifood systems transformations

Convenors: Artur Cristóvão; Hanna Tamsalu; Livia Madureira

Special Session 3E – Laboratory complex Room 1.14

- *Advisory skills at the frontier – insight from short food supply chain advising from Horizon Europe Advisory Networks COREnet and EU4Advice*
Fedele Colantuono; Jan Willem van der Schans, Marta Fernandez, Áine Macken-Walsh, Lisa Blix Germundsson

17:30-19:00 - Tuesday, 1st July 2025

TOPIC 1 – AKIS approaches and policies: from concepts to action and impact

Convenors: Esmail Karamidehkordi; Fernando Landini; Simona Cristiano

Special Session 4A – Laboratory complex B.01

- *Transformative approaches in Monitoring, Evaluation, and Learning, enhancing organizational capacities for innovation and systemic change: the TAP-AIS example*
Manuela Bucciarelli; Aurelie Toillier; Nevena Alexandrova-Stefanova

TOPIC 2 – Collective learning, innovation processes and capacity building: new tools and methodologies

Convenors: Alexandros Koutsouris; Hycenth Tim Ndah; Patrizia Proietti

Special Session 4B – Laboratory complex Room 1.04

- *PREMIERE online repository for multi-actor project proposals*
Hanne Cooreman; Jon Woning

Session 4B – Laboratory complex B.02

LEARNING

- *Learning in large networks: developing a Dynamic Learning Agenda for climate smart advisors*
Ellen Bulten; Jorieke Potters; Kevin Collins; Martin Javornicky; Kevin Heanue
- *Integrating routinised and reflective learning to enhance collaborative knowledge development on large dairy farms*
Louise Axelsson; Magnus Ljung
- *Integrating codified and tacit knowledge in advisory services for medicinal plant cultivation: challenges and opportunities in Basilicata Region*
Valentina Carta; Simona Cristiano; Maria Assunta D'Oronzio
- *How can we assess the plural adoption processes of a digital technology in agriculture and the systemic changes induced? Proposal of a methodological framework applied to the SoYield® case in Senegal*
Céphas Djossouvi; Chloé Alexandre
- *Development of a Hybrid Human-AI personalised learning path for VET for innovation in agriculture*
Aiden Brady

TOPIC 4 – Education, advisory services and the wider AKIS's contribution to social inclusion and the health and wellbeing of farmers and communities

Convenors: David Rose; Jorie Knook; Mark Moore; Tomas Russell

Session 4D – Laboratory complex Room 1.13

Online

- *Whole Farm Planning for the 21st Century: Integrating Childcare into Your Whole Farm Plan*
Shoshanah Inwood
- *The Development of the Irish Farm Accident Causation Model*
Carolyn Scott

TOPIC 5 – How education and advice drive agrifood systems transformations

Convenors: Artur Cristóvão; Hanna Tamsalu; Lívia Madureira

Session 4E – Laboratory complex Room 1.14

SUPPORTING AGROECOLOGICAL TRANSITION: NEW METHODS AND APPROACHES

- *Agroecological transitions in the Douro wine region: Trade-off Analysis (TOA) methodology*
Sofia Neto; Lívia Madureira; Mário Santos; **Carla Ferreira**
- *Impact of Agricultural Extension on Agroecological Transitions of peri-urban Market Gardening in Ouagadougou (Burkina Faso): A Kirkpatrick Model Evaluation*
Patrice Djamen; Gédéon Sakandé; Achille Diendéré; Nifaagnourpèdomè Poda; Thomas Yaméogo
- *Co-design of SMART indexes to assess agrobiodiversity in NUC farming: the experience of 9 Living Labs in Europe*
Paola Hernandez
- *Land use characterization in the Itamarati settlement through aerial survey: contributions to research, rural and university extension, and agrifood system transformation*
Juliana Carrijo Mauad; Marcelo Silva; Laiane Palacio

Wednesday, July 2nd 2025

Field Trips

9:00-18:00



[Field Trip 1 – Visit to Barroso Globally Important Agricultural Heritage System](#)



[Field Trip 2 – Learn About the agroecological transitions in Douro wine region](#)



[Field Trip 3 – Visit to the LIFE Maronesa Project](#)

Gala Dinner

19:30-21:30

Panoramic Restaurant

Thursday, 3rd July 2025

Plenary Session 2

9:00-10:30 - Thursday, 3rd July 2025

Auditório de Geociências (Geosciences Auditorium)

Online streaming: <https://utadtv.utad.pt/live/>

Chair:



Ataharul Chowdhury (Associate Professor and Graduate Program Coordinator, Capacity Development and Extension, University of Guelph, Canada and the President of the Executive Board of the AIAEE – Association for International Agricultural and Extension Education; Canada).

Guest speakers:



Elsa Vasseur (Associate Professor William Dawson Scholar, Innovation Chair in Animal Welfare and Artificial Intelligence (WELL-E); Canada).



John Leamy (ICT Innovation & Research Manager at Teagasc - Agriculture and Food Development Authority Ireland; Ireland).



Robert Strong (Professor of the Department of Agricultural Leadership, Education, and Communications at Texas A&M University, USA).

11:00-12:30 - Thursday, 3rd July 2025

TOPIC 1 – AKIS approaches and policies: from concepts to action and impact
Convenors: Esmail Karamidehkordi; Fernando Landini; Simona Cristiano

Session 5A – Laboratory complex B.01

EXTENSION AND ADVISORY SERVICES: PRACTICES, ACTORS, AND IMPACTS

- *Sharing best practices: Lessons from the organic advisory systems of Italy and Sweden*
Roberta Milardo; Lisa Blix Germundsson
- *Conceptualising Rural Communication Services in Indonesia – policies and practices within the AKIS landscape*
Elske van de Fliert; Anggelina Putri Ratu; Arifin Nur Hidayat; Cindy Vebyola Batubara; Husna Wulansari
- *Disputing the Agenda? Coexistence of Different Ideologies in Brazilian Rural Extension*
André Macedo; Vanilde Souza Esquerd; Ricardo Borsatto
- *‘More than cocoa’: Analysing agricultural extension and advisory services for non-cocoa tree crops in Ghana*
Paul Schmidt; Kingsley Ofofu Ampong
- *What influences the choice of advisory services of Italian farmers?*
Concetta Menna; Rossella Ugati; Elisa Ascione; Teresa Del Giudice; Ferdinando Gandolfi; Alessandro Sapio; Eleonora Caruso

TOPIC 2 – Collective learning, innovation processes and capacity building: new tools and methodologies

Convenors: Alexandros Koutsouris; Hycenth Tim Ndah; Patrizia Proietti

Session 5B – Laboratory complex B.02

METHODS & TOOLS 1

- *Social learning videos: Exploring potentials of a transdisciplinary methodology for the EU project Gov4all*
Patricia Fry; Léa Klaue; Susan Thieme
- *The “farmer’s and advisory journey”, a tool for advisors to reflect on change in farming and their role as advisors*
Florence Bedoin; Caroline Evrat-Georgel
- *The “Game of Left Behind Territories”: A Strategy for Enhancing Collective Learning Pathways and Driving Systemic Change*
Maria João Parreira; Artur Cristovão; Iva Pires

-
- *Games-based learning for aggregated farming in Western, Kenya*
Andrew Bell; Wei Zhang; Balentine Oingo; Dickson Kinuthia; Ivy Blackmore; Upeksha Hettiarachchi; Kristin Davis
 - *What do agricultural advisors need from a Decision Support Tool to drive agroecological transitions? The case of Ntui Living Lab, Cameroon*
Beatriz Herrera; Roman Spiegelsberger; Hycenth Tim Ndah; Viviane Mandah; Alvine Tchouga; Precillia Tata Ngome; Gwladys Mabah; Komi Fiaboe; Diego Cerrudo; Ludovic Temple; Andrea Knierim; Marc Corbeels
 - *Understanding Effective Follower Behaviors: A GLOB(E)al Perspective*
Jennifer Strong

Special Session 5B – Laboratory complex Room 1.04

- *Understanding and developing Innovation Support Services (ISS): the contribution of HORIZON projects - a joint session between i2connect, ATTRACTISS and modernAKIS*
Alexandros Koutsouris

Session 5B – Online - Laboratory complex Room 1.13

- *Diagnosing Agricultural Advisory Service Methods to Drive Agroecological Transition in Rwanda*
Shu-Wei Chow; Maria Gerster-Bentaya; Hycenth Tim Ndah; Vicky Ruganzu; Marc Corbeels
- *Advancing Sustainability-Oriented practices through South-South Collaboration in Rural Vocational Training Centres*
Enrique Fernández Flores
- *Agroforestry Business Model Innovation Network (AF4EU)*
Eduardo Sousa; **Ana Oliveira**; José Castro; João Paulo Castro; Marina Castro
- *Combining the living lab and farmer's field schools approaches in a system of rice intensification: lessons learned and challenges in the Senegal River Valley (Podor)*
Sidy Tounkara; Alioune Diallo; Laure Tall; Paul Ndiaga Ciss; Papa Gueye; Ousmane Dianka
- *Integrating Drone Technology Into Smart Farming: Identifying Key Competences for Agricultural Experts and Drone Operators*
Athanasios Arvanitidi; Anna Palaiologk; Nikoleta Krousouloudi

Session 5E – Online - Laboratory complex Room 1.14

- *The role of education and advising in the implementation of agritourism on farms: modern approaches and prospects*
Tetyana Kalna-Dubinyuk; David Acker

-
- *Communication Methods for Aflatoxin Management to Facilitate Household Food Security in Southwest Nigeria*
Tiwalola Alabi; Adeoye Okubena; Stephen Atilade; Abimbola Sabiyi; Helen Hambly
 - *Green entrepreneurial intentions in Higher Education Institutions*
Maria Correia; Carla Marques; Rui Silva
 - *Exploring sustainability awareness and practices related to food among hospitality and tourism students*
Manuela Carvalho; Luís Tinoca; Anabela Raymundo

Plenary Session 3

14:00-15:30 - Thursday, 3rd July 2025

Auditório de Geociências (Geosciences Auditorium)

Online streaming: <https://utadtv.utad.pt/live/>

Chair:



Artur Cristóvão (Retired Full Professor at the Department of Economics, Sociology and Management, University of Trás-Montes e Alto Douro (UTAD); Senior researcher at the Centre for Transdisciplinary Development Studies (CETRAD), Portugal.

Guest speakers:



Gerald Schwarz (Thünen Institute of Farm Economics, Germany).



Luís Marcos (CEO of ADVID – Associação Desenvolvimento da Viticultura Duriense; Cluster da Vinha e do Vinho e CoLAB VINES & WINES).



Teresa Pinto-Correia (MED – Mediterranean Institute for Agriculture, Environment and Development, U. Évora, CHANGE Associate Lab; Vice-President of the Mission Board on Soil Deal for Europe, Horizon Europe).

16:00-17:30 - Thursday, 3rd July 2025

TOPIC 1 – AKIS approaches and policies: from concepts to action and impact

Convenors: Esmail Karamidehkordi; Fernando Landini; Simona Cristiano

Session 6A – Laboratory complex B.01

CO-CREATION OF KNOWLEDGE AND INTERACTIVE INNOVATION IN AKIS

- *Insights from Evaluating Swedish EIP-Agri Projects 2017–2024: Challenges, Outcomes, and Lessons Learned*
Lisa Blix Germundsson; Erik Hunter; Charlotte Norrman
- *How AKIS players deal with the idea that farmers know best: an analysis of attempts to redefine modes of knowledge production and dissemination in France*
Nicolas Giraud
- *Research agendas in the interplay among researchers, extension agents and farmers: The case of the National Institute of Agricultural Technology (Argentina)*
Fernando Landini; Santiago Conti
- *Co-Creation of Knowledge and Information Sharing in Rural Pakistan: Strengthening AKIS for Climate Change Adaptation*
Sana Ullah; Maria Navarro

Session 6A – Online - Laboratory complex Room C1.07

- *Accompaniment of capacity building processes for the design of multi-stakeholder and multilevel agroecological initiatives: the case of the Ñuble region, Chile*
Carolina Barra; Santiago Peredo y Parada; Consuelo Calafat-Marzal
- *Leveraging Agricultural Knowledge and Information Systems for Nature-based Solutions: A Pathway to Sustainable and Resilient Farming*
Melika Gholamian Sefidarboni; **Shahla Choobchian**
- *The AKISInteractivity index: a system perspective assessment of interactions within the Agricultural Knowledge and Innovation Systems*
Edward Kyei Twum; Simona Cristiano; Valentina Carta

TOPIC 2 – Collective learning, innovation processes and capacity building: new tools and methodologies

Convenors: Alexandros Koutsouris; Hycenth Tim Ndah; Patrizia Proietti

Session 6B – Laboratory complex B.02

METHODS & TOOLS 2

- *Learning and extension methods preferences by farmers for promoting beef genetics tools in Northern Australia*
Patricia Menchon; Amy Cosby; Dave Swain; Jaime K. Manning

- *How do farmers select advisory sources? A Greek study*
Evangelos Lioutas; Chrysanthi Charatsari; Giuseppe La Rocca; Marcello De Rosa
- *Analyzing the role of agricultural extension and education in improving the agricultural startups ecosystem*
Alireza Norouzi; **Enayat Abbasi**; Esmail Karamidehkordi
- *Didactical Strategies for developing interactive innovations in rural Europe: Lessons from the I2CONNECT project*
Eleni Zarokosta; Alex Koutsouris; Niels Rump
- *Analysing the diversity of farmers' pesticide use through professional dialogue networks analysis*
Emma Le Merlus; Marie-Hélène Jeuffroy; Jean-Marc Meynard; Claude Compagnone

Session 6B – Laboratory complex Room 1.04

METHODS & TOOLS 3

- *Toward refined conceptualizations and methodological approaches to understand shifts in knowledge production and guide interventions for agroecology transition*
Bonnie Averbuch; Jérôme Bindelle; Fanny Boeraeve; Benjamin Dumont; Bienvenu Kambashi Mutiaka; Elke Plaas; Gerald Schwarz; Martin Hvarregaard Thorsøe; Torsten Rødel Berg
- *Supporting farmers as a structuring activity for an organization: The case of multi-stakeholder cooperatives in France*
Célia Auquier; Ketty Bravo; Amandine Largeaud; **Pierre Triboulet**
- *Levers and limits for agricultural collectives under Geographical Indication to take action in transitions. Six case studies from the French cheese sector within the ADAOPT project*
Florence Bedoin; Delphine Neumeister; Sylvain Dernet
- *A framework for assessing and enabling national agroecology extension systems: approach and results from its application in five West African Countries*
Patrice Djamen; **Martin Bosompem**; Daniel Koffi; Christophe Rigourd; Astou Diao Camara; Khady Nani Dramé; Abdoul Moutalib Dit Seybatou Ndiaye; Emmanuel Bamidele Tologbonse; Alfredo Handem; Cherno Talato Jaló
- *Developing a socially distributed knowledge production model for agricultural research and innovation projects*
Chrysanthi Charatsari; Evangelos Lioutas; Panagiota Sergaki; Stefanos Nastis; Dimitrios Aidonis; Anastasios Michailidis

Special Session 6B - Laboratory complex Room 1.13

- *Let's play! Special session with a serious game for strengthening the governance of agrifood innovation systems*
Zofia Krystyna Mroczek; Manuela Bucciarelli; Nevena Alexandrova-Stefanova

Special Session 6E - Laboratory complex Room 1.14

- *How can Living Labs became effective tools for farmer advisory? The case of LivingSoiLL (Mission Soil EU project)*
Cristina Carlos, Livia Madureira, Leonor Pereira, Cristina Micheloni, Ekaterina Kleshcheva; Anderson Galvão, Carmem Leal, Emili Santos, Octávio Sacramento, Pedro G. Silva

Closing Session

17:30-18:30- Thursday, 3rd July 2025

Laboratory complex B.01

Friday, 4th July 2025

ATTRACTISS/i2Connect team

9:00-16:00 - Friday, 4th July 2025

Workshop organisers and facilitators

Museu do Douro (Douro Museum), Peso da Régua

Alexandros Koutsouris (Head of the Lab of Agricultural Extension, Agricultural Systems & Rural Sociology, Dept. of Agricultural Economics and Rural Development, Agricultural University of Athens; Greece)

Krista Mikkonen (Project Manager of the Association of ProAgria Centres, Finland)

Patrizia Proietti (Senior research at the CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Council for Agricultural Research and Economics; Expert of the Italian National Rural Network; Italy)

Rui Almeida (Chairman of the European Forum for Agricultural and Rural Advisory Services (EUFRAS); Partner & Operational Director of CONSULAI, Portugal)

Simona Cristiano (Senior research at the CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Council for Agricultural Research and Economics; Research Center for Agricultural Policies and Bioeconomy; Italy)

The ESEE conference will host a training day organised by the ATTRACTISS project. ATTRACTISS is a Horizon Europe projects which aims to empower innovation support services as a pathway for a more sustainable agriculture & forestry sector (<https://attractiss.eu/>)

The ATTRACTISS training is a learning-by-doing training where we will explore how innovation can be supported using real life examples.

Objectives:

Create a shared understanding about what interactive innovation - and its processes!
- are, why they are important, and how to make the most of them.

Explore skills and tools that can help you (as part of an ISS!) facilitate and support interactive innovation processes.

Share a space where we will learn, try, practice, experiment and reflect on interactive innovation-related learnings, skills and tools.

Collectively and individually reflect on the common learning process.

By the end of the day you will:

- Understand what interactive innovation processes are, why they are important and how to make the most of them.
- Be able to identify and support individuals and groups in exploring and honing ideas.
- Have a supportive network when developing your training and further exploring the possibilities of interactive innovation!

Extended Abstracts

TOPIC 1 – AKIS approaches and policies: from concepts to action and impact

Convenors: Esmail Karamidehkordi; Fernando Landini; Simona Cristiano

Session 1A

AGROECOLOGY AND SUSTAINABILITY IN AGRICULTURAL TRANSFORMATION

Agroecological transitions and Agricultural Knowledge and Innovation Systems in Europe: theoretical, methodological and practical insights

Tanya Zerbian¹

¹ Institute of Economics, Geography and Demography, Centre for Human and Social Sciences, Spanish National Research Council (CSIC), Spain

Short abstract

As calls for transforming agrifood systems intensify, agroecological transitions are increasingly recognised as key pathways toward greater socio-ecological sustainability. Given their knowledge-intensive nature, such transitions require renewed attention to Agricultural Knowledge and Innovation Systems (AKIS). This paper presents findings from a critical review of AKIS research in Europe through the lens of agroecological transitions. Grounded in a transformative agroecology perspective, an analytical framework is developed to assess how AKIS research engages with critical tensions of agroecological transitions, particularly regarding the democratisation of knowledge and innovation systems, attention to epistemic injustices, and the development of inclusive, bottom-up knowledge and innovation processes. The review reveals a growing emphasis on farmers' agency, diverse knowledge systems, and the role of informal actors, helping to reframe AKIS as socially embedded and territorially situated. However, persistent limitations remain. While participatory and transdisciplinary approaches are often referenced, they are rarely operationalised. Moreover, limited engagement with the politics of AKIS, as well as how they reinforce or challenge epistemic injustices, restricts the identification of levers through which AKIS could contribute to more inclusive and systemic change. The findings underline the importance of moving beyond functionalist framings to better align AKIS research and policy with transforming agrifood systems, particularly by addressing how knowledge is co-produced, governed, and contested across scales and networks.

1. Purpose

Although the path to sustainable agrifood systems remains contested, organic and agroecological farming are increasingly seen as a cornerstone for advancing such transitions (Wezel et al., 2020). Given their knowledge-intensive nature, Agricultural Knowledge and Innovation Systems (AKIS) play a pivotal role in facilitating their adoption (Moschitz et al., 2021). Despite some variations in definition, AKIS are broadly understood as a strategic framework for identifying, analysing, and assessing the various actors involved in the production, exchange, and application of agriculture-related knowledge and innovation, as well as their relationships and interactions (Knierim et al. 2015). Nevertheless, guidelines, strategies, and public policies for developing AKIS aligned with knowledge-intensive farming systems, as well as addressing broader sustainability goals, such as social inclusion and climate adaptation, are scarce, underdeveloped and not executed adequately (Laurent et al., 2022). This paper presents findings from a critical review of AKIS research to identify insights, gaps and limitations in assessing their transformative potential in Europe through the lens of

agroecological transitions. As will be further explained, agroecological transitions involve shifting from productivity- and efficiency-driven agriculture to sustainability-oriented agrifood systems, integrating technological, societal, institutional, and organisational changes at multiple scales, emphasising a broader paradigm shift in how we understand, organise and govern agrifood systems (Gliessman, 2016).

2. Materials and methods

2.1 Analytical framework

The analytical framework of the study is underpinned by a transformative approach to agroecology, which emphasises a paradigm shift that puts governance, democracy and power at the centre of sustainability transitions (Anderson et al., 2020). Accordingly, it calls for a rupture of conventional thinking about agrifood systems, arguing for the hybridisation of epistemological domains and, thus, for the interactions of agroecology's three main dimensions: science, movement, and practice (Rivera-Ferre, 2018).

Building on this notion, key agroecological frameworks and seminal works were reviewed to identify relevant elements for identifying relevant insights in AKIS research concerning transformative agroecological transitions. This exercise led to the identification of six analytical themes: **content** (what types of knowledge and innovation are considered); **process** (how AKIS research frames and analyses knowledge and innovation processes); **actors** (how are the roles of different AKIS actors considered and analysed); **purpose** (what is the purpose of AKIS research, how is the role of AKIS conceptualised in agrifood systems change); **governance** (how AKIS research situates and analyses knowledge and innovation within broader governance frameworks; and finally, **spatio-temporal scale** (how AKIS research incorporates the territorial dimension of knowledge and innovation). These themes collectively emphasise the crucial role of epistemic justice and the democratisation of research and innovation in sustainable agrifood systems by supporting diverse ways of knowing and socially embedded learning processes rooted in local contexts and farmers' experiences (Anderson et al., 2020; Pimbert, 2018).

2.2 Literature review methodology

Critical reviews, a form of narrative review, are valuable for refining or developing theoretical frameworks by integrating diverse sources with analytical depth (Jesson & Lacey, 2006). Following a systematic approach to ensure the methodological robustness (Byrne, 2016), the review was based on an adapted PRISMA protocol (Page et al. 2020) consisting of the phases: identification, screening, and inclusion.

A literature search was conducted on 31 January 2025 in Web of Science (WoS), Scopus, Agricola (National Agricultural Library-US), and AGRIS (FAO), using AKIS, sustainability transitions, and food systems as core terms, along with related concepts. After removing duplicates, titles and abstracts were screened and assessed by the author based on specific inclusion and exclusion criteria, resulting in 50 selected papers. The review included peer-reviewed studies that explicitly framed their research within the AKIS framework and examine its role, or of elements of it, in transitions to agrifood systems sustainability (or other permutations of the concept), with a focus on the European context (including the UK pre-Brexit). Studies were excluded if they focused solely on farm-level innovation, or did not explicitly situate their analysis within an AKIS framework, such as those focusing on advisory services without a connection to broader AKIS.

The selected papers were then analysed using qualitative directed content analysis (Hsieh & Shannon, 2005) according to the six themes of the analytical framework. Initially, all articles

were read in full to extract general information, which was systematically recorded in a tailored Excel table, followed by the coding of each included paper using the software Atlas.ti.

3. Findings

3.1 Content

Most of the reviewed literature acknowledges that transitions toward sustainable agrifood systems require innovation beyond technical fixes, calling for integrated approaches that address organisational, social, and institutional dimensions that integrate codified and tacit knowledge. Significantly, in recent years, particular attention has been given to farmers' microAKIS, emphasising the diverse advice channels they actively mobilise (Sutherland & Labarthe, 2022). This shift has helped reveal the prominent role of tacit and informal knowledge in compensating for limitations of formal systems, especially in areas such as labour, marketing, and the ethical or social dimensions of farming (Madureira et al., 2022). However, despite increasing openness to knowledge pluralism, there is still limited engagement with the deeper epistemological shifts agroecological transitions demand, particularly the integration of underrepresented knowledge systems such as traditional and local.

3.2 Process

A common entry point in the reviewed literature is the understanding of AKIS as a framework that challenges unidirectional knowledge flows, recognising the plural, networked nature of knowledge and innovation processes (Charatsi et al., 2024). This is particularly emphasised in relation to the role of collective, experiential learning in enabling knowledge-intensive and non-technological innovation (Giagnocavo et al., 2022), as well as the bidirectional nature of advisor–farmer relationships (Coquis et al., 2018). While there is growing recognition to creating enabling environments for such processes, persistent fragmentation and the continued promotion of hierarchical knowledge flows within formal AKIS structures are identified as significant barriers (Koutsouris & Zarokosta, 2022). Accordingly, (PAR) and transdisciplinarity are often cited as promising approaches in overcoming these barriers (Kurtsal et al., 2022). Yet, they remain under-theorised and rarely operationalised in empirical AKIS research, particularly regarding their role in challenging power dynamics, limiting a critical engagement with co-production processes beyond instrumental understandings.

3.3 Actors

A central concern in the reviewed literature is the growing plurality of actors within AKIS and how farmers navigate this diversity based on their individual contexts and innovation pathways (Sutherland & Labarthe, 2022). In this context, studies highlight that the long-term privatisation and diversification of advisory services in Europe has enhanced inequalities in access to relevant advice, particularly for structurally disadvantaged groups, such as smallholders (Konečná & Sutherland, 2022). Accordingly, public advisory services are argued to be better positioned to address these gaps and support sustainability transitions due to their policy-oriented mandate (Prager et al., 2017). However, studies signal a lack of responsiveness of public advisors to farmers' needs, often prioritising ensuring mandatory compliance (Killis et al., 2022), with new actors emerging to respond to this gap, such as NGOs, family, and peer networks (Koutsouris & Zarokosta, 2022). These findings assert farmers' agency in seeking and mediating advice within less favourable environments, challenging traditional roles of actors and experts in knowledge and innovation networks.

3.4 Purpose

Most AKIS research adopts a functionalist or procedural approach, focusing on improving the system's responsiveness to support farmers' innovation trajectories and align with EU policy objectives (Knierim et al., 2017). Nevertheless, a growing body of research calls for AKIS to more explicitly support paradigm shifts by engaging with how knowledge is produced, validated, and mobilised, placing the democratisation of knowledge at the centre (Kok & Klerkx, 2023). Although not a dominant focus, several studies underscore the role of knowledge collectivisation as a foundation for transformative change, such as through Living Labs (Potters et al., 2022). However, AKIS research still falls short of systematically addressing how to strengthen AKIS transformative capacity to support plural, bottom-up, and reflexive learning processes, such as farmer-to-farmer knowledge co-creation.

3.5 Governance

The effect of the long-term liberalisation processes across Europe on the governance and organisation of AKIS is a central debate in the literature, with an increasing ambivalent stance toward AKIS governance shaped by market mechanisms (Prager et al., 2017). While such developments can broaden the range of advisory channels available to farmers, it is recognised that they also risk creating misalignments with the multifunctional goals AKIS are expected to support (De Rosa et al., 2023). While not dominant, as emphasised earlier, a growing strand of the literature thus calls for engaging with the politics of AKIS, particularly how their capacity to support inclusive and systemic change is shaped by the institutional environments in which they are embedded (Fieldsend, 2020). This shift requires recognising that AKIS are not neutral policy tools to improve coordination and knowledge flows between the research-advisor-farmer axis – a common approach in EU policy discourse (Fieldsend, 2020), but sites of contestation and collective construction of alternative futures.

3.6 Spatio-temporal scale

A recurrent trend in the literature is the analysis of AKIS at the national scale, with studies acknowledging regional variation both between and within countries (Knierim et al., 2017). However, much of this work remains largely diagnostic: while territorial disparities are described, few studies systematically examine how territorial dynamics actively shape AKIS processes. More recent research brings greater nuance by increasingly showcasing the situated, multiscalar, and temporal dynamics of innovation trajectories, framing AKIS as historically contingent, relational, and mutable (Sutherland et al., 2023). Following this relational turn, scholars have begun to tackle the persistent challenge of scaling context-specific knowledge through multi-scalar connections. Significantly, there is a call for coordinated, multi-level strategies that acknowledge and work with the situated nature of knowledge, such as linking localised experimentation and farm- or regional-level networks with broader, higher-level knowledge systems (Koutsouris and Karakosta, 2022).

4. Practical implications

The reviewed literature contributes to reframing AKIS as more socially embedded and territorially situated systems, with growing recognition of farmers' agency, diverse knowledge sources, and collective learning processes. These insights help broaden the understanding of innovation beyond technological uptake, aligning with agroecological transitions that emphasise inclusive and situated knowledge practices. However, the gap between these conceptual advances and their translation into practice remains significant. Participatory and transdisciplinary approaches are increasingly referenced but rarely examined in depth or integrated into the methodological foundations of AKIS research. Moreover, limited

engagement with the political and epistemological dimensions of knowledge, such as power asymmetries or epistemic injustice, limits the identification of potential levers through which AKIS could confront structural inequalities or support more systemic change.

5. References

- Charatsari, C., Michailidis, A., & Lioutas, E. D. (2024). Do farm advisory organizations promote sustainability? A study in Greece. *Agricultural Systems*, 218. <https://doi.org/10.1016/j.agsy.2024.104003>
- Clapp, J. (2022). Concentration and crises: exploring the deep roots of vulnerability in the global industrial food system. *The Journal of Peasant Studies*, 50(1), 1–25. doi.org/10.1080/03066150.2022.2129013
- Coquil, X., Cerf, M., Auricoste, C., Joannon, A., Barcellini, F., Cayre, P., Chizallet, M., Dedieu, B., Hostiou, N., Hellec, F., Lusson, J. M., Olry, P., Omon, B., & Prost, L. (2018). Questioning the work of farmers, advisors, teachers and researchers in agro-ecological transition. A review. In *Agronomy for Sustainable Development* (Vol. 38, Issue 5). Springer-Verlag France. <https://doi.org/10.1007/s13593-018-0524-4>
- de Rosa, M., Olivieri, G., Menna, C., Gandolfi, F., & Giudice, T. del. (2023). Multifunctional farm advisory services in promoting change in agricultural systems: The case of Campania region of Italy. *AIMS Agriculture and Food*, 8(4), 962–977. <https://doi.org/10.3934/AGRFOOD.2023051>
- Fieldsend, A. F. (2020). Agricultural knowledge and innovation systems in European Union policy discourse: Quo vadis? *Studies in Agricultural Economics*, 122(3), 115–123. <https://doi.org/10.7896/j.2055>
- Giagnocavo, C., de Cara-García, M., González, M., Juan, M., Marín-Guirao, J. I., Mehrabi, S., Rodríguez, E., van der Blom, J., & Crisol-Martínez, E. (2022). Reconnecting Farmers with Nature through Agroecological Transitions: Interacting Niches and Experimentation and the Role of Agricultural Knowledge and Innovation Systems. *Agriculture (Switzerland)*, 12(2). <https://doi.org/10.3390/agriculture12020137>
- Gliessman, S. (2016). Transforming food systems with agroecology. *Agroecology and Sustainable Food Systems*, 40(3), 187–189. DOI:10.1080/21683565.2015.1130765
- HLPE (2020). *Food Security and Nutrition: Building a Global Narrative towards 2030*. A Report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. Rome.
- Ingram, J., & Maye, D. (2020). What Are the Implications of Digitalisation for Agricultural Knowledge? *Frontiers in Sustainable Food Systems*, 4. <https://doi.org/10.3389/fsufs.2020.00066>
- Ingram, J., & Mills, J. (2019). Are advisory services “fit for purpose” to support sustainable soil management? An assessment of advice in Europe. *Soil Use and Management*, 35(1), 21–31. <https://doi.org/10.1111/sum.12452>
- Jesson, J., & Lacey, F. (2006). How to do (or not to do) a critical literature review. *Pharmacy Education*, June 200, 6(2): 139–148. DOI: 10.1080/15602210600616218
- Kilis, E., Adamsone-Fiskovica, A., Šūmane, S., & Tisenkopfs, T. (2022). (Dis)continuity and advisory challenges in farmer-led retro-innovation: biological pest control and direct marketing in Latvia. *Journal of Agricultural Education and Extension*, 28(5), 653–670. <https://doi.org/10.1080/1389224X.2021.1997770>
- Knierim, A., Labarthe, P., Laurent, C., Prager, K., Kania, J., Madureira, L., & Ndah, T. H. (2017). Pluralism of agricultural advisory service providers – Facts and insights from Europe. *Journal of Rural Studies*, 55, 45–58. <https://doi.org/10.1016/j.jrurstud.2017.07.018>

- Kok, K. P. W., & Klerkx, L. (2023). Addressing the politics of mission-oriented agricultural innovation systems. *Agricultural Systems*, 211. <https://doi.org/10.1016/j.agsy.2023.103747>
- Konečná, M., & Sutherland, L. A. (2022). Digital innovations in the Czech Republic: developing the inner circle of the Triggering Change Model. *Journal of Agricultural Education and Extension*, 28(5), 577–600. <https://doi.org/10.1080/1389224X.2022.2039247>
- Koutsouris, A., & Zarokosta, E. (2022). Farmers' networks and the quest for reliable advice: innovating in Greece. *Journal of Agricultural Education and Extension*, 28(5), 625–651. <https://doi.org/10.1080/1389224X.2021.2012215>
- Kurtsal, Y., Rinaldi, G. M., Grande, M. M., & Viaggi, D. (2022). Education and training in agriculture and the Bioeconomy: Learning from each other. In *Agricultural Bioeconomy: Innovation and Foresight in the Post-COVID Era* (pp. 287–313). Elsevier. <https://doi.org/10.1016/B978-0-323-90569-5.00002-0>
- Kvam, G. T., Hårstad, R. M. B., & Stræte, E. P. (2022). The role of farmers' microAKIS at different stages of uptake of digital technology. *Journal of Agricultural Education and Extension*, 28(5), 671–688. <https://doi.org/10.1080/1389224X.2022.2046617>
- Labarthe, P., & Beck, M. (2022). CAP and advisory services: From farm advisory systems to innovation support. *EuroChoices*, 21(1), 5–13. <https://doi.org/10.1111/1746-692X.12354>
- Laurent, C., Nguyen, G., Triboulet, P., Ansaloni, M., Bechtet, N., & Labarthe, P. (2022). Institutional continuity and hidden changes in farm advisory services provision: evidence from farmers' microAKIS observations in France. *Journal of Agricultural Education and Extension*, 28(5), 601–624. <https://doi.org/10.1080/1389224X.2021.2008996>
- Madureira, L., Labarthe, P., Marques, C. S., & Santos, G. (2022). Exploring microAKIS: farmer-centric evidence on the role of advice in agricultural innovation in Europe. *Journal of Agricultural Education and Extension*, 28(5), 549–575. <https://doi.org/10.1080/1389224X.2022.2123838>
- McDonald, R., & Macken-Walsh, A. (2016). An actor-oriented approach to understanding dairy farming in a liberalised regime: A case study of Ireland's New Entrants' Scheme. *Land Use Policy*, 58, 537–544. <https://doi.org/10.1016/j.landusepol.2016.08.025>
- Moschitz, H., Muller, A., Kretzschmar, U., Haller, L., de Porras, M., Pfeifer, C., Oehen, B., Willer, H., & Stolz, H. (2021). How can the EU Farm to Fork strategy deliver on its organic promises? Some critical reflections. In *EuroChoices* (Vol. 20, Issue 1, pp. 30–36). Blackwell Publishing Ltd. <https://doi.org/10.1111/1746-692X.12294>
- Potters, J., Collins, K., Schoorlemmer, H., Stræte, E. P., Kilis, E., Lane, A., & Leloup, H. (2022). Living Labs as an Approach to Strengthen Agricultural Knowledge and Innovation Systems. *EuroChoices*, 21(1), 23–29. <https://doi.org/10.1111/1746-692X.12342>
- Prager, K., Creaney, R., & Lorenzo-Arribas, A. (2017). Criteria for a system level evaluation of farm advisory services. *Land Use Policy*, 61, 86–98. <https://doi.org/10.1016/j.landusepol.2016.11.003>
- Rivera-Ferre, M.G., 2018. The resignification process of Agroecology: Competing narratives from governments, civil society and intergovernmental organizations. *Agroecol. Sustain. Food Syst.* 42, 666–685. <https://doi.org/10.1080/21683565.2018.1437498>.
- Sutherland, L. A., & Labarthe, P. (2022). Introducing 'microAKIS': a farmer-centric approach to understanding the contribution of advice to agricultural innovation. In *Journal of Agricultural Education and Extension* (Vol. 28, Issue 5, pp. 525–547). Routledge. <https://doi.org/10.1080/1389224X.2022.2121903>
- Sutherland, L. A., Adamsone-Fiskovica, A., Elzen, B., Koutsouris, A., Laurent, C., Stræte, E. P., & Labarthe, P. (2023). Advancing AKIS with assemblage thinking. *Journal of Rural Studies*, 97, 57–69. <https://doi.org/10.1016/j.jrurstud.2022.11.005>

Wezel, A., Herren, B.G., Kerr, R.B. et al. Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. *Agron. Sustain. Dev.* 40(2020). doi.org/10.1007/s13593-020-00646-z

Identification of Challenges and Opportunities for adopting Climate Mitigation Actions on Dairy Farms in Ireland

Niamh Dunphy^{1,2}, Seamus Kearney² & Sinéad Flannery¹

¹ School of Agriculture and Food Science, University College Dublin, Dublin, Ireland

² Dungarvan Advisory Office, Teagasc, Waterford, Ireland

Short abstract

Purpose | The purpose of this study is to identify the challenges and opportunities for adopting climate mitigation actions on dairy farms using the COM-B model of behaviour change.

Design/Methodology/Approach | This study employed a qualitative methodological approach consisting of 24 semi-structured interviews with dairy farmers in the republic of Ireland. This study provides insights into the challenges and opportunities for adopting climate mitigation actions at farm level. This study utilises the Capability-Opportunity-Motivation Behavioural (COM-B) (Michie *et al.*, 2011) model as the theoretical and analytical framework.

Findings | An increase in workload, being sceptical of the benefits of mitigation actions, and increases in costs incurred were the three biggest challenges farmers experience when implementing climate mitigation actions in this study. An increase in revenue and farm productivity, wanting to benefit the environment, and advisory support were the three biggest opportunities when adopting climate mitigation actions on farm.

Practical and theoretical implications | From the findings of this study, policy and AKIS recommendations are offered. A call for policies that subsidise the cost of mitigation actions for farmers and promote actions that reduce workload levels for farmers are proposed. AKIS recommendations on how agricultural advisors can support farmers when implementing mitigation actions are also offered.

1. Purpose

Agriculture is one of the biggest contributors to GHG (Greenhouse Gas) emissions, accounting for 11% of global GHG emissions (Statista, 2024). The European Parliament declared a European and global climate emergency in 2019 (Erbach, 2021). The UN Paris Agreement set out ambitious climate targets for the European Union (EU) to achieve by 2030 and 2050. The 2030 goal is to reduce GHG emissions by 55% compared to 1990 levels (Teevan *et al.*, 2021), while the EU is legally committed to achieving net-zero emissions by 2050 (World Economic Forum, 2021). Knowledge on farmer decision-making is essential to reduce GHG emissions arising from agriculture (Farstad *et al.*, 2022). Therefore, the purpose of this study is to identify the challenges and opportunities for adopting climate mitigation actions on dairy farms using the COM-B model of behaviour change. This study aimed to employ the COM-B model to shed light on the challenges and opportunities influencing farmer adoption of climate mitigation actions at farm level.

2. Methodology

In-depth semi-structured interviews with farmers ($n = 24$) were conducted to identify the challenges and opportunities farmers experience when adopting climate mitigation actions. Dairy farmers who avail of public advisory services in the Republic of Ireland comprised the study population. Farmer selection for the semi-structured interviews was purposive. A criteria sheet was developed by the research team which ranked farmers into three categories; (a) lowly engaged ($n = 6$); (b) moderately engaged ($n = 9$); and (c) highly engaged ($n = 9$) with climate mitigation actions. The criteria sheet consisted of climate mitigation actions farmers could implement on their farm. Figure 1 shows the location and engagement levels of each semi-structured interviewees. Each interview took place on farm and lasted 50 minutes on average.

2.1 Data Analysis

Data analysis was informed by the theoretical framework of this study; the Capability, Opportunity and Motivation Behaviour (COM-B) Model. This model was developed by Michie *et al.* (2011) and proposes humans need each of the three elements of the COM-B model to change behaviour. Thematic analysis was employed throughout the data analysis stage of this paper using the software package NVivo. Inductive coding was utilised primarily, and themes were formed. A deductive approach was applied to categorise the themes based on three elements of the COM-B model. The frequency of which themes emerged in the data was used as an indicator of their level of influence as challenges and opportunities in implementation level.

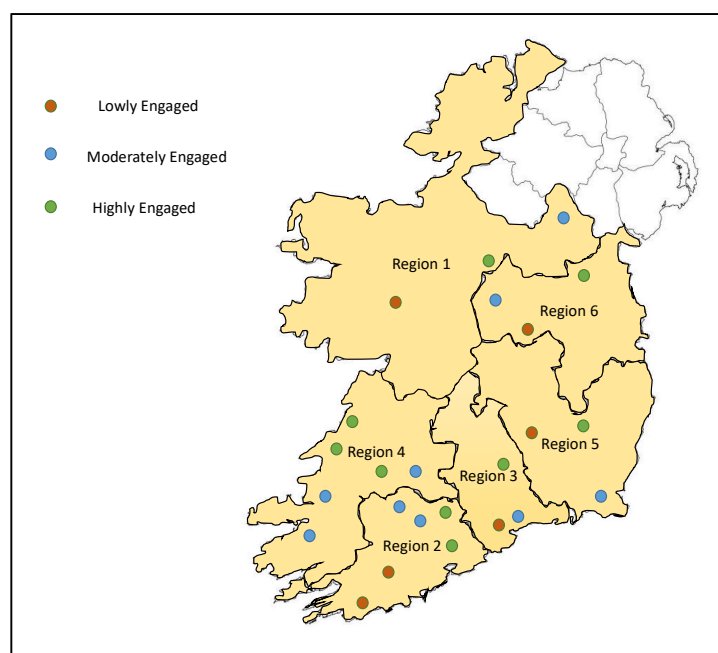


Figure 1: Region, location and engagement level of semi-structured interviews in Ireland.

3. Findings

In line with the COM-B model, the factors that influenced the adoption of climate mitigation actions varied across the sample. Table 1 provides a summary of the findings from this study.

Table 1: COM-B model for climate mitigation actions at farm level

Capability	Opportunity	Motivation
Psychological <ul style="list-style-type: none"> Knowledge & Education (+,-) 	Physical <ul style="list-style-type: none"> Agricultural Advisor (+,-) Policy (+) 	Automatic <ul style="list-style-type: none"> Farmer Habit (+,-) Wanting to benefit the environment (+)
Physical	Social <ul style="list-style-type: none"> Publicity (+) Other farmers (+,-) 	Reflective <ul style="list-style-type: none"> Suits farm system (+,-) Financial (+,-) Workload (-) Potential Success (-)

Note: Challenges (-) and opportunities (+) that influence farmer adoption of climate mitigation actions.

3.1 Farmers' capability to implement climate mitigation actions

Farmer Knowledge and Education

Farmer knowledge of how to implement climate mitigation actions on their farm acted as both a challenge and opportunity for adopting climate mitigation actions at farm level. Lack of knowledge and awareness around how to implement climate mitigation actions and not being fully aware of the advantages of implementation hindered adoption levels.

The findings of this study suggest farmers that have a higher knowledge level has a positive influence on implementation levels of climate mitigation actions. All farmers interviewed as part of this study have an awareness of climate mitigation actions, but they do not necessarily know how to implement these mitigation actions. For example, all farmers interviewed were aware of grass measuring, but a lack of procedural knowledge acted as a barrier when opting to implement grass measuring on their farm.

3.2 Farmers' opportunity to implement climate mitigation actions

Agricultural Advisor Influence

Within this study, it was evident agricultural advisors have an influential role, the third biggest, in farmers' decision to implement climate mitigation actions on their farm. Most farmers reported their agricultural advisor as having a positive influence on their decision to implement climate mitigation actions on their farm.

Policy

Policy measures were found to influence farmers positively in relation to the uptake of mitigation actions on their farm. Although policy measures are forceful, for some farmers it meant that unless they were forced to change their farming habits, they would not: *"Sometimes until you're forced to do certain things, you'll not do it."* (Farmer 1)

Other Farmers

Other farmers had both a positive and negative influence in implementing climate mitigation actions on farms. In this study, farmers report they start doing an action because another farmer is implementing the action or another farmer encourages them to start implementing the action: *"If you see your neighbour doing something it would get you thinking like we're putting in solar panels now and the farmer next door is now as well because we have."* (Farmer 10).

3.3 Farmers' motivation to implement climate mitigation actions

Farmer Habit

Farmer's habits acted as both a challenge and an opportunity when adopting mitigation actions on their farm. In relation to spreading protected urea instead of a type of fertiliser that emits more GHG emissions, farmers tend to stick with their habitual ways and continue to do what they have always done on their farm. However, for farmers who are in the habit of implementing climate mitigation actions on their farm, farmer habit has a positive effect on these farmers and reinforces the action. Some farmers have fenced off watercourses and stopped topping hedges as these were measures in an agri-environmental scheme in recent years and they got into the habit of implementing these mitigation actions. These farmers have continued to implement these actions since the scheme ended.

Wanting to benefit the environment

Farmers in this study reported they implement climate mitigation actions on their farm for the environmental benefits the action has. This was identified as the second biggest driver influencing the implementation of climate mitigation actions on their farm. There is a sense of pride amongst farmers when they speak about the hedgerows on their farm and if they see other farmers doing something for environmental reasons, they are proud of each other. When farmers see the positive results of implementing a climate mitigation action, this encourages them to keep repeating the action. Some farmers reference how they *"couldn't go back to cutting the hedges"*.

Suits Farm System

Farmers are influenced positively to implement a mitigation action if it suits their farm system. Similarly, farmers are influenced negatively to implement a mitigation action if it does not suit their farm system. Contrary to this, many farmers find implementing climate mitigation actions on their farm suits their farming system and this positively influences them to implement these actions each year.

Financial

Financial risks and incurring costs to the farmer act as a challenge for farmers when implementing climate mitigation actions. In this study, increasing farm expenses was the third biggest barrier farmers experienced. Farmers in this study are not willing to spend money to reduce their GHG emissions. Farmers report *"the big motivation is what you can save financially"*. An important point to note is some farmers implement climate mitigation actions for profitability for their farm and the positive climate side-effects are a bonus.

Workload

Findings from this study show farmers are less likely to implement a climate mitigation action if it increases a farmer's workload. Tasks that are time-consuming and laborious have a relatively low uptake on farm. *"I stopped milk recording and I never went back to it because it's another job and I'm here on my own and it's very slow in the morning and evening."* (Farmer 14). Based on data frequency, a higher workload is the biggest challenge for farmers to implement climate mitigation actions on their farms. Farmers in the current study feel some climate mitigation actions are not always worth the time invested.

4. Practical Implications

Considering the findings from this study, practical recommendations to the Agricultural Knowledge and Innovation System (AKIS) and policy makers can be made to increase the level of climate mitigation actions farmers are engaged with. Future policies should subsidise the cost of mitigation actions whilst also promoting actions that reduce workload levels for farmers. Additionally, farmer habits should be leveraged to ensure continuation of behaviour change at farm level. For example, participation in previous agri-environmental schemes has led to the formation of habitual practices among farmers, resulting in the continued implementation of scheme-related actions even after financial incentives ceased. This suggests future policies should introduce payments to engage with climate mitigation actions which will hopefully result in sustained longer-term change in farmer habit. Finally, peer-to-peer learning opportunities for farmers should be facilitated by the AKIS to address scepticism experienced by farmers in relation to some climate mitigation actions. These changes to policy have the potential to increase adoption of climate mitigation actions on farm.

Theoretical Implications

The COM-B model was used as the theoretical and analytical framework for this study. The findings from this study show influencing factors related to capability, opportunity and motivation are all present for farmers when implementing climate mitigation actions on their farms. This study demonstrates the value of shifting from behavioural frameworks that focus solely on personal factors such as beliefs, attitudes, and knowledge to frameworks that consider both internal and external influences on farmers' decision-making processes

5. References

- Erbach, G. (2021). European climate law. *Regulation (EU)*, 1119.
- Farstad, M., Melås, A. M. & Klerkx, L. (2022). Climate considerations aside: What really matters for farmers in their implementation of climate mitigation measures. *Journal of Rural Studies*, 96, 259-269. <https://doi.org/10.1016/j.jrurstud.2022.11.003>
- Michie, S., Van Stralen, M. M. & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6, 42. <https://doi.org/10.1186/1748-5908-6-42>
- Statista. (2024). *Agriculture emissions worldwide - statistics & facts* [Online]. Statista. Available: <https://www.statista.com/topics/10348/agriculture-emissions-worldwide/#:~:text=In%202023%2C%20agricultural%20processes%20like,percent%20of%20global%20GHG%20emissions>. [Accessed 10th February 2025].
- Teevan, C., Medinilla, A. & Sergejeff, K. (2021). The green deal in EU foreign and development policy. *ECDPM Briefing Note*, 131.
- World Economic Forum. (2021). *What you need to know about the european green deal - and what comes next*. [Online]. World Economic Forum. Available: <https://www.weforum.org/agenda/2021/07/what-you-need-to-know-about-the-european-green-deal-and-what-comes-next/> [Accessed 16th December 2024].

Advancing Agroecological Innovations in Sub-Saharan Africa: Agricultural Knowledge and Innovation Systems in Angola with Perspectives from Zambia

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Short abstract

Agricultural Knowledge and Innovation Systems (AKIS) are essential for fostering agroecological innovation, particularly among smallholder farmers in sub-Saharan Africa. Yet, the structural and functional dynamics of provincial AKIS in Angola remain underexplored. This study investigates the configuration of AKIS in Huambo Province, Angola, using comparative insights from Zambia, to enhance knowledge flows and innovation uptake. Social network analysis reveals distinct patterns: Zambian smallholders engage actively with farmer-based organizations (FBOs), agro-dealers, and extension agents, although links to universities and public research institutions are weak. In Angola, knowledge diffusion is primarily informal, driven by family ties, farmer field schools, and NGOs. Centrality measures underscore the intermediary role of FBOs and field schools in both contexts. Trigger Cycle Model analysis highlights the influence of familial networks in awareness, assessment, and implementation stages, especially in Angola. While MOSAP initiatives increased awareness of biopesticides post-2015, adoption remains constrained by systemic and financial barriers. Zambia demonstrates more institutionalized coordination, bolstered by private sector participation. Theoretically, this study advances understanding of localized AKIS governance. Practically, it suggests that strengthening institutional linkages, formalizing knowledge intermediaries, and reducing adoption barriers could significantly improve the efficacy of AKIS in Angola and similar settings.

Keywords: Agroecological innovation; Angola; Zambia; Agricultural Knowledge and Innovation Systems (AKIS); Africa

1. Purpose

Agriculture in Sub-Saharan Africa plays a critical role in addressing food insecurity, climate change, and population growth. Agroecological innovations, such as biopesticides, green manure, and organic compost, are essential for enhancing sustainability, particularly for smallholder farmers. Despite their potential, adoption rates remain low due to weak connections between formal and informal actors within Agricultural Knowledge and Innovation Systems (AKIS) (Klerkx & Begemann, 2020). This study aims to design an Agricultural Knowledge and Innovation System (AKIS) to support agroecological innovations in Angola, drawing insights from Zambia.

2. Methodology

A multi-actor innovation framework guided this study, which employed mixed methods to analyze AKIS in the Eastern Province of Zambia and Huambo Province of Angola. Data collection included surveys of 400 farmers and interviews with 12 stakeholders in Angola (February–June 2022) and interviews with 30 actors in Zambia (June–August 2022). Social Network Analysis (SNA) was used to map actor influence, knowledge flows, and network connectivity, while thematic analysis identified key patterns and insights from qualitative data (Adolwa et al., 2017).

3. Findings

The study revealed that Zambian smallholder farmers maintain strong ties with farmer-based organizations (FBOs), Camp Extension Officers, and agro-dealers, which facilitate knowledge transfer and input provision. However, weak links with universities and public extension services highlight systemic gaps. In both countries, input suppliers play a significant role in biopesticide adoption. Peer-to-peer networks, family members, and farmer field schools emerged as critical for raising awareness and influencing adoption decisions. The social network analysis of Zambia's Agricultural Knowledge and Innovation System (AKIS) highlights the central role of smallholder farmers as primary beneficiaries and key agents of knowledge transfer. Strong ties exist between farmers, farmer-based organizations (FBOs), agro-dealers, and Camp Extension Officers, while weaker links with universities and public extension advisers indicate gaps in the AKIS. Weak ties, however, serve as crucial bridges for accessing diverse knowledge and resources. The Trigger Cycle Model analysis (Sutherland et al. 2012; Knierim et al., 2015) reveals that family members, farmer field schools, and FBOs play essential roles across innovation adoption phases, while NGOs and input suppliers exhibit varying engagement levels. Findings from Angola's AKIS further underscore the importance of farmer-led knowledge sharing, with smallholder farmers having the highest network size, input suppliers demonstrating strong connectivity, and farmer field schools acting as key intermediaries. Strengthening weak ties and fostering farmer-driven research could enhance knowledge exchange and support sustainable agricultural innovations.

4. Implications

This research highlights several actionable recommendations to enhance AKIS and foster agroecological innovation adoption: Policymakers should bridge gaps between smallholder farmers and formal actors, such as universities and public extension services, to improve information flow. Governments should promote collaboration through multi-stakeholder forums and knowledge-sharing platforms to create integrated and inclusive AKIS. Prioritizing funding for farmer-driven research can ensure practical and contextually relevant solutions. Enhanced training for extension officers is crucial to support agroecological practices effectively. Policies incentivizing private sector participation can strengthen their role in knowledge dissemination and innovation adoption. Enabling NGOs to collaborate with local actors through funding and technical assistance can amplify their impact in promoting agroecological practices.

5. References

- Adolwa, I. S., Schwarze, S., Bellwood-Howard, I., Schareika, N., & Buerkert, A. (2017). A comparative analysis of agricultural knowledge and innovation systems in Kenya and Ghana: sustainable agricultural intensification in the rural–urban interface. *Agriculture and Human Values*, 34(2), 453–472. <https://doi.org/10.1007/s10460-016-9725-0>

-
- Klerkx, L., & Begemann, S. (2020). Supporting food systems transformation: The what, why, who, where and how of mission-oriented agricultural innovation systems. *Agricultural Systems*, 184. <https://doi.org/10.1016/j.agsy.2020.102901>
- Klerkx, L., Petter Stræte, E., Kvam, G. T., Ystad, E., & Butli Hårstad, R. M. (2017). Achieving best-fit configurations through advisory subsystems in AKIS: case studies of advisory service provisioning for diverse types of farmers in Norway. *Journal of Agricultural Education and Extension*, 23(3), 213–229. <https://doi.org/10.1080/1389224X.2017.1320640>
- Klerkx, L., van Mierlo, B., & Leeuwis, C. (2012). Evolution of systems approaches to agricultural innovation: Concepts, analysis and interventions. In *Farming Systems Research into the 21st Century: The New Dynamic* (pp. 457–483). Springer Netherlands. https://doi.org/10.1007/978-94-007-4503-2_20
- Knierim, A., Boenning, K., Caggiano, M., Cristóvão, A., Dirimanova, V., Koehnen, T., Labarthe, P., & Prager, K. (2015). The AKIS concept and its relevance in selected EU member states. *Outlook on Agriculture*, 44(1), 29–36. <https://doi.org/10.5367/oa.2015.0194>
- Matuschke, I. (2008). *Evaluating the impact of social networks in rural innovation systems: An overview*. <https://www.researchgate.net/publication/23778928>
- Sutherland, L.-A., R. J. F. Burton, J. Ingram, K. Blackstock, B. Slee, and N. Gotts. 2012. “TriggeringChange: Towards a Conceptualisation of Major Change Processes in Farm Decision-Making.” *Journal of Environmental Management* 104:142–151. <https://doi.org/10.1016/j.jenvman.2012.03.013>

Aligning incentives for innovation and environmental sustainability. A framework for sustainable productivity growth in agriculture

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Short abstract

This study examines how agricultural innovation systems can be strategically directed to foster sustainable productivity growth (SPG). It focuses on the Agricultural Knowledge and Innovation System (AKIS), investigating the roles of stakeholders, institutional settings, and public policy in promoting sustainable agricultural practices and productivity growth. Emphasising the importance of policy directionality, the study argues for innovation frameworks that support both food security and environmental sustainability. Methodologically, it builds on a critical review of literature in agricultural innovation systems and innovation theory, incorporating the dimension of environmentally sustainable directionality. The analysis explores how AKIS can steer innovation towards resolving trade-offs between productivity and sustainability while identifying synergies through aligned stakeholder incentives. It also reviews policy approaches and governance features that foster coherent and adaptive policy mixes capable of guiding innovation for SPG. Findings highlight the critical role of governments in creating enabling environments and aligning incentives across the AKIS to facilitate knowledge transfer and innovation uptake. The study underscores

the value of mission-oriented innovation policies and institutional collaboration. Practically, it offers guidance for policymakers to design targeted and effective innovation policies. Theoretically, it contributes to understanding how innovation directionality and governance can enhance knowledge diffusion, driving both productivity and sustainability.

1. Purpose

This study analyses how innovation systems can be directed towards sustainable productivity growth (SPG) in agriculture. It focuses on the role of the agricultural knowledge and innovation system (AKIS), exploring how different stakeholders, institutional frameworks, and public policies can contribute to the development and adoption of sustainable agricultural practices that also increase productivity. It stresses the need of policy interventions with clear aims and directionality to achieve challenging societal goals such as food security and environmental sustainability.

Several institutions, governments and international organisations are working with definitions and concepts around SPG (OECD, 2025). In this work, SPG is defined as agricultural productivity growth that advances social, environmental, and economic development objectives to meet the food and nutrition needs of current and future generations. Using this definition and focusing on environmental sustainability, this study aims to provide a framework to analyse levers directing innovation for SPG. To achieve this, this work explores how the incentives of the actors in the AKIS can be aligned to induce innovation towards SPG, discussing the role of private and public actors, and emphasising the role of governments in fostering innovation for SGP. It also analysis policy approaches and mixes that can induce agricultural innovation for SPG. The work aims to refine the existing analytical framework in agricultural innovation systems used in OECD to uncover and evaluate policies' features that effectively conduct the AKIS towards SPG.

2. Approach

The study is based on a critical revision of the existing literature on agricultural innovation systems and innovation theories. Building on the agricultural innovation systems framework (OECD, 2013), the analysis seeks to include the dimension of environmentally sustainable directionality for innovation.

Departing from a discussion and literature review of the AKIS and its role in making innovation work for SPG, it focuses on the directionality of innovation, reviewing the literature on theories, models, and empirical frameworks on directing innovation for solving potential productivity and sustainability trade-offs and aligning incentives to leverage potential synergies. Finally, it analyses policy approaches and mixes to align incentives and induce innovation for SPG, focusing on the desired characteristics of governance and policies, searching for coherent policy mixes with a clear directionality to drive SPG.

3. Findings

Global agriculture faces unprecedented challenges: climate change, resource depletion, demographic pressures, and the imperative to ensure farmers' livelihoods all call for a transition that balances productivity growth with environmental sustainability. These multiple pressures require a shift in how agricultural and innovation policies are designed and how the AKIS is governed.

While innovation is key for this transformation, not all innovation leads to environmental sustainability. A well-financed innovation system may still fall short of environmental goals if

incentives are misaligned or if directionality is lacking (Acemoglu, 2023; OECD, 2023). Therefore, government intervention is critical, not only to strengthen the AKIS, but to steer it toward SPG through clear strategic priorities, investments, and governance frameworks (OECD, 2013; Pigford et al., 2018).

All actors in the AKIS have a role to play in fostering SPG (Figure 1). However, this research highlights the critical role of governments in generating enabling conditions and the relevance of aligning incentives of all actors in the AKIS for driving SPG in agriculture. Institutional support, stakeholder collaboration, and investment in research and development (R&D) are key factors influencing knowledge transfer and innovation adoption.

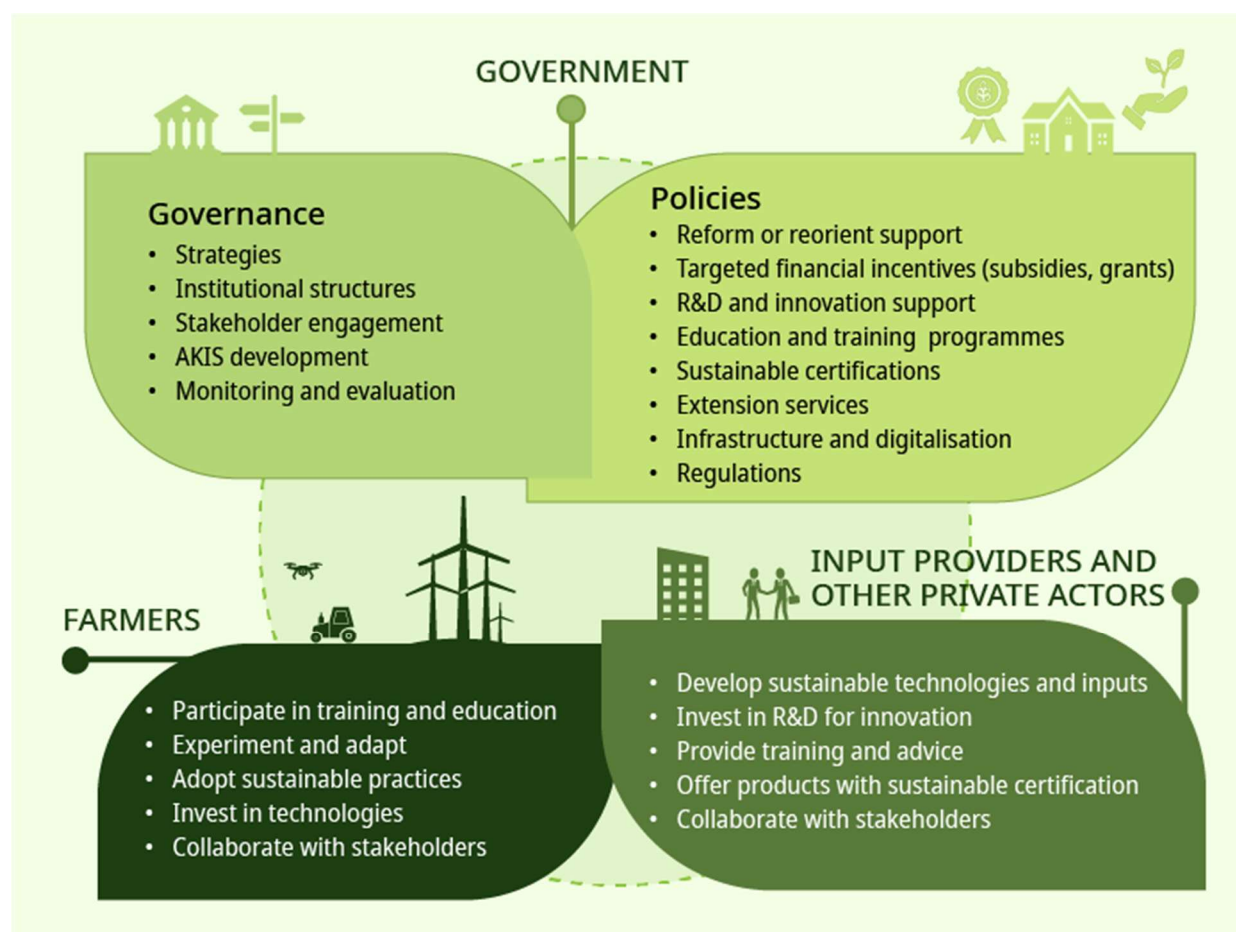
Aligning incentives across all AKIS actors (farmers, researchers, advisors, private companies, and non-governmental organisations) is essential to foster innovation that meets both market demands and sustainability objectives (Ruttan and Hayami, 1984; Klerkx et al., 2012). Governments can help by adopting policy mixes that integrate market-based instruments, regulations, and targeted support for sustainable practices (Mantino and Vanni, 2019; OECD, 2022).

In addition, mission-oriented innovation policies (MOIPs) have emerged as promising tools to address complex societal challenges by providing direction and coordination across sectors (Larrue, 2021; OECD, 2024). Applied to agriculture, these policies can help mobilise collective efforts and investments toward shared sustainability goals. By identifying innovation priorities and aligning stakeholder actions, missions can accelerate transitions to resilient and sustainable agricultural systems (Kok and Klerkx, 2023).

Knowledge flows, stakeholder collaboration, and monitoring and evaluation mechanisms are critical to ensure that innovation outcomes serve public and private interests (OECD, 2013). However, strong AKIS systems may still fall short of environmental goals if innovation is primarily driven by productivity-

enhancing incentives that ignore sustainability trade-offs (OECD, 2015; 2023). In this context, adaptive and systemic policy approaches are necessary. Isolated measures are unlikely to address the interconnected and dynamic nature of innovation processes (OECD, 2016). Instead, coordinated policy packages that explicitly incorporate directionality—through missions or other mechanisms—can better guide innovation toward SPG (Mazzucato, 2018; OECD, 2024).

Figure 1: What governments, farmers and others can do for sustainable productivity growth



Source: Adapted from OECD (2024).

Therefore, the research proposes a system approach to innovation policy. Governments have a key role in the AKIS. They must ensure not only that innovation systems are strong, coherent and integrated, but also that they are strategically oriented. Rather than isolated measures, governments need to design policy mixes that embed directionality to steer innovation toward public goods and sustainability outcomes. Achieving SPG requires more than scientific excellence or technological breakthroughs; it demands governance, incentives, and policy coherence to align innovation trajectories with broader sustainability outcomes.

4. Practical implications

From a practical perspective, the study provides actionable insights for policymakers on designing and implementing effective innovation frameworks that enhance SPG in agriculture. It underscores the importance of aligning incentives across stakeholders and of building strong and well-governed AKIS. In particular, the findings highlight the value of embedding directionality into innovation policy, by setting clear sustainability goals and using tools, such as MOIP, governments can spur R&D and adoption efforts toward desired outcomes. This enables more strategic use of public funds, more coherent policy mixes, and greater coordination among actors, accelerating progress toward both productivity and environmental targets.

5. Theoretical implications

Theoretically, the research contributes to the literature on agricultural innovation systems by emphasising the importance of directionality and of how targeted policies with explicit sustainability aims shape the trajectory of knowledge diffusion and technological change. It advances our understanding of how innovation can be guided by policy design and governance mechanisms to contribute to broader societal goals. The study adds to the growing body of work on the evaluation of innovation policies, suggesting that assessments should go beyond inputs and outputs to consider the direction and impact of innovation on sustainability, inclusiveness, and long-term productivity.

6. References

- Acemoglu, D. (2023). Green innovation and the transition to a clean economy. *Annual Review of Economics*, 15, 1–31. DOI: 10.1146/annurev-economics-051420-114814
- Klerkx, L., van Mierlo, B., & Leeuwis, C. (2012). Evolution of systems approaches to agricultural innovation: Concepts, analysis and interventions. In Darnhofer, I., Gibbon, D., & Dedieu, B. (Eds.), *Farming Systems Research into the 21st Century: The New Dynamic* (pp. 457–483). Springer. DOI: 10.1007/978-94-007-4503-2_20
- Kok, K.P., & Klerkx, L. (2023). Addressing the politics of mission-oriented agricultural innovation systems. *Agricultural Systems*, 211, 103747.
- Larrue, P. (2021). The design and implementation of mission-oriented innovation policies: A new systemic policy approach to address societal challenges. OECD Science, Technology and Industry Policy Papers, No. 100. OECD Publishing. DOI: 10.1787/3f6c76a4-en
- Mantino, F., & Vanni, F. (2019). The role of policy in the evolution of rural development paradigms. *European Countryside*, 11(2), 152–171. DOI: 10.2478/euco-2019-0009
- Mazzucato, M. (2018). *Mission-oriented research & innovation in the European Union: A problem-solving approach to fuel innovation-led growth*. Brussels: European Commission. DOI: 10.2777/360325
- OECD (2013). *Agricultural Innovation Systems: A Framework for Analysing the Role of the Government*. OECD Publishing. DOI: 10.1787/9789264200593-en
- OECD (2015). *Innovation, Agricultural Productivity and Sustainability in the Netherlands*. OECD Food and Agricultural Reviews. OECD Publishing. DOI: 10.1787/9789264238473-en
- OECD (2016). *The Innovation Imperative: Contributing to Productivity, Growth and Well-Being*. OECD Publishing. DOI: 10.1787/9789264239814-en
- OECD (2022). *Policy Mixes for Sustainability Transitions: New Approaches and Insights from the OECD*. OECD Publishing. DOI: 10.1787/8c9dc4e5-en
- OECD (2023). *Agricultural Innovation for Sustainable Productivity Growth: Country Case Studies – The Netherlands*. OECD Food, Agriculture and Fisheries Papers, No. 177. OECD Publishing. DOI: 10.1787/9fc0c6b4-en
- OECD (2024). *Agricultural Policy Monitoring and Evaluation 2024: Innovation for Sustainable Productivity Growth*. OECD Publishing, Paris, DOI: 10.1787/74da57ed-en
- OECD (2025). Sustainable Agricultural Productivity to Address Food Systems Challenges: Measurement, Data, Drivers and Policies, Proceedings from the OECD Conference, 28 October 2024, OECD Publishing, Paris.
- Pigford, A. A. E., Hickey, G. M., & Klerkx, L. (2018). Beyond agricultural innovation systems? Exploring an agricultural innovation ecosystems approach for niche design and development in sustainability transitions. *Agricultural Systems*, 164, 116–121. DOI: 10.1016/j.agsy.2018.04.007
- Ruttan, V. W., & Hayami, Y. (1984). Toward a theory of induced institutional innovation. *Journal of Development Studies*, 20(4), 203–223. DOI: 10.1080/00220388408421938

Identifying innovations and knowledge systems in agroecological transitions

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Short abstract

This work identifies the types of innovations that motivate agroecological transitions in empirical cases described in the scientific literature and which occur in various geographies. At the same time, it makes it possible to identify how farmers and other actors learn and share knowledge about agroecology using the AKIS approach - Agricultural Knowledge and Innovation Systems. We surveyed the scientific literature available in online databases using the expression 'agroecologic* transition*', restricting ourselves to articles that reported practical cases of agroecological transition. A total of 107 articles was then selected and their content analysed using the *Iramuteq* software. The software's features show that the publications are divided into four classes: one that highlights 'agricultural transitions' (*Farm Transition*); one that addresses 'farmer transitions' (*Farmer Transition*); one that expresses 'local food transitions' (*Local Food*) and one that emphasises soil and crop management techniques (*Soil/Crop*). The identification of innovations in agroecological transitions points to what has been socially valued and empirically applied by farmers and society to make more sustainable agri-food systems possible. If we have identified a lack of available taxonomies to describe these innovations, the most prominent ones in agroecological transitions not always associated with purely agroecological practices. The building of these innovations is also consolidated on different compositions of access to and sharing of knowledge between farmers, citizens and institutional actors.

Keywords: Innovations, Agroecological Transitions, AKIS - Agricultural Knowledge and Innovation System

1. Purpose

There are many empirical experiments applied to agri-food systems that aim to make them more sustainable. These experiments involve the adoption of various strategies and innovations. Among them, the transition to agroecology and associated innovations have emerged as a promising alternative (Hebinck et al., 2021; Elsner et al., 2023; Fonseca et al., 2024). In this paper, we aim to identify which innovations have been associated with agroecological transitions in the scientific literature, mapping elements that are indicators of innovation and knowledge systems (AKIS - Agricultural Knowledge and Innovation Systems) that are mobilised in parallel with transitions. In terms of conceptualisation, therefore, we used taxonomies of innovation and the concept of AKIS. Due to the wide use of the word 'innovation', different types of experiences and practices can be considered as such (OECD & Eurostat, 2005). However, as there is a lack of references on typologies of innovations in agricultural transitions, especially in agroecology, we used the categories suggested by Sutherland et al. (2018) as support. The concept of AKIS, in turn, allowed us to visualise the

emergence of innovations as collaborative and dynamic responses between farmers and other social spheres (Chesbrough, 2012; EU SCAR, 2015).

2. Methodology

As the aim of this work is to identify the most relevant innovations in agroecological transitions, and to indicate how they are related to the knowledge systems accessed by farmers, we carried out a survey of articles published on the Scopus® and Web of Science™ databases. The search term was 'agroecologic* transition*'. With this command, we found 526 documents, 262 of which were extracted from Scopus® and 264 from Web of Science™. After refinement, in order to extract only scientific articles, remove duplicates and publications with a theoretical approach, 107 documents remained, published between 2012 and 2023. To identify the innovations, we analysed the content of the textual extracts from the selected publications. We used the *Iramuteq* software (version 0.7), which analyses the content of various textual materials and uses quantitative and qualitative resources. The quantitative analyses use multivariate statistics, giving a chi-squared value (χ^2) to the most commonly used words. The qualitative analyses make use of the evaluation of the lexical component of the words and the how they are connected in the textual composition. The software allows for a range of analyses, but in this work we have emphasised the use of Descending Hierarchical Classification (DHC) and Similarity Analysis (SA).

3. Findings

The DHC, which allows us to identify words that form part of the same system of representation, grouped the publications analysed into four classes - by grouping together, in each class, a set of words with the highest chi-square (χ^2). For each of these classes, we carried out a subsequent SA in order to find the most representative words related to agroecological innovations and associated AKIS indicators. We found: 1st class: which contains 36.3% of the publications, and whose most prominent words were 'farm' and 'transition'. We have therefore named this class *Farm Transition*; 2nd class: which brings together 26.6% of the articles and where 'transition' and 'farmer' are highlighted in the SA. This is why we call it *Farmer Transition*; 3rd class: with 12% of the documents, with the words 'food' and 'local' standing out - *Local Food*; 4th class: with 25.1% of the publications. In SA, 'soil' and 'crop' are highlighted - that's why the class was called *Soil-Crop*. From this point on, we will indicate which innovations and references to AKIS were found in the texts analysed. Farm Transition includes documents that refer to both agriculture and livestock. For this group, we found the following associated innovations: crop introduction and diversification systems; the adoption and changes in irrigation practices and management; the design of new agricultural practices and crop-livestock integration. In relation to AKIS, we identified the sharing of knowledge and the influence of simulating practices carried out on farms. In *Farmer Transition*, as the name suggests, we find innovations that affect and emerge from the actions of the farmers themselves, their communities and organisations. These include social organisation initiatives (such as cooperatives and farmers' movements), certification projects and local production for urban consumers. In terms of AKIS indicators, it is possible to identify: demonstration practices; extension services and knowledge; farmer participation, education and training; learning about governance and the actions of rural families and communities. *Local Food* innovations include: local markets; public policies; the protection and enhancement of biodiversity; tourism services (associated with winemaking); new designs in the use of resources. Indicative of AKIS is the sharing of knowledge and the promotion of local agricultural initiatives. Finally, *Soil-Crop* distinguishes innovations that take place around soil conservation and improvements in its chemical and biological fertility. Innovations aimed at reducing the use of pesticides and emissions from dairy farming, as well as increasing crop

yields, are also highlighted. The SA, therefore, did not provide us with any indications of associated AKIS.

4. Practical Implications

The innovations that have been associated with agroecological transitions give indications of how farmers and society have been finding solutions to overcome the challenges of unsustainable agri-food systems (Toffolini et al., 2017; Cristofari, et al., 2018; Prost et al., 2018). Consequently, from a practical point of view, identifying such innovations also provides indications of which strategies - political, social, technical and cognitive - are being valued and mobilised, and which are yet to be explored and stimulated. In Europe, to be precise, and where 53 of the studies analysed come from, emerging political strategies such as the Farm to Fork Strategy (European Commission, 2020) and The European Green Deal (European Commission, 2019) aim to create a more sustainable food system and intend to consolidate the sustainability of agri-food systems by various means (Wrzaszcz & Prandecki, 2020; Riccaboni et al., 2021; Boix-Fayos & Vente, 2023). These guidelines may be directing the actions of farmers and citizens, leading to the emergence of innovations associated with agroecological transitions. And although we analysed a database on 'agroecological transitions', the practical perspectives portrayed in the studies do not indicate that the innovations underway are necessarily purely agroecological. As for AKIS, it is most evident in the *Farmer Transition* and *Local Food* classes. This is because both groups deal with agroecological innovations on local and territorial scales. In these circumstances, knowledge exchange and learning are facilitated, as is the formation of innovation systems. In these two classes, it is important to note that the knowledge and experience of farmers and their communities is highlighted, in connection with the transfer of knowledge that traditionally occurs in the work of organisations such as cooperatives and agricultural extension services.

5. Theoretical Implications

Types of innovations, together with the AKIS, are important indicators of how agroecological transitions are being catalysed. They are indicators of how transitions to sustainability are prioritised, constituted and operationalised. From a theoretical point of view, the work opens up a perspective for the development and adaptation of innovation taxonomies when applied to the context of agroecology. This is because the available classifications do not explore, for example, those that derive from techniques that develop from observations, analyses and experiments carried out by farmers. Neither do they deal with technological innovations in transitions, opening up space for this type of innovation to be investigated in greater depth.

6. References

- Boix-Fayos, C., & de Vente, J. (2023). Challenges and potential pathways towards sustainable agriculture within the European Green Deal. *Agricultural Systems*, 207. DOI: 10.1016/j.agry.2023.103634
- Chesbrough, H. (2012). Open Innovation: Where We've Been and Where We're Going. *Research-Technology Management*, 55(4), 20-27. DOI: 10.5437/08956308X5504085
- Cristofari, H., Girard, N., & Magda, D. (2018). How agroecological farmers develop their own practices: a framework to describe their learning processes. *Agroecology and Sustainable Food Systems*, 42(7), 777-795. DOI: 10.1080/21683565.2018.1448032
- Elsner, F., Herzig, C., & Strassner, C. (2023). Agri-food systems in sustainability transition: A systematic literature review on recent developments on the use of the multi-level perspective. *Frontiers in Sustainable Food Systems*, 7. DOI: 10.3389/fsufs.2023.1207476

-
- European Commission. (2019). The European Green Deal Striving to be the first climate-neutral continent. European Commission. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
- European Commission. (2020). Farm to Fork strategy for a fair, healthy and environmentally-friendly food system. European Commission. https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en
- EU SCAR (2015). *Agricultural Knowledge and Innovation Systems Towards the Future – a Foresight Paper*. https://ec.europa.eu/research/scar/pdf/akis-3_end_report.pdf
- Fonseca, A. F., Polita, F., & Madureira, L. (2024). How Agroecological Transition Frameworks Are Reshaping Agroecology: A Review. *Land*, 13(11). DOI: 10.3390/land13111930
- Hebinck, A., Klerkx, L., Elzen, B., Kok, K. P., König, B., Schiller, K., ... & von Wirth, T. (2021). Beyond food for thought–Directing sustainability transitions research to address fundamental change in agri-food systems. *Environmental Innovation and Societal Transitions*, 41, 81-85. DOI: 10.1016/j.eist.2021.10.003
- OECD and Eurostat. (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. Paris, France: OECD.
- Prost, L., Reau, R., Paravano, L., Cerf, M., & Jeuffroy, M. H. (2018). Designing agricultural systems from invention to implementation: the contribution of agronomy. Lessons from a case study. *Agricultural Systems*, 164, 122-132. DOI: 10.1016/j.agry.2018.04.009
- Riccaboni, A., Neri, E., Trovarelli, F., & Pulselli, R. M. (2021). Sustainability-oriented research and innovation in ‘farm to fork’ value chains. *Current Opinion in Food Science*, 42, 102-112. DOI: 10.1016/j.cofs.2021.04.006
- Sutherland, L. A., Labarthe, P., Elzen, B., & Adamsone-Fiskovica, A. (2018). AgriLink’s Multi-Level Conceptual Framework Main Report. <https://old.agrilink2020.eu/wp-content/uploads/2019/02/AgriLink-conceptual-framework-main-report.pdf>
- Toffolini, Q., Jeuffroy, M. H., Mischler, P., Pernel, J., & Prost, L. (2017). Farmers’ use of fundamental knowledge to re-design their cropping systems: situated contextualisation processes. *NJAS-Wageningen Journal of Life Sciences*, 80, 37-47. DOI: 10.1016/j.njas.2016.11.004
- Wrzaszcz, W., & Prandecki, K. (2020). Agriculture and the European Green Deal. *Zagadnienia Ekonomiki Rolnej/Problems of Agricultural Economics*, (4). DOI: 10.30858/zer/131841

Session 2A

PUBLIC POLICIES AND INSTITUTIONAL FRAMEWORKS FOR AGRI-FOOD INNOVATION

Role of agricultural experiment stations in AKIS: How could the Brandenburg's (Germany) agricultural experiment stations be well set up for the undergoing agriculture transformations?

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Short abstract

Agriculture faces numerous challenges like climate extremes, biodiversity loss, soil and water pollution or high operating costs, low producer prices and farm closures. Agricultural research, especially through experiment stations (AES), plays a key role in addressing these challenges by developing innovations and providing practical solutions. In Brandenburg, 18 AES are conducted by 11 institutions, but their fragmented structure limits effectiveness and visibility. Considering the current development and demand for agricultural transformation, the question arises whether the Brandenburg AES are fulfilling this key role. This case study explored whether AES are meeting their intended role. A participatory change management process was initiated, involving stakeholders such as farmers, researchers, and policymakers. The first step assessed the current state of Brandenburg's AES, identifying structures and usage. In the second step, visions for future frameworks were developed. The study offers an initial overview of all AES in Brandenburg and highlights their importance. The results show AES are vital, but there are gaps in awareness, utilization, and communication. Issues like recruitment and multitasking among researchers also emerged. Furthermore, Brandenburg lacks a state strategy for AES, particularly in implementing research and practical trials. These findings reveal both the challenges and potential for improving AES in Brandenburg.

1. Agriculture Transformation: AES are essential for sustainable agriculture and transformation processes

Agriculture worldwide is undergoing a transformation driven by the dynamic interplay of environmental and socio-economic factors, including global market demands, urbanization, intensification of agriculture, climate extremes, biodiversity loss, soil and water degradation, high operating cost and low producer prices. To meet these challenges and ensure future environmentally friendly and socially sustainable agricultural production with lower resource input while maintaining sufficient food production, a transformation of agriculture is required (OECD, 2023; WR, 2023; ZKL, 2021). The question arises whether agricultural practices can be transformed and go beyond existing paradigms to develop innovative and sustainable agricultural systems. Agricultural research, including field trials, plays a crucial role in this transformation process and is a key factor for the future viability of agriculture. Specifically, agricultural experiment stations (AES) play a pivotal role at the interface with practical farming, acting as a driving force for solution-oriented approaches and the implementation

of adaptation measures (WR, 2023). Agricultural and horticultural production processes are highly complex, as they are part of a dynamic biological-ecological-technological system. This requires, on the one hand, a precise consideration of natural conditions within certain economic and political frameworks. On the other hand, this system is constantly evolving and changing due to, for example, new crop varieties, fertilizers, technologies, or climatic changes. All these changes raise questions about how known mechanisms behave under these conditions and how they affect the landscape, the ecosystem, and the environment. This gives rise to a multitude of research questions and experimental tasks (Thomas, 2006). "It is a misconception to believe that this form of field research is becoming increasingly obsolete [...] Field trials address specific issues related to the development, testing, and monitoring of agricultural practices and their effects on the environment, on the farm itself, its organization and economic viability, and on the usability and quality of agricultural products." (Thomas, 2006, p. 14) Thus, AES serves both as a site for innovation development, answering practical and relevant questions, and developing feasible farming practices. At the same time, it is a platform for consultation and knowledge exchange (including technical and experiential knowledge) between science, farming practice, and advisory services (MLUK, 2024) as well as a place of learning for sustainable development. Furthermore, AES are relevant as they provide region-specific yield and climate data, which are fundamental for agro-ecosystem model calibration and validation (Kersebaum et al. 2015) With this current development and demand for a transformation, the question arises whether the Brandenburg AES are fulfilling this key role. The following research questions will be addressed in this case study:

- I) What significance and tasks do the AES currently fulfil in Brandenburg?
- II) Are the AES living up to their significance and tasks in playing a key role in agricultural transformation?

2. Transformation of AES in Brandenburg: A Participatory Change Management Approach

This case study investigates the current state of the AES in the federal state of Brandenburg and outlines a participatory process to develop a future vision and action plan for the system. To guide this transformation, an adapted change management model was applied, structured around the three phases of change process developed by Lewin in the 1940's (Hinze, 2020): 1) Unfreezing: Create awareness of the need for change and generate willingness to change, 2) Moving: actual changes, includes the development of solutions, trying out new behaviours and changing structures and processes, and 3) Freezing: Change processes are consolidated and completed by stabilizing the changes achieved.

1) Necessity for Transformation of AES (Unfreezing phase)

The initial step involved establishing the urgency and rationale for transforming the AES in Brandenburg. This was achieved through a literature review and interviews with field research representatives. The aim was to not only justify the need for change but also to encourage active engagement among stakeholders by highlighting the individual and collective benefits of participation.

2) Survey of the Status Quo (Unfreezing phase)

A comprehensive survey was carried out to identify strengths, weaknesses and areas in need of development within the AES. This included examining internal institutional capacities as well as system-wide gaps. The analysis was designed to represent the perspectives of all key actor groups: I) Knowledge generators (institutes conducting field research), II) Knowledge users and communicators (practitioners, advisors, and educational institutions), and III)

Funders (mainly government representatives). Data collection involved 14 guided expert interviews with stakeholders from AES-affiliated institutes (9 of 11), the Brandenburg coordination office for research-based experimentation (2 participants), and the Ministry of Agriculture (3 participants). An additional 30 stakeholders participated in an online survey (12 practitioners, 11 advisors, and 7 educational institutions).

3) Developing a Future Vision (Transition from Unfreezing phase to Moving phase)

To collectively shape a future perspective for the AES, a participatory workshop was held with representatives from all actor groups. The workshop utilized the Market of opportunities method to collect and evaluate visions. Existing ideas from the status quo assessment were thematically organized and presented on pin boards, with participants invited to add, prioritize, and discuss them. In the second phase, the World Café method (Brown & Isaacs, 2007) was used to deepen discussions on three selected themes derived from the collected visions. Small-group conversations rotated across tables to encourage cross-pollination of ideas and generate actionable goals. This format fostered inclusivity, creativity, and mutual understanding among participants.

4) Action Plan Development & Accompanying process support (Moving phase and Freezing phase)

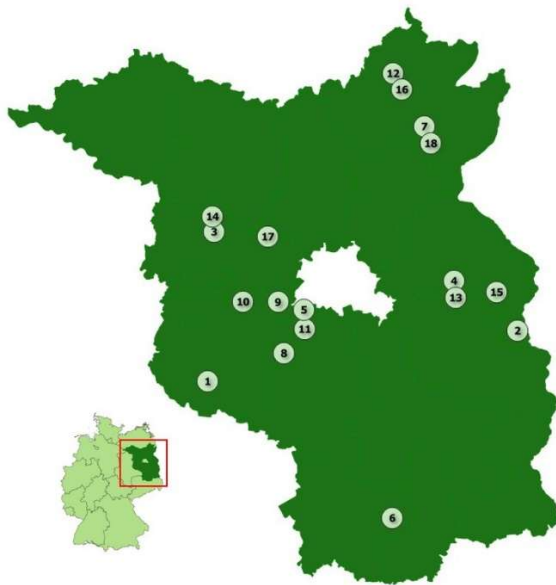
Based on the shared vision and goals, a structured action plan will be developed. Key considerations include the allocation of responsibilities, transparent communication, stakeholder involvement, and continuous evaluation. Special attention will be paid to identifying decision-making authority, assessing the impacts of proposed changes, and ensuring external stakeholder integration.

This case study demonstrates how a participatory, structured change management approach can effectively support system transformation. Through inclusive data collection and collaborative vision-building, the foundation for a future-oriented AES in Brandenburg has been laid. The next step involves translating these insights into concrete actions and sustainable institutional processes. This survey provided a first summarized overview of all experimental stations in the state of Brandenburg.

3. Status Quo of Brandenburg's AES

In Germany, agricultural research is primarily conducted by industry and publicly funded institutions. These institutions - such as federal and state research institutes, universities, and non-university organizations like the Fraunhofer, Leibniz, Helmholtz, and Max Planck Institutes - receive core funding from the federal government, the states, or both. They also rely heavily on third-party funding from sources including the federal government, EU, states, private companies, and foundations (DAFA, 2025). Additionally, non-profit, non-university research organizations (often regional associations focused on specific topics like preservation of genetic material) play a role in agricultural research, mainly through external funding. Nationwide, around 100 federal and state institutions conduct research on agricultural topics (BZL, 2025). In Brandenburg alone, 18 Agricultural Experimental Stations from 11 institutes focus on arable and crop production as well as fruit and vegetable growing.

Brandenburg's Agricultural Experimental Stations (AES)



Federal Research Centre for Cultivated Plants in Germany

1. AES of the Julius Kühn Institute (JKI)

Brandenburg State Office for Rural Development, Agriculture and Land Consolidation (LELF)

2. AES Nuhnen

3. AES Paulinenaue

Non-university state research institutes

4. AES Müncheberg of the Training and Research Institute for Horticulture and Arboriculture e.V. (LVGA)

5. AES Großbeeren of the Training and Research Institute for Horticulture and Arboriculture e.V. (LVGA)

6. AES of the Research Institute for Post-Mining Landscapes (FIB)

Universities

7. AES of the Eberswalde University for Sustainable Development (HNEE)

8. AES Thyrow of the Humboldt-Universität zu Berlin (HU)

Non-university research institutes

9. Fieldlab for Digital Agriculture of the Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB)

10. Leibniz Innovation Farm for Sustainable Bioeconomy of the Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB)

11. AES of the Leibniz Institute of Vegetable and Ornamental Crops (IGZ)

12. AES Dedelow of the Leibniz Centre for Agricultural Landscape Research (ZALF)

13. AES Müncheberg of the Leibniz Centre for Agricultural Landscape Research (ZALF)

14. AES Paulinenaue of the Leibniz Centre for Agricultural Landscape Research (ZALF)

15. PatchCrop of the Leibniz Centre for Agricultural Landscape Research (ZALF)

16. AgroScapeLab of the Leibniz Centre for Agricultural Landscape Research (ZALF)

17. AES Berge of the Institute of Agricultural and Urban Ecological Projects (IASP)

18. AES of the Association for the conservation and recultivation of cultivated plants (VERN)

AES research focuses vary from agrobiodiversity, nutrient management or digital applications in crop production to climate protection and adaptation strategies. A unique feature of all AES is the distinctive climatic conditions found throughout Germany – heterogeneous soils, low annual precipitation, and extreme weather events like heavy rains or drought periods – positioning them as future models for other regions in Germany. All institutes are in regular exchange with practice and consider their research as "research for practice." Sixty-seven percent of the institutes collaborate permanently or regularly with partner businesses and conduct on-farm trials. Knowledge transfer is a core responsibility for 9 out of 10 institutes alongside their research. Through various formats, such as field days, specialist events or publications, they regularly engage with target groups such as practitioners, advisors, scientists, policymakers, and students. One of the main challenges facing all AES is the shortage of personnel, high staff turnover, and the multitasking requirements for scientists. The first points are mainly due to the growing shortage of skilled workers and the high proportion of third-party funded employees. Since personnel costs in third-party funding are often limited, scientists are often expected to take on additional roles outside their primary qualification (e.g. event manager, moderator, journalist for the general press, homepage designer for projects, or scriptwriter and director for educational videos) to carry out or fulfil knowledge transfer tasks and formats. Further challenges of the AES are seen in the implementation of participatory research and the realization of knowledge transfer. They face difficulties in the long-term and binding involvement of practice partners – especially in on-farm research. For this, additional personnel capacity, financial resources, and appropriate social and communication skills of the scientists are needed. Successful knowledge transfer demands not only research but also to have the resources and capacity to process, promote, and implement knowledge for the target groups. In scientific qualification, non-scientific publications and transfer activities are often not recognized or rewarded. It was also indicated that some AES events or offers did not find any participants. This raising questions about possible causes: Lack of practical relevance?, Timing unfavourable for practitioners?, Advertising is not reaching the target groups?, Is there an oversupply of certain topics? It is therefore not surprising that 9 out of 18 AES in Brandenburg are known to fewer than 10 of 30 respondents (practitioners, advisors, representatives of educational institutions), and only 4 AES are known to just under half of the respondents. Although 73% consider research for

practice to be a main task of the AES, only 52% of practitioners and consultants see their questions addressed in the research from AES. However, about 89% of advisors and educators use current research findings in their work and attribute a high level of importance (78%) to the AES for their work. The results show two key challenges: (I) the recruitment and retention of skilled workers, and (II) the development of target group-specific knowledge transfer formats that support the rapid dissemination of innovations into broad practice and the integration of practitioners into research.

4. Future vision of the Brandenburg AES

50 individual vision points for the future of AES in Brandenburg were collected. Not all visions received the same level of support. However, when focusing on the points that received majority approval (50% or more), the following vision for the future emerges: Agricultural research in Brandenburg is undergoing a fundamental transformation shaped by innovation, practical relevance, and cooperation. The aim is to establish sustainable and efficient AES that sustainably strengthens agriculture and horticulture. Field trials in Brandenburg are designed to identify practice-oriented questions, develop innovative solutions, and rapidly transfer them into agricultural practice. Both scientific precision trials on AES and practice-oriented on-farm trials are equally promoted. Close collaboration with practitioners ensures dynamic knowledge transfer, implementation of new methods, and shorter innovation cycles. AES results are swiftly integrated into advisory services, education, and training so that farmers and gardeners in Brandenburg can quickly benefit. A central platform provides an overview of all ongoing trials in the region, enhancing transparency and accessibility of research findings. Experimental stations are equipped with state-of-the-art technology to guarantee precise and reliable results. Long-term secured funding ensures that highly qualified personnel are retained at the stations, preserving valuable expertise and practical knowledge. The goal is that “The best work with us”. Long-term and continuous field trials remain a cornerstone of the AES research. They are essential to understanding the long-term impacts of new cropping systems, varieties, and methods. These trials are systematically continued and expanded to meet increasing demands for sustainability and climate adaptation. Long-term partnerships with institutes across Brandenburg and Germany promote joint research and ongoing exchange of results. Open and trusting dialogue between experimental stations is actively supported to create a cooperative network, leveraging synergies and avoiding duplication of efforts: Collaboration over competition.

5. From vision to action plan

The results show that AES currently do not fully live up to their key role in the agricultural transition. Two key findings can be highlighted. First, all stakeholders view the AES as essential for the future development of a resilient, diverse, and broadly-based agricultural sector. Second, it becomes evident that the AES in Brandenburg are still highly fragmented. For instance, the AES are not fully known to all target groups, and existing offerings are either underutilized or not widely recognized. Moreover, not all formats or the number of available programs appear to be used efficiently. To ensure resource-efficient and target group-specific delivery, both established and new formats are needed - each didactically and content-wise tailored to the audience. Structural challenges were also identified, such as recruiting and retaining skilled personnel and the multitasking demands placed on researchers. In summary, the findings point to existing gaps that need to be addressed, but also reveal significant potential for the further development of the AES in Brandenburg. In order to exploit this potential and support the transformation of agriculture, the next step will be to develop an action plan with all stakeholders. This plan will build on the described future vision and define specific areas of action and measures for the active implementation of the goals.

6. References

- Brown, J., & Isaacs, D. (2007). Das World Café: Kreative Zukunftsgestaltung in Organisationen und Gesellschaft [The World Café: Shaping Our Futures Through Conversations That Matter]. Carl-Auer Verlag, ISBN: 978-3896705884
- Commission on the Future of Agriculture (ZKL), (2021). The Future of Agriculture: A common agenda. Commission on the Future of Agriculture. <http://bmel.de/goto?id=91482>
- Federal Information Center for Agriculture (BZL), (04/2025). Forschungslandschaft: Agrar-Forschungseinrichtungen [Research landscape: Agricultural research institutions]. Federal Agency for Agriculture and Food. <https://www.praxis-agrar.de/forschung-fuer-die-praxis/agrar-forschungseinrichtungen>
- German Agricultural Research Alliance (DAFA), (04/2025). A primer on agricultural research in Germany. German Agricultural Research Alliance. <https://www.dafa.de/forschungslandschaft/#toggle-id-7-closed>
- German science and humanities council (WR), (2023). Future perspectives for agricultural, food and nutritional sciences. DOI: 10.57674/a4rt-ke57
- Hinz, O. (2020). Change Maker: Wirksame Veränderungen unter maximaler Unsicherheit [Change Maker: Effective change under maximum uncertainty]. Verlag Franz Vahlen GmbH, ISBN: 978-3800662395
- Kersebaum, K.C., Boote, K.J., Jorgenson, J.S., Nendel, C., Bindi, M., Frühauf, C., Gaiser, T., Hoogenboom, G., Kollas, C., Olesen, J.E., Rötter, R.P., Ruget, F., Thorburn, P.J., Trnka, M., Wegehenkel, M. (2015). Analysis and classification of data sets for calibration and validation of agro-ecosystem models. *Environmental Modelling & Software* .402-417 (72). <https://doi.org/10.1016/j.envsoft.2015.05.009>.
- Ministry of Agriculture, Food, Environment and Consumer Protection of the State of Brandenburg (MLEUV), (04/2024). Landwirtschaftliches Versuchswesen in Brandenburg [agricultural experiment stations of Brandenburg]. Ministry of Agricultural, Environment and Climate protection of Brandenburg <https://mleuv.brandenburg.de/mleuv/de/bildung-forschung-und-beratung/agrarforschung/landwirtschaftliches-versuchswesen/#>
- OECD (2023). Policies for the Future of Farming and Food in the European Union. OECD Agriculture and Food Policy Reviews. OECD Publishing. Paris. <https://doi.org/10.1787/32810cf6-en>

Identification of barriers and oportunities for developing policies to foster innovation in the agri-food sector of the madrid region: a study based on the akis approach

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Short abstract

Promoting innovation in the agri-food sector of the Community of Madrid is a key challenge to ensure its sustainability and competitiveness. In this context, the European Union's Agricultural Knowledge and Innovation Systems (AKIS) framework provides a comprehensive theoretical lens to analyze how the diverse actors within the agri-food ecosystem—including farmers, research centers, companies, and public administrations—interact in the generation, transfer, and application of knowledge.

With the aim of identifying the sector's perception of barriers and the most effective measures to stimulate innovation, this study examines the opinions and experiences of actors involved in the agri-food value chain through a methodological triangulation combining qualitative approaches (12 in-depth interviews, 25 triangular discussion groups, and one workshop) and quantitative methods (an online survey with 119 responses). The findings will contribute to guiding decision-making in agri-food innovation policies by incorporating the perspectives of professionals active in the value chain.

Keywords: Agri-food innovation, Agricultural Knowledge and Innovation Systems (AKIS), Public policies, Co-creation processes, Multi-actor approach

1. Purpose

This study is part of the preparation of the Innovation Promotion Plan for the Agri-Food Sector of the Community of Madrid 2024. Its purpose is to contribute to the design of public policies aimed at fostering innovation based on the analysis of perceptions and needs of various sector stakeholders. In this context, innovation plays an increasingly critical role in the agri-food sector, acting as a driver of sustainability, competitiveness, and rural development. In recent years, innovation promotion has become an essential element of both European and national political agendas (MAPA, 2021).

However, the primary sector's weight in the economic fabric of the Community of Madrid is substantially lower than the national average. Moreover, this sector has progressively declined in regional economic terms, measured by GDP, workforce size, cultivated land area, and number of holdings (Community of Madrid, 2023; INE, 2024). Despite these challenges, fostering primary sector development remains strategic due to its contribution to a more resilient and sustainable economy, its role in biodiversity preservation, population retention in rural areas, and the provision of locally sourced, healthy food with a lower environmental

footprint—particularly in a context of increasing urbanization and climate change (MAPA, 2021; Community of Madrid, 2022).

In this scenario, as Cruz et al. (2021) emphasize, innovation is the cornerstone of value creation for the agri-food sector. The Community of Madrid ranks among Spain's most innovative regions according to European innovation metrics (MAPA, 2021), creating a favorable ecosystem for advancing agricultural innovation initiatives. The Spanish Strategy for Science, Technology, and Innovation 2021–2027 (EECTI) prioritizes key areas such as food systems and bioeconomy, aiming to significantly increase R&D investment and align it with the EU average by 2027 (MAPA, 2021).

To bridge the gap between these policy ambitions and sectoral realities, enhancing innovation in the agri-food sector of the Community of Madrid is essential to ensure its sustainability and competitiveness. This study aims to identify the perceived barriers and opportunities for innovation within the sector and propose effective measures to stimulate innovation, considering the differing perspectives of stakeholders across the value chain.

To operationalize this aim, the overall objective of the study is to propose measures to promote innovation in the agri-food sector of the Community of Madrid, which will define the policies of the Innovation Promotion Plan for the sector in 2024. To achieve this, the following specific objectives are set:

- 1) Identify the barriers perceived by the sector to innovation.
- 2) Generate co-creation spaces for actors along the value chain to jointly develop innovation promotion measures.

2. Methodology

This study is grounded in the AKIS (Agricultural Knowledge and Innovation Systems) approach, defined by the European Commission as “the combined organization and flows of knowledge between individuals, organizations, and institutions that use and produce knowledge for agriculture and related fields” (European Commission, 2023). The AKIS model emphasizes collaboration, co-creation of knowledge, and shared innovation as key elements to overcome the limitations of the traditional technology transfer model (Cruz et al., 2021). Therefore, the research involves gathering opinions from various actors in the agri-food sector and applying methodologies that encourage collaboration and the generation of shared knowledge. In line with the CAP 2023–2027, which promotes more integrated and participatory AKIS (MAPA, 2021), this work analyzes how to strengthen Madrid's agri-food innovation system by identifying concrete and feasible measures.

The research applies a triangulated methodology combining qualitative and quantitative methods, enabling evidence cross-checking and enhancing the reliability of findings (Carter et al., 2014).

Four main techniques were employed:

- (1) In-depth interviews with 12 key sector actors (producers, researchers, technicians, policymakers), providing detailed experiential diagnoses.
- (2) Triangular discussion groups (25 total), gathering diverse AKIS profiles (farmers, technicians, managers, agri-food industry representatives).
- (3) A participatory workshop, which allowed validating and complementing the identified measures.
- (4) An online structured survey with 119 valid responses, quantifying sectoral perceptions on barriers, opportunities, and priority innovation measures.

Both the triangular groups and the workshop served as co-creation spaces for participants, enabling them to collaboratively identify barriers to innovation and propose desired enhancement measures. This approach aligns with the understanding that co-creation with diverse stakeholders in innovation networks opens opportunities to successfully develop and implement sustainable innovations (Moons, Daems & Van de Velde, 2021).

3. Findings

The identification of perceived barriers and requested measures was structured using the “3Cs” innovation model developed by Cruz et al. (2021). According to these authors, three key elements must function effectively for innovation systems: knowledge, communication, and change. It is essential to value all sources of knowledge (both formal and empirical), facilitate communication among diverse sector actors, and drive the necessary changes to effectively integrate innovative solutions into practice (Cruz et al., 2021).

The study reveals significant barriers to innovation (Table 1), which were presented during the collaborative workshop, enabling sector stakeholders to jointly propose additional promotion measures (Table 2) through co-creation.

Table 1: Perceived Barriers to Innovation by Category

Category	Barriers to Innovation
Structural	<ul style="list-style-type: none"> • Aging population and lack of generational renewal • A sector with insufficient training and skills • Secondary or part-time dedication to the activity • Limited collaboration/cooperativism • Work overload prevents dedicating time to innovation
Economic	<ul style="list-style-type: none"> • Lack of financial capacity to innovate • Low profitability of the sector • Scarcity of subsidies and difficulties in accessing them • Risk aversion to innovation
Commercialization & Logistics	<ul style="list-style-type: none"> • Sector dominated by small holdings and companies at competitive disadvantage versus large corporations (e.g., logistics capacity, packaging, distribution, access to major retail) • Lack of knowledge about new consumption trends • Lack of recognition and valorization of Madrid-origin products • Weak price negotiation power due to lack of cooperativism
Bureaucratic & Regulatory	<ul style="list-style-type: none"> • Applying for aid and funding involves high workload due to complex and bureaucratic procedures • Regulations discourage innovation (e.g., direct commercialization)
Knowledge Transfer	<ul style="list-style-type: none"> • Lack of connection and differing languages between sector and research • Scientific knowledge insufficiently reaches the sector • Research not adapted to practical sector needs • Innovation is usually accessed through suppliers who have an interest in selling their products

Source: Own elaboration

Table 2: Innovation Promotion Measures by Category

Category	Innovation Promotion Measures
Funding	<ul style="list-style-type: none"> • Increased financial and fiscal support for innovation, especially for small enterprises • Promotion of microcredits and new financing models • Incentives for agroecological practices, alternative crops, and digitalization
Knowledge Transfer	<ul style="list-style-type: none"> • Improved communication between research centers, administration, and the agri-food sector <ul style="list-style-type: none"> • Development of effective knowledge transfer structures and channels • Applied research targeting sector needs • Visibility of success stories as inspiration and innovation drivers
Training and Advisory Services	<ul style="list-style-type: none"> • Development of training tailored to innovation needs: e.g., digitalization, marketing, agronomic techniques, circular economy • Promotion of agri-food technical education in schools and universities • Advisory services for entrepreneurship, subsidy acquisition, and certifications • Strengthening the role of the “Agro-advisor” • Promoting intergenerational knowledge exchange through mentorships
Creation of Meeting Spaces	<ul style="list-style-type: none"> • Creation of innovation hubs and meeting spaces for the sector • Promotion of cooperatives for shared machinery and infrastructure services
Sector Support and Promotion	<ul style="list-style-type: none"> • Educational and marketing campaigns to inform about benefits of local products • Encouragement of local product consumption in public procurement • Support for shared logistics centers • Promotion of fairs and markets for local products
Regulatory Environment	<ul style="list-style-type: none"> • Simplification of administrative and bureaucratic procedures for accessing aid and commercialization of new agri-food products • Reduction of legal barriers for innovative projects

Source: Own elaboration

4. Practical and theoretical implications

The findings provide valuable insights for policymakers and industry stakeholders to design and implement evidence-based innovation policies in the agri-food sector. The study also contributes to the theoretical advancement of AKIS by offering empirical data on stakeholder interactions and innovation dynamics within a regional context.

This preliminary work offers a structured overview of the sector’s needs and lays the foundation for subsequent research phases, which will include modeling interrelations between measures through Fuzzy Cognitive Mapping and simulating prospective scenarios.

5. References

- Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum*, 41(5), 545–547.
- European Commission. (2023). Evaluation of the strategic AKIS approach in CAP strategic plans (p. 3). EU CAP Network.

-
- Community of Madrid. (2020). Diagnosis, SWOT and Needs. Rural Development Programme of the Community of Madrid 2014–2020.
- Community of Madrid. (2022). Smart Specialization Strategy (S3) of the Community of Madrid 2021–2027. Madrid: Community of Madrid.
- Community of Madrid. (2023). Operation type 6.1.1 Evaluation report: Aid for the incorporation of young farmers within the Rural Development Programme of the Community of Madrid 2014–2020.
- Cruz, J. L., Sayadi, S., Albisu, L. M., Juan Esteban, T., & Yubero, A. (2021). AKIS: From knowledge to innovation in the agri-food sector. Madrid: INIA-CSIC.
- Instituto Nacional de Estadística (INE). (2023). Survey on the Structure of Agricultural Holdings (ESA) 2023.
- Instituto Nacional de Estadística (INE). (2024). Regional Accounts of Spain. Regional Gross Domestic Product. Series 2000–2023.
- Falcone, P. M., & De Rosa, S. P. (2020). Use of fuzzy cognitive maps to develop policy strategies for optimizing municipal waste management: A case study in the Land of Fires (Italy). *Land Use Policy*, 96, 104680.
- Kafetzis, A., McRoberts, N., & Mouratiadou, I. (2010). Use of fuzzy cognitive maps to support the analysis of actors' perceptions on water resources use and water quality policy. *Studies in Fuzziness and Soft Computing*, 247, 383–402.
- Ministry of Agriculture, Fisheries and Food (MAPA). (2021). Innovation in the agri-food sector. Analysis and Prospective – AgrInfo Series No. 32. Madrid: MAPA.
- Moons, I., Daems, K., & Van de Velde, L. L. J. (2021). Co-creation as the solution to sustainability challenges in the greenhouse horticultural industry: The importance of a structured innovation management process. *Sustainability*, 13(13), 7149.

The WELL-E Initiative: Inclusive Innovation to deliver data-driven solutions with and for the Canadian Dairy Industry

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Short abstract

Purpose | Evolving theoretical frameworks of responsible and inclusive innovation argue systems change must properly address real-world stakeholder needs and create positive impacts for society and environment. These principles lie at the heart and mission of the Research and Innovation Chair in Animal Welfare and Artificial Intelligence (WELL-E). Our team works to integrate intentionally both stakeholder and domain expert knowledge with cutting-edge AI methods and tools for the improvement of animal (and human) welfare. WELL-E is a Digital Living Laboratory, focused on the needs of animals and end-users, and is currently running at two research facilities: a university training environment and a vocational training environment for incarcerated persons, creating a community of practice allowing co-creation of technology, knowledge, and information with farmers, educators, researchers, and extensionists.

Design/Methodology/Approach | Beginning with the university training environment, we have been working directly with farm staff and management to co-develop and pilot new practices for animal housing and management. Specifically through living lab experiments from 2019-2024, we aimed to understand how end users transition herds from a movement-restricted system to having regular outdoor access in a practical way while enhancing animal welfare and ethics. Our next major project focusses on working directly with the vocational training environment staff on the construction of a new dairy as a research location to test cutting-edge technologies and practices for the deployment of responsible AI tools on farms, embracing F.A.I.R. principles and empowering end users to be at the forefront of these innovations.

Findings | While our team's research on developing new knowledge has led to major changes in practice, we have since been working directly with farm staff and management at the research training farm on how best to introduce increased movement opportunities (group size on exits, handler methods, etc.), ensuring its swift adoption across Canada. Vocational farm staff have been working directly with WELL-E to build training curriculum on stockmanship and clerical work (data entry, use of sensors), as well as to pilot new tools and technologies.

Practical and theoretical implications | These two initiatives are the first in WELL-E's Digital Living Lab network of partner farms, which is set to begin its extension to commercial farms later this year. Our collaborative approach promotes responsible and inclusive innovation through integration of new knowledge and technologies to the dairy industry and empowers end users to be at the forefront of positive welfare developments, ensuring their sustainability and reinforcing the importance of stakeholder participation in innovative scientific research.

Keywords | Inclusive Innovation, AKIS, Digital Living Lab, Animal Welfare, Responsible AI

Future-proof guiding framework using system approaches in shaping innovation for impact

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Short abstract

Innovations targeting sustainability, inclusivity, and resilience often face delayed impact, especially in the Global South, where systemic capacities are limited. To address this, we developed a foresight-informed analytical framework that guides decision-making by identifying and shaping context-specific innovation frontiers. Building on a typology of emerging agrifood technologies, the framework integrates layers such as paradigms and political economy models. It was tested using real-world cases and foresight methodologies including Delphi surveys, scenario-building, and backcasting. Findings highlight that innovation impact is systemic, shaped by the maturity and interaction of technologies within clusters and interdisciplinary fields. Singular technologies are insufficient; instead, leveraging

“cluster power” and “innovation field power” is essential. The framework also addresses the “lagging behind” factor, advocating for strategic investment and policy alignment across innovation layers. Practically, it supports curriculum design, adaptive advisory systems, and anticipatory governance. Theoretically, it introduces new concepts for systemic innovation management. This approach enables accelerated, equitable innovation impact in the Global South.

1. Purpose

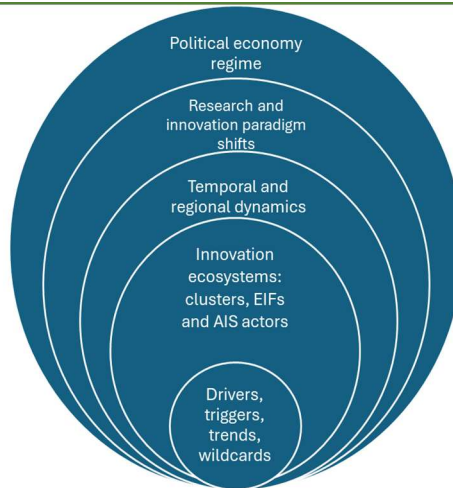
Innovations, particularly those aimed at sustainability, inclusivity, and resilience, require substantial time to translate from creation to impactful outcomes. This timeline is often critically constrained in Global South countries, which frequently lack the systemic capacities necessary to foster innovation, including effective education and extension systems. To address this challenge, we have developed a comprehensive guiding framework. This framework leverages foresight insights and findings to direct decision-making, thereby shaping social mission-oriented and context-specific innovation frontiers, accelerating the pathway to impact.

2. Approach

An analytical framework was constructed, building upon the foresight-based typology of emerging agrifood technologies and innovations developed by Alexandrova-Stefanova et al. (2024). This typology, which distinguishes between singular technologies/innovations, their clusters, and interdisciplinary emerging innovation fields, was enriched with additional layers, including paradigms and political economy models through extensive literature reviews. The resulting framework has been then rigorously tested against real-world use cases and future scenarios of emerging technologies and innovations within the framework of innovation policy labs – multiactor policy innovations in various contexts, as genetic resources and local seed policy in Columbia, startup-strategy in Ethiopia, AKIS and honey products diversification in Uzbekistan, and digitalisation in rice production strategy management in Madagascar. Foresight methodologies employed included real-time Delphi surveys, morphological scenario-building, backcasting, and stress-testing. ([UN Futures Labs foresight guide](#)).

3. Findings

The long-term transformation of agrifood systems hinges on understanding and proactively guiding the development of technologies and innovations. This new foresight-based framework offers a holistic perspective, moving beyond individual advancements to recognize the systemic interplay of forces, actors, and contexts in building sustainable, equitable, and resilient agrifood futures. It proposes a multi-level approach, where strategic adjustments at higher, more encompassing layers are essential to effectively steer and manifest changes at lower, more specific layers of technological development and impact.



Layer 1: Drivers, trends, triggers, and wild cards are the immediate forces to steer the innovation towards sustainability, inclusivity and resilience

The foundational first layer of this framework identifies the most direct forces influencing agrifood technologies and innovations. Dominant drivers like climate change and demographic shifts necessitate specific technological developments, for instance, in climate-resilient agriculture. Key trends, such as the increasing demand for a blend of efficiency, democratization, and sustainability, guide the design and deployment of emerging innovations. Critical triggers, like effective governance and skills development, are crucial for enabling innovation scaling. Finally, potential wild cards, radical disruptions such as ecological collapses, highlight the need for adaptable systems.

Layer 2: Innovation ecosystems and future scenarios are catalyzing and directing innovation

Layer 2 focuses on **innovation ecosystems**, recognizing that the true potential of individual technologies and innovations is realized within a supportive environment, crucially including policy innovation (Alexandrova et al., 2024). These ecosystems encompass groupings like innovation clusters and emerging innovation fields (EIFs), where synergies often surpass the sum of individual components. While clusters can drive progress, their potential is often limited by the "lagging behind" factor, where the slowest-advancing component restricts overall synergy and impact. Conversely, interdisciplinary EIFs, characterized by their inherent integration, facilitate "leapfrogging" and accelerate progress (Choi & Pak, 2006; WIPO, 2024). A recent Delphi survey highlighted the potential of EIFs like Web 3.0 and Nature-positive agriculture for improving smallholder livelihoods, while precision agrifood systems showed high potential for broader sustainable agrifood transformation in LMICs (Alexandrova-Stefanova et al., 2024). This underscores the need for robust open access digital infrastructure and nature-protective practices for successful technologies and innovations.

This layer also integrates **future scenarios** into the analysis of Agrifood Innovation Systems (AIS) (Alexandrova-Stefanova et al., 2023). These scenarios explore how AIS might evolve and how stakeholders, including emerging actors like Artificial Intelligence (AI), will be affected. Empowering all stakeholders, from researchers to farmers and policymakers, is key to fostering effective AIS and managing the human component of innovation.

Layer 3: Temporal and regional factors help contextualizing technologies and innovations

Layer 3 explicitly accounts for **temporal and regional factors**, acknowledging that technologies and innovations emerge at different paces and with uneven impacts across various locations (Alexandrova et al., 2023, 2024). Innovation clusters have distinct timelines

of dominance, influenced by their maturity and investment trends. The impact of technologies and innovations hinges on the crucial interplay between their Earliest Time to Mature (ETM)—when they are widely accessible and adopted, overcoming technical, financial, social, and legal hurdles—and their Earliest Time to Significant Impact (ETSI)—when they begin to generate meaningful, system-level change in areas like sustainability or inclusivity. A technology might be mature (ETM) but take years to show significant impact (ETSI) if the enabling environment, or Agrifood Innovation System (AIS), is not ready, as seen with grassroots innovations in some African countries where their ETSI is projected far out (in 2040) despite current maturity. This gap underscores the vital importance of system readiness: a short interval between ETM and ETSI indicates strong policy, institutional, and user support, ensuring both inclusivity and impact, while a long gap signals the need for greater effort to align the broader system with the innovation's full potential, a critical consideration for prioritizing technologies in urgent development contexts. Critically, significant **regional disparities** exist, creating a "two-speed world" in technological uptake (WIPO, 2024, Alexandrova-Stefanova et al. 2024). While North America, Europe, and Asia show leadership in various clusters, regions like Latin America and Sub-Saharan Africa face considerable disadvantages, often struggling to harness emerging technologies and innovations for food security and development.

Layer 4: Research and Innovation Paradigm Shifts (RIPS) as an instrument for redefining the innovation landscape

Layer 4 introduces **Research and Innovation Paradigm Shifts (RIPS)** as fundamental changes in the frameworks influencing science, technology, and innovation (STI) in agrifood systems (Alexandrova-Stefanova et al., 2024). RIPS, such as the **Convergence of technologies**, **Biomimicry**, and **Open- and Open-source innovation** (Alexandrova-Stefanova et al., 2024), create space for disruptive solutions, encompassing both high-tech and grassroots innovations. These shifts are crucial for identifying opportunities, prioritizing investments, and proactively addressing the sustainability and equity implications of technological progress. Expert assessments indicate that Biomimicry is likely to dominate by 2035, while Convergence will lead by 2070. However, Open- and open-source innovation and Biomimicry are considered most impactful for sustainability and equity (Alexandrova-Stefanova et al., 2024).

Layer 5: Political Economy Models are the overarching framework for transformation

The **fifth and highest layer** of the framework centers on **political economy models**, which exert the most profound influence on **technologies and innovations**. These models dictate how innovations are defined, generated, scaled, and integrated into societal missions. Classical free-market approaches, while potentially accelerating innovation, can also exacerbate inequalities if unchecked, prioritizing profit over sustainability (Mazzucato, 2021). Public investment, often the bedrock of major technologies and innovations, needs to be adequately supported to enable regulatory capacity and prevent profit extraction without societal contribution. Conversely, models like the developmental state steer innovation emergence through strategic investments, while coordinated market economies foster collaboration. More recently, the **shared economy model**, emphasizing collaboration, open innovation, and the democratization of technologies, promotes more inclusive and equitable advancements through open innovation and citizen science. This collaborative approach enhances resilience and sustainability, ensuring wider distribution of technological benefits.

Interactions between layers serve to adjusting upstream for downstream impact

A central tenet of this multi-level framework is the interconnectedness of its layers, where decisions and dynamics at higher, more encompassing levels directly influence and shape the manifestations at lower, more specific levels of technologies and innovations. For technologies and innovations to be truly effective and aligned with desired agrifood systems, we must ensure that the "level up" is appropriately adjusted. When problems or limitations are observed at one layer, it often signals a need for intervention at a higher, more strategic layer to facilitate change downstream. Consider a pervasive issue like climate change (a driver from Layer 1). Its increasing severity can demand fundamental shifts in Research and Innovation Paradigm Shifts (RIPS) (Layer 4), pushing for widespread adoption of Biomimicry and Convergence of technologies to develop more sustainable technologies and innovations. However, if the prevailing Political Economy Model (Layer 5) heavily favors short-term profits and proprietary research, it can actively hinder the development and diffusion of such environmentally critical, often open-source, innovations within innovation ecosystems (Layer 2) and their widespread adoption across diverse regions (Layer 3). Conversely, if the political economy model (Layer 5) is intentionally adjusted to promote a shared economy model (a RIPS from Layer 4), this shift will directly foster open innovation within innovation ecosystems (Layer 2). This, in turn, can accelerate the development and equitable distribution of technologies and innovations (Layer 1 manifestations) across different regions (Layer 3), even those currently disadvantaged. Thus, when challenges persist at the level of specific technologies and innovations, it often signals the necessity of assessing and adjusting the overarching political economy models to truly enable transformative change. Ultimately, we found that optimizing investment, and policy, across those layers, is the only way to effectively accelerate the impact of innovation.

4. Practical Implications

The framework enables proactive decision-making, shifting from reactive responses to strategic anticipation. Its practical implications enable for targeted curriculum development to address future skills gaps, such as preparing for AI-driven agriculture by integrating relevant competencies into educational programs today. It supports the design of adaptive advisory services for innovation, ensuring extension services can effectively guide farmers in deciding on the use of emerging technologies, as well as ex-ante and ex-post assessment and transparent feedback mechanisms. The framework also facilitates proactive policy formulation to address the societal impacts of new technologies, including establishing ethical guidelines for their deployment, well in advance of widespread adoption. It guides resource allocation towards high-potential areas and critical needs, ensuring investments yield the most impactful returns. Finally, it helps establish early warning systems for potential disruptions, allowing stakeholders to prepare for both technological breakthroughs and unforeseen challenges, thereby enhancing the overall resilience of agrifood systems.

5. Theoretical Implications

It guides policies on AIS by introducing concepts such as cluster and innovation field power, highlighting the importance of systemic approaches. It acknowledges the "lagging behind" factor, emphasizing the need for targeted strategies to address the slowest-advancing components within clusters. Furthermore, it incorporates technology readiness assessment, network effects, adaptive governance, foresight-driven ecosystems, and anticipatory social impact assessment. This comprehensive approach enables the development of robust,

foresight-informed strategies for shaping innovation and accelerating impact in the Global South.

6. References

- Alexandrova-Stefanova, N., Nosarzewski, K., Mroczek, Z.K., Audouin, S., Djamen, P., Kolos, N. & Wan, J. (2023). Harvesting change: Harnessing emerging technologies and innovations for agrifood system transformation – Global foresight synthesis report. Rome. FAO and Cirad. <https://doi.org/10.4060/cc8498en>
- Alexandrova-Stefanova, N., Nosarzewski, K., Mroczek Z.K., Audouin, S., Djamen, P., Kolos, N. & Wan, J. (2024). Shaping sustainable agrifood futures: pre-emerging and emerging technologies and innovations for impact - An extended global foresight report with regional and stakeholders' insights. Rome, FAO and Paris, CIRAD. <https://doi.org/10.4060/cd2743en>- <https://agritrop.cirad.fr/610673>
- Choi BC, Pak AW. (2006) Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. Clin Invest Med. 2006 Dec;29(6):351-64. PMID: 17330451.
- Mazzucato, M. (2021). Mission economy: A moonshot guide to changing capitalism. Penguin UK.
- WIPO (World Intellectual Property Organization). 2024a. World Intellectual Property Report 2024: Making innovation policy worth for development. Geneva. https://www.wipo.int/web-publications/world-intellectual-property-report-2024/assets/60090/944_WIPR_2024_WEB.pdf

Living Labs in Agroecological Transition: Bridging Academia, Agricultural Extension, and Practical Implementation

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Short abstract

The transition to agroecology can benefit from participatory approaches and co-creation as tools to integrate scientific knowledge, farmer expertise, and policy perspectives, ultimately helping to bridge the gap between academic research and real-world agricultural practices (Chambers, 1994; Pretty, 1995). While transdisciplinary frameworks have gained traction in sustainability research (Lang et al., 2012), there is still a lack of structured dialogue on how participatory methods translate into impactful agroecological transitions (Nunes Dantas, 2022). This paper draws on insights from stakeholder-driven research initiatives to explore the practical applications of participatory methods such as World Café discussions, stakeholder panels, and focus groups. Findings indicate that these approaches can enhance the relevance and usability of agroecological research, particularly when structured facilitation and iterative engagement strategies are employed (Ostrom, 1990; Gliessman, 2015). However, challenges remain power imbalances, disciplinary silos, and engagement

fatigue often hinder effective knowledge co-production (Rosendahl et al., 2015). By showcasing empirical evidence from participatory research in agroecology, this study contributes to ongoing discussions on transdisciplinarity and stakeholder engagement, emphasizing the role of collaborative knowledge production in shaping sustainable food systems (Fazey et al., 2018; Nunes Dantas, 2022). Additionally, this study presents a living lab model developed as a demonstrator, making knowledge and innovation practically demonstrable. This model provides a space for obtaining feedback, exploring needs, and co-designing solutions with stakeholders and users within the living lab environment.

Keywords: Participatory research, co-creation, agroecological transition, transdisciplinarity, stakeholder engagement, knowledge integration, living lab demonstrator approach

References

- Chambers, R. (1994). Participatory rural appraisal (PRA): Analysis of experience. *World Development*, 22(9), 1253–1268. [https://doi.org/10.1016/0305-750X\(94\)90003-5](https://doi.org/10.1016/0305-750X(94)90003-5)
- Fazey, I., Schäpke, N., Caniglia, G., Patterson, J., Hultman, J., van Mierlo, B., ... & Wyborn, C. (2018). Ten essentials for action-oriented and second-order energy transitions, transformations, and climate change research. *Energy Research & Social Science*, 40, 54–70. <https://doi.org/10.1016/j.erss.2017.11.026>
- Gliessman, S. R. (2015). *Agroecology: The ecology of sustainable food systems* (3rd ed.). CRC Press.
- Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., ... & Thomas, C. J. (2012). Transdisciplinary research in sustainability science: Practice, principles, and challenges. *Sustainability Science*, 7(S1), 25–43. <https://doi.org/10.1007/s11625-011-0149-x>
- Nunes Dantas, M. (2022). Pursuing sustainability in food systems through womanism and community development: Family farmers cooperative in Northeast Brazil (Doctoral dissertation, Concordia University). Spectrum Research Repository. <https://spectrum.library.concordia.ca/id/eprint/991136/>
- Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press.
- Pretty, J. N. (1995). Participatory learning for sustainable agriculture. *World Development*, 23(8), 1247–1263. [https://doi.org/10.1016/0305-750X\(95\)00046-F](https://doi.org/10.1016/0305-750X(95)00046-F)
- Rosendahl, J., Zanella, M. A., Rist, S., & Weigelt, J. (2015). Scientists' situated knowledge: Strong objectivity in transdisciplinarity. *Futures*, 65, 17–27. <https://doi.org>

Session 3A

INTERACTIONS, NETWORKS, AND KNOWLEDGE DYNAMICS WITHIN AKIS

Strengthening innovation processes through AKIS approach from Farmers perspectives: A preliminary results

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Short abstract

Connecting farmers and researchers is a key challenge from the AKIS approach (EU SCAR, 2012, Klerkx and Proctor, 2013, Knierim et al. 2015; Moschitz et al., 2015). Advisors and innovation brokers allow the communication and cocreation processes (Cruz et al, 2022, 2021 and Sayadi et al. 2022). This paper examines the enhancement of the Agricultural Knowledge and Innovation Systems (AKIS) approach from the perspectives and experiences of farmers, with a focus on the processes of knowledge generation, communication, and change. For that a brief survey has been elaborated addressed to farmers during 2025 attending training and transfer activities.

The findings indicate significant challenges, including the low level of farmer collaboration in the design and generation of knowledge, the absence of forums or meeting spaces between researchers and the sector, inadequate communication channels, and differences in language and objectives. However, key opportunities to improve the innovation and effectiveness of AKIS are also identified.

The main functions that a good agricultural advisor should have are mainly “offering training and technical support”, “accompanying the incorporation of new practices” and “dynamizing and managing knowledge transfer activities”.

Keywords: Multiactor; cocreation; knowledge transmission; agricultural extension; agricultural advisor profile, Andalusia (Spain).

1. Purpose

In the context of ongoing transformations in agriculture and rural development, the capacity of farmers to engage with and drive innovation has become a critical element of sustainable agri-food systems. Agricultural Knowledge and Innovation Systems (AKIS) have emerged as a key conceptual and practical framework to strengthen these innovation processes by enhancing the connectivity among farmers, advisors, researchers, educators, and policymakers.

While policy and academic discussions around AKIS have advanced significantly in recent years—especially within the European Union—less attention has been given to the direct perspectives and lived experiences of farmers within these evolving systems. Understanding how farmers themselves perceive and interact with AKIS actors and mechanisms is essential

to ensure that innovation processes are inclusive, context-sensitive, and truly empowering at the grassroots level.

This communication presents preliminary results from ongoing research aimed at exploring the role of AKIS in fostering innovation from the standpoint of farmers. Drawing on qualitative data gathered through interviews and participatory workshops in Andalusia (Spain), we highlight the opportunities and challenges that farmers encounter in accessing knowledge, collaborating with stakeholders, and co-creating solutions to address local agricultural needs. By bringing farmers' voices to the center of the discussion, this preliminary and exploratory study contributes to the broader agenda of transforming agricultural extension and education into more inclusive and dynamic systems of innovation.

2. Methodology

Based on face-to-face surveys conducted in May 2025 with 66 farmers participating in training courses across Andalusian provinces, the research captures direct insights into how these producers access knowledge, perceive innovation, and engage with the broader network of agricultural stakeholders.

The questionnaire consists of 14 questions structured in 3 blocks: (i) Knowledge and source of information, (ii) Communication and innovation, and (iii) Respondent data. The importance of the topics has been quantified in a scale evaluation from 0: "not at all important" to 9: "very important". Once completed, the surveys have been carefully reviewed to ensure that they are complete and consistent.

3. Findings

Below are the most significant preliminary findings from the surveys conducted with farmers who attend training and knowledge transfer activities.

When asked about the most important sources of agricultural knowledge for their work, over 80% of farmers indicated that "Personal experience" (54%) and "Formal education" (27%) are their main sources of knowledge.

Most farmers (71%) believe traditional knowledge is "Correct but adapted to specific local conditions and not generalizable," and 21% consider it to have "Proven effectiveness." Meanwhile, 88% of farmers think that scientific knowledge from researchers and technicians has "Proven effectiveness," though 44% feel that it "Only works in laboratories and experimental farms, not in real farms."

Regarding factors that facilitate innovation in the agricultural sector, farmers were asked to select one option. The majority believe innovation is best promoted by "Improving communication between researchers and the sector" and "Developing projects and activities that integrate researchers and farmers" (35% for both). A smaller share (12%) believe innovation should be driven by "Research based on the sector's needs (Table1).

Table 1: Factors that facilitate innovation in the agricultural sector

Factors	%
Improve communication between researchers and the sector	35
Develop projects that integrate researchers and the agricultural sector	35
Conduct research based on the sector's needs	12
Use new technologies (Internet, WhatsApp, etc.) for communication	6
Conduct more applied and goal-oriented research	6
Create meeting spaces for researchers and professionals	3
Greater collaboration between the sector and R&D agents	3
Increase outreach activities (conferences, seminars, etc.)	0

As for barriers to communication between farmers and researchers/technicians, over half of respondents identified the "Lack of adequate communication channels" (27%) and the "Absence of meeting spaces" (24%) as key issues. Additionally, both the "Lack of interest from farmers in communicating with researchers/technicians" and "Differences in goals" were cited by 18% of farmers (Table 2).

Table 2: Barriers to communication between farmers and researchers/technicians

Barriers	%
Lack of adequate communication channels	27
Lack of meeting spaces	24
Lack of interest from farmers	18
Diverging goals	18
Distrust	9
Others (e.g., distance between farmers and technicians)	3
Language differences	0

To better disseminate research results and promote innovation, farmers were offered several communication channels and asked to identify the most useful ones. Most selected "Direct support on the farm or by phone" (38%) and "Technical outreach sessions" (36%). Only 12% saw "Participation in the design of research/transfer projects" as an interesting way to stay updated. Digital platforms and scientific journals were not considered useful (Table 3).

Table 3: Effective communication channels for disseminating research results

Channels	%
Direct support on the farm or by phone	38
Technical outreach sessions	36
Participation in the design of research/transfer projects	12
Sector-specific publications	3
Mobile apps	3
Scientific conferences	3
Trade fairs, exhibitions	3
Online agricultural technicians	3
Digital outreach platforms	0
Scientific journals	0

To complement these insights, the survey also aimed to identify the most suitable profile of an "agricultural advisor" (Innovation Broker) from the farmers' perspective. According to the results, the advisor should mainly "Provide training and technical support" (41%), "Manage CAP paperwork" (26%), and "Accompany farmers in adopting new practices" (15%) (Table 4).

Table 4: Functions of an ideal agricultural advisor

Functions	%
Provide training and technical support	41
Manage CAP paperwork	26
Support adoption of new practices	15
Promote applied research projects	9
Facilitate knowledge transfer activities	6
Collect research proposals from the sector	3

As for desirable personal qualities, farmers highlighted the "Ability to analyze problems and how to address them" (51%), "Listening skills to understand farmers' needs" (29%), and "A strong network of contacts to find the best solutions" (15%) (Table 5).

Table 5: Key qualities of a good agricultural advisor

Qualities	%
Problem analysis and problem-solving ability	51
Listening skills to understand farmers' needs	29
Strong contact network for solutions	15
Flexibility in finding solutions	3
Ability to mediate	3

Finally, regarding the sociodemographic characteristics of surveyed farmers, all participants were from various provinces of Andalusia and engaged in different production systems (e.g., greenhouse horticulture, olive groves, almond farming). Most follow conventional farming practices (68%), while 18% are certified in organic agriculture. Among those not certified, 35% expressed interest in transitioning to organic farming, 6% are currently in conversion, and 9% practice organic methods without certification.

The most represented age group is 26–35 years old (41%), followed by 18–25 (23%), 36–45 (21%), 46–55 (9%), and over 55 (6%). Educationally, over half have secondary education (32%) or vocational training (21%), while 41% hold university degrees. Only 6% have only primary education. In terms of employment, 35% are salaried workers and 32% are active farm owners. Most have been engaged in farming for less than 11 years (62%).

4. Practical Implications

Need for Farmer-Inclusive Research and Extension Models: Policymakers and R&D institutions should promote participatory approaches that involve farmers in the design, implementation, and evaluation of research and innovation projects. This could improve the relevance and uptake of scientific knowledge.

Investment in Communication Infrastructure: The lack of communication channels and meeting spaces highlights a practical barrier that must be addressed through regional or national innovation policy. Establishing regular forums, digital platforms tailored to farmers, and hybrid advisory systems can bridge the existing gap.

Redefining the Role of Agricultural Advisors: Advisors should be trained not only in technical knowledge but also in facilitation, listening, and problem-solving skills. Their role should be expanded to that of innovation brokers who can connect farmers with researchers and policy support structures.

Profile and Training of Agricultural Advisors: Extension systems must invest in developing advisors who combine technical knowledge with soft skills. Based on the findings, training programs for advisors should emphasize:

- Problem analysis and solution design
- Active listening and communication
- Building and leveraging professional networks

This would help advisors act effectively as **facilitators of innovation** rather than just conveyors of information.

Role Diversification and Alignment with Farmer Needs: The functions most valued by farmers include training and technical support (41%), support with administrative processes (CAP paperwork, 26%), and guidance in adopting new practices (15%). Advisory services should be structured to **align with these expectations**, ensuring they are perceived as useful and trustworthy by the farming community.

Embedding Advisors in Innovation Systems: To bridge the existing gap between research and practice, advisors should be embedded in **multi-actor networks** that connect farmers, researchers, and policymakers. Their intermediary role is key to translating scientific knowledge into actionable practices and capturing bottom-up innovation from the field.

Targeted Innovation Support for Young and New Farmers: Given the younger profile of respondents and their openness to new practices (e.g., conversion to organic farming), innovation and training programs should prioritize this demographic, leveraging their potential as early adopters and multipliers of change.

5. Theoretical Implications

Re-evaluation of Knowledge Sources in Agriculture: The findings challenge traditional dichotomies between formal and informal knowledge systems. Farmers continue to rely heavily on experiential knowledge, which suggests that theories of knowledge transfer and innovation in agriculture must account for the interplay between personal experience, formal education, and local knowledge systems.

Limitations of the Linear Model of Knowledge Transfer: The perceived disconnect between researchers and farmers, alongside doubts about the applicability of scientific knowledge to real-world farms, supports critiques of the linear R&D–extension–adoption model. It reinforces the need for co-creation and participatory models of innovation (e.g., Agricultural Innovation Systems or AKIS frameworks).

Trust and Credibility in Knowledge Systems: The mixed perceptions regarding traditional and scientific knowledge point to the need for further theorization on how trust, context-specificity, and perceived utility shape farmers' acceptance of innovations. These elements should be integrated into models of knowledge dissemination.

Reconceptualization of the Agricultural Advisor Role: The findings suggest that farmers value advisors not only for administrative or technical support but also for their capacity to analyze problems, listen, and connect actors. This supports the theoretical shift from "extension agent" to **innovation broker**, as proposed by modern AKIS literature. It implies a broader, more relational and systemic role in knowledge transfer and innovation.

Multi-dimensionality of Trust and Expertise: Farmers' perceptions about advisors highlight that expertise alone is not enough; **relational qualities** such as listening skills, problem-solving capacity, and networking abilities are critical. This challenge traditional notions of advisory

work based purely on technical qualifications and calls for a redefinition of what constitutes credibility and effectiveness in the advisor role.

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6. References

- Cruz, J. L.; Sayadi, S.; Albisu, L. M. 2022. AKIS: Del conocimiento a la innovación en el sector agroalimentario. Libro INIA-CSIC. 157 páginas. INIA-CSIC. ISBN (papel): 978-84-7498-586-3. http://libros.inia.es/libros/product_info.php?products_id=1507.
- Cruz, J. L.; Albisu, L. M.; Zamorano, J. P.; Sayadi, S. 2021. Agricultural interactive knowledge models: researchers' perceptions about farmers' knowledges and information sources in Spain. *The Journal of Agricultural Education and Extension*. Taylor and Francis Ltd. United Kingdom. <https://doi.org/10.1080/1389224X.2021.1932537>. pp: 325-340.
- EU SCAR (Standing Committee on Agricultural Research). (2012). *Agricultural Knowledge and Innovation Systems in Transition – a reflection paper*. Brussels: European Commission. Available in <https://ec.europa.eu>
- Klerkx, L., & Proctor, A. (2013). Beyond fragmentation and disconnect: Networks for knowledge exchange in the English land management advisory system. *Land Use Policy*, 30(1), 13–24. <https://doi.org/10.1016/j.landusepol.2012.02.003>
- Knierim, A., Boenning, K., Caggiano, M., Cristóvão, A., Dirimanova, V., Koehnen, T. & Roest, K. (2015). The AKIS concept and its relevance in selected EU member states. *Outlook on Agriculture*, 44(1), 29–36. <https://doi.org/10.5367/oa.2015.0194>
- Moschitz, H., Roep, D., Brunori, G., & Tisenkopfs, T. (2015). Learning and innovation networks for sustainable agriculture: processes of co-evolution, joint reflection and facilitation. *The Journal of Agricultural Education and Extension*, 21(1), 1–11. <https://doi.org/10.1080/1389224X.2014.991113>
- Sayadi, S.; Ruiz, F. A.; Arrebola, F.; Cruz, J.L.; Parra López, C.; Albisu, L.M. 2022. Small ruminants research and training needs assessment according to stakeholder's perspective in Andalusia (South Spain). Option Mediterranean revue. 1st Joint Meeting, FAO-CIHEAM Networks on Sheep and Goats and on Mediterranean Pastures. Meknès, Morocco/Maroc, 23-25 Oct 2019.

Theoretical typology of linkages among research, extension and farmers: A call for a pragmatic approach

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Short abstract

This paper presents a typology of linkage models among research, extension and farmers, developed through a comprehensive literature review. In contrast to conventional reviews, the focus was not placed on the documents' research findings, but rather on the underlying assumptions regarding desirable modes of interaction among actors. A total of 136 documents published between 1981 and 2021 were analyzed using five theoretical axes: scientific paradigms, communication models, conceptualizations of innovation, power and hierarchy relations, and the recognition of actors' agency and otherness. Four distinct models were identified: Classical Transfer of Technology (ToT), Moderate ToT, Constructivist and Pragmatic. The main contribution of this work lies in offering an empirically grounded typology, connected to theoretical dimensions often overlooked in the literature, and in distinguishing between approaches usually treated as equivalent, such as the ToT variants. Moreover, the identification of the Pragmatic model stands out, as it shares constructivist assumptions but incorporates cost-benefit considerations as a criterion for selecting the most suitable linkage model in each context. This proposal aims to foster critical and context-sensitive reflections on the articulation among actors in agricultural innovation processes.

1. Introduction and theoretical framework

The relationships and interactions among AKIS actors are fundamental to boosting agricultural innovation processes. Within AKIS, different authors have focused on the linkages among research, extension and farmers. In this context, it has become common sense to criticize the traditional transfer of technologies approach (ToT) and to recommend systemic and interactive innovation models (mostly) using standardized arguments. In this paper, we present a theoretical typology of linkage models among research, extension and farmers, invite us to critically reflect on our own assumptions, and make the case for a more pragmatic approach when recommending linkage models in different contexts.

The 'transfer of technology' (ToT) approach, also known as 'diffusion of innovations theory', is based on the paradigm of Modernization Theory (Landini & Conti, 2023). Modernization Theory, an approach emerged during the post-Second World War era, argued that 'underdeveloped' countries should adopt the cultural, social and production practices of Western 'developed' societies, mostly the United States. In this process, the adoption of 'scientific' production technologies played a key role in the 'development' of 'poor' countries. In this context, the ToT approach understands agricultural innovation in terms of the transfer of technologies from researchers to farmers through extension agents (Landini & Conti, 2023). Importantly, the ToT approach has been criticized for neglecting farmers' local knowledge (Méndez-Sastoque, 2020), overvaluing the potential positive impact of scientific

knowledge, having a limited vision of how innovation works (Klerkx et al., 2012), and for its linear underlying communication model (Leeuwis & Aarts, 2011), among others.

In general, the traditional ToT approach usually is contrasted with other approaches following two different axes. On the one hand, the ToT approach, considered simplistic, is compared to systemic innovation models, such as the AKIS or the Agricultural Innovation Systems (AIS) (Klerkx et al., 2012). On the other hand, the traditional ToT approach, understood as linear, is contrasted with interactive innovations models (for instance, co-innovation), which understand innovation as a result of an interactive, non-linear, and unpredictable process (Klerkx & Begemann, 2020).

Interestingly, despite the changes in the way innovation is understood, researchers, extension agents/advisors and farmers are still considered key actors. Nonetheless, it is apparent that these new models change the role assigned to researchers, extension agents and farmers, as well as the expected modes of interaction among them. For instance, farmers are no longer conceived solely as adopters or simple users of knowledge, but are also considered as generators of knowledge and innovations (Onumah et al., 2023). In parallel, the role of researchers is also rethought, so they are no longer considered "suppliers" of innovation, but rather as key actors in innovation processes that contribute "inventions," (Fieldsend, 2020) which can eventually become innovations within processes of social learning, coordination, and socio-institutional change.

In the context of these changes in the way in which the roles of researchers, extension agents and farmers are understood in agricultural innovation processes, in this paper we present the results of a comprehensive literature review aimed to develop a typology of linkages among research, extension and farmers. In particular, we analyze the assumptions underlying the desirable modes of interaction among researchers, extension workers, and farmers implicit in the academic production of scholars working on the topic. To do this, we draw on theory in five different axes:

Underlying scientific paradigms. Scientific paradigms are articulated assumptions and beliefs about the nature of reality, the possibility of knowing it and the correct modes of conducting research. In general, authors highlight four or five scientific paradigms: positivist, post-positivist, critical theory, constructivist and pragmatic (Galati, 2012; Kelly et al., 2018).

Models for thinking about communication. Leeuwis and Aarts (2011) describe three models to think about communication in the context of innovation processes: objective or transmission model, subjective or interaction model, and construction or transaction model.

Academic thinking about innovation. Innovation can be understood in different ways. In this paper we differentiate between the ToT approach (Landini & Conti, 2023), and a constructivist interactive approach, also named as co-innovation (Boyce et al., 2018).

Power and hierarchy relationships among actors. Power and hierarchy are linked to scientific paradigms, the communication models and the way of thinking about innovation used by the different authors. Here, we use standard definitions, and understand power as the capacity of influence or control others' behavior (Young & Arrigo, 2019), and 'social hierarchy' as the subordination of individuals or social groups to others based on value criteria (Magee & Galinsky, 2008).

Recognition of agency and otherness of actors. In this dimension, we analyze the degree to which authors value researchers', extension agents' and farmers' agency, and acknowledge them as 'others', in the sense of subjects with their own rationale, values and worldview (Córdoba & Vélez-De La Calle, 2016).

2. Methodology

We conducted a comprehensive literature review. However, in contrast to most literature research, in this article we did not focus on the research results of the analyzed documents but on the authors' underlying assumptions about the research-extension-farmer linkage. We used Google Scholar search engine and EBSCO and SciELO databases and looked for articles in English, Spanish and Portuguese. Importantly, while many systematic literature reviews usually prioritize Web of Science (WoS) and/or Scopus, because they are considered the highest quality and most transparent scientific databases (Pranckutė, 2021), we did not use them because we did not aim at synthesizing quality research results but at analysing the authors' underlying beliefs and assumption about the research-extension-farmer linkage.

The review was conducted in 2021. We used the following terms in different combinations to conduct the search for documents, along with their translations into Spanish and Portuguese: linkage/relationship/interaction, agricultural research, rural extension and innovation. We considered scientific articles, books, book chapters, and technical documents from renowned institutions. We reviewed all the results obtained in EBSCO and SciELO, whereas we analyzed only the first 100 results of each search in Google Scholar. In total, we selected 136 documents. The date of publication ranged from 1981 to 2021, with 74% of the articles having been published in 2010 or later.

The documents were categorized using the five dimensions and sub-dimensions described in the Introduction with the support of Atlas.ti software. Then, usual configurations of sub-dimensions were used to build a typology of different ways of understanding the linkage among research, extension and farmers. Under the next heading we present a synthesis of the results. A detailed description of the findings and their interpretation is also presented in a recent publication (Landini et al., in press).

3. Findings

As a result of the study, four different types of linkages were identified: Classical ToT (15%), Moderate ToT (44%), Constructivist (36%) and Pragmatic (5%). Percentages were calculated based on the number of documents that were classified. Interestingly, we did not observe any evident connection between publication dates and type of model.

Classical ToT model. It assumes, with no hesitation or discussion, that researchers have to develop knowledge and technologies while extension agents have to transfer them, and farmers to adopt them. The underlying scientific paradigm is positivism, since there is an unrestricted trust in science and a clear perception of its superiority. This model is characterized by an objective communication model and a view of innovation as transfer and adoption of technologies. This leads to an unequal distribution of power among innovation actors and to a lack of acknowledgment of extension agents and farmers agency and otherness.

Moderate ToT model. These authors criticize the traditional ToT model and highlight the need for feedback from farmers and extension agents. Nonetheless, researchers keep a prominent position. The underlying scientific paradigm is post-positivism, which assumes the superiority of scientific knowledge, without neglecting other possible (though secondary) knowledge sources. These authors tend to think in terms of a subjective communication model and support a ToT approach though acknowledging the importance of feedback loops to check for the usefulness of the knowledge and innovations created by the researchers. Power and hierarchy are nuanced though the power imbalance remains. Finally, otherness is moderately

acknowledged as a source of feedback but not as capacity to create knowledge or innovate independently.

Constructivist model. This discusses the central role occupied by researchers in the previous model and opens to the idea of co-creation of knowledge and of co-innovation. The underlying scientific paradigm is constructivism since knowledge is understood as co-creation or co-construction. Two communication models are supported in these documents, the construction and the subjective ones, though the first one is more frequent. Innovation is conceptualized as a constructivist, interactive processes, in line with interactive innovation and co-innovation. At least in theory, these documents level the power balance and strive for egalitarian relationships among innovation actors. Finally, the acknowledgment of agency and otherness of extension agents and farmers is complete, since they are considered as equal partners in the innovation process.

Pragmatic model. It is based on the constructivist model's assumptions but with a key difference. Even though these authors also criticize the traditional ToT model, pragmatist scholars argue that a constructivist approach, for instance co-innovation, may be costly and time consuming, and should be put into practice only with the expected benefits surpass its costs. If not, practices in line with a moderate ToT approach would be preferable.

4. Discussion and conclusions

This work offers different contributions to current literature. First, it contributes a typology of linkage models among research, extension and farmers. Despite theory suggest the existence of different linkage models (see for instance Klerkx et al., 2012), our typology adds to current literature (1) by linking those models with theories and concepts usually not considered by scholars (for instance, underlying communication models, acknowledgment of agency and otherness...) and (2) by building the typology based on the empirical analysis of existing academic literature and not just in theory. This last point is particularly important, because makes it easier to link theory with empirical production and vice versa.

Second, our results also suggest that, in contrast to what most author have traditionally suggested, even us, (e.g. Klerkx et al., 2012; Landini & Conti, 2023; Méndez-Sastoque, 2020) there is not only one ToT approach, but two different ones, one traditional (generally used to describe the approach), and one moderate, which acknowledges the practical value of farmers' and extension agents' feedback, while keeping the central role assigned to researchers. Interestingly, different documents that used the initial understanding of AKIS (Agricultural Knowledge and Information Systems) fit the moderate ToT model.

Finally, this paper also contributes to literature by differentiating between a constructivist and a pragmatic model of linking research, extension and farmers. Importantly, this difference, to the best of our knowledge, has not been argued in the literature before (Fieldsend, 2020; Klerkx et al., 2012; Landini & Conti, 2023; Méndez-Sastoque, 2020). However, it seems particularly important, since it highlight the importance of including in the equation cost-effectiveness when developing empirical interventions and designing policy.

This study has limitations. In particular, the sample cannot be considered as representative, so the quantitative distribution of different types of models only applies to our specific sample. In addition, only a few papers with a pragmatic approach were identified, which implies that the description of the pragmatic model should be considered preliminary, and that further analysis of papers with this particular approach would be desirable.

5. References

- Boyce, W., Srinivasan, M., Turner, J., Percy, H., & Fielke, S. (2018). Combining a cognitive framework and a co-innovation research strategy to address water use efficiency. *Rural Extension and Innovation Systems Journal*, 14(1), 137-141.
- Córdoba, M., & Vélez-De La Calle, C. (2016). La alteridad desde la perspectiva de la transmodernidad de Enrique Dussel. *Revista Latinoamericana de Ciencias Sociales, Niñez y Juventud*, 14(2), 1001-1015. DOI: 10.11600/1692715x.14208160615
- Fieldsend, A. (2020). Agricultural knowledge and innovation systems in European Union policy discourse: Quo vadis? *Studies in Agricultural Economics*, 122(3), 115-123. DOI: 10.7896/j.2055
- Galati, E. (2012). Visión compleja de los paradigmas científicos y la interpersonalidad en la ciencia. *Cinta de Moebio*, 44, 122-135. DOI: 10.4067/S0717-554X2012000200003
- Kelly, M., Dowling, M., & Millar, M. (2018). The search for understanding: The role of paradigms. *Nurse Researcher*, 25(4), 9-13. DOI: 10.7748/nr.2018.e1499
- Klerkx, L., & Begemann, S. (2020). Supporting food systems transformation: The what, why, who, where and how of mission-oriented agricultural innovation systems. *Agricultural Systems*, 184, 102901. DOI: 10.1016/j.agsy.2020.102901
- Klerkx, L., Van Mierlo, B., & Leeuwis, C. (2012). *Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions*. In I. Darnhofer, D. Gibbon & B. Dedieu (Eds.), *Farming systems research into the 21st century: The new dynamic* (pp. 457-483). Springer. DOI: 10.1007/978-94-007-4503-2_20
- Landini, F., & Conti, S. (2023). Factors contributing to rural extension agents' support for a transfer of technology (ToT) approach: a multiple linear regression analysis. *The Journal of Agricultural Education and Extension*, 29(5), 605-625. DOI: 10.1080/1389224X.2022.2120027
- Landini, F., Conti, S., & Villalba, A. (in press). Construction of a typology of research-extension-farmer linkage models. *Rural Society*. DOI: 10.1080/10371656.2025.2455858
- Leeuwis, C., & Aarts, N. (2011). Rethinking communication in innovation processes: creating space for change in complex systems. *The Journal of Agricultural Education and Extension*, 17(1), 21-36. DOI: 10.1080/1389224X.2011.536344
- Magee, J., & Galinsky A. (2008). Social hierarchy: The self-reinforcing nature of power and status. *The Academy of Management Annals*, 2(1), 351-398. DOI: 10.1080/19416520802211628
- Méndez-Sastoque, M. 2020. Hacia una Extensión Rural Fundada en el Diálogo Sinérgico de Saberes: Campesinos y Extensionistas Construyendo Juntos. *Redes. Revista do Desenvolvimento Regional*, 25(1), 189-210. DOI: 10.17058/redes.v25i1.14684
- Onumah, J., Asante, F., & Osei, R. (2023). Actor roles and linkages in the agricultural innovation system: options for establishing a cocoa innovation platform in Ghana. *Innovation and Development*, 13(2), 301-322. DOI: 10.1080/2157930X.2021.1965752
- Pranckutė, R. (2021). Web of Science (WoS) and Scopus: The titans of bibliographic information in today's academic world. *Publications*, 9(1), 12. DOI: 10.3390/publications9010012
- Young, T., & Arrigo, B. (2019). *The dictionary of critical social sciences*. Routledge.

Reflections on a 6-year transition toward systemic framing of innovation support in a multi-level, pluralistic and heterogenous Australian AKIS – insights for practice

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Short abstract

Sustainable transition theory, with its origins in complex adaptive systems thinking can presume that the requisite systemic framing of the transition is in use in practice. In relation to sustainability transitions in the agricultural sector, this translates to a systemic framing of the services supporting innovation within Agricultural Knowledge and Innovation Systems. Where a systemic framework of innovation support is here conceptualized as actioned through the facilitation of strong orientation, coordination and feedback loops amongst actors in the Agricultural Knowledge and Innovation System. This paper reports on beneficiary and provider insights from a 6-year program of supporting a transition towards systemic framing of innovation support services in an Australian Agricultural Knowledge and Innovation System. Data was gathered through a desktop review of the latest project evaluations and from the transcripts of recent beneficiary and provider reflexive activities on the progress of purposeful structural changes made to the program in 2019. Data was thematically analysed to produce the enclosed account of how the elements introduced have strengthened the orientation, coordination and feedback loops within the innovation support services. Observations about the practical and theoretical implications of such are also provided.

1. Purpose

It is theorised that sustainable agricultural transitions will rely on innovation support services that can facilitate sustainable transitions of Agricultural Knowledge and Innovation Systems (AKIS) (Kountios et al., 2024). We define an AKIS as “the combined organisation and knowledge flows between persons, organisations and institutions who use and produce knowledge for agriculture and interrelated fields” (Faure et al., 2019, p.147; Knierim et al., 2013; European Union, 2012). In this paper we apply the infrastructural frame of the AKIS as described by Klerkx et al. (2012) and others (Labarthe et al., 2013). An infrastructural framework brings into focus who is involved in agricultural innovation, how they interact and the rules they are using to govern their interaction.

From this viewpoint, our case of an Australian AKIS can be seen as a system of multi-level, pluralistic and heterogenous actors. Multi-level because the Australian federated governmental system is three -tiered, and thus actors are located within and across regional, state and national levels of public organisation. Pluralistic because the actors involved are hosted within many types of organisations along the public to private continuum. Heterogenous because those multi-level, pluralistic actors could be applying a range of

differing frameworks of the situation, to what ends it should be driven, and how innovation occurs.

An assumption implicit in the application of AKIS theory towards sustainable transitions, with its origins in complex adaptive systems thinking, is that within multi-level, pluralistic and heterogenous AKIS, such as our case, there is a level of homogeneity in a systemic view of innovation amongst those involved in Innovation Support Services (ISS). Where a range of innovation frameworks could be in use (Landini, 2025). After Mathe et al. (2023, p. 411) who draws on others (Faure et al., 2019; Mathe et al, 2016) we define ISS as those “activities carried out between providers and beneficiaries in regular interaction to respond to a specific demand emerging from a joint analysis of a situation. We define a systemic view of innovation support as involving the following three activity domains:

- I. Maintaining the orientation of the actors involved towards a shared mission
- II. Coordinating those same actors in the pursuit of that mission
- III. Supporting robust feedback loops between action and progress towards the mission

This aligns with Klerkx et al. (2012) roles of innovation brokering in agricultural innovation systems. Namely, articulating the knowledge demand, maintaining networks and facilitating social learning respectively.

In our case, an explicit aspiration to institutionalise a systems approach to innovation across the ISS was made in 2019. A “pipeline approach” (Kenny et al., 2019, p.3) was rejected by the reviewers of the existing ISS, citing extensive feedback from beneficiaries and providers that orientation, coordination and feedback loops required strengthening. See Kenny et al. (2019, p.2) for a list of ISS orientation, coordination and feedback deficits as cited by members of the AKIS at that time.

Consequently, a revised structure was proposed to achieve institutionalisation of systems thinking within the ISS, through targeted changes across the three activity domains. In terms of orientating the system towards a shared mission, 5-year collaborative regional planning consolidated into national priority areas, i.e. missions, was initiated. To better coordinate the action towards regionally-developed yet nationally-consolidated missions, resourcing of the national leadership and coordination of the ISS was increased, regional and national advisory panels were introduced and leadership coordination in each strategic priority area proposed. Feedback loops were strengthened by annual participatory adaptive planning cycles within the 5-year strategy, the provision of an innovation fund to seed short innovation loops and a robust Monitoring and Evaluation (M&E) framework. Finally, dedicated resources were allocated to building capability through professional development in systems thinking across the actors involved in ISS. The latter is the subject of a PhD and will not be reported upon here.

In this paper, we reflect on this approach to institutionalising systems thinking in an Australian agricultural industry’s ISS through structural experimentation. We ask how the implementation of the proposed infrastructure is progressing and if the interventions are operating as expected. In doing so, we identify what remains outstanding or is emerging as an opportunity for further improvement. We also consider the practical and theoretical implications of our analysis.

2. Methodology

Three methods of data collection were used. First, a desk top review of key documents such as milestone reports, evidence pack produced for the next iteration of ISS in the case industry and research outputs from related projects such as those assessing the structure and function of innovation in the case industry.

Secondly, key providers and beneficiaries of the ISS were supported to reflect on:

- How has implementation of the strategy responded to each challenge listed by stakeholders at the start of the revised program in 2019?
- What challenges remain outstanding or have emerged?
- What lessons would you share with others seeking to do the same in other industries?

Lastly, the desktop review and reflection activities were triangulated with a reflection workshop conducted with the national advisory panel for our case ISS which is chaired by an independent leading AKIS subject matter expert, as well as beneficiaries and providers of the support services.

Data from each source was grouped according to each structural intervention and analysed for themes. Themes were grouped into domains, and these are reported in the findings section. The practical and theoretical implications are reported in the final sections of the paper.

3. Findings

The ISS are on track to delivering on contracted outcomes with increased project recognition and attribution of positive impact amongst beneficiaries (Larsen, 2025). Providers and beneficiaries are reporting strengthening of orientation, coordination and feedback loops in the ISS as foundational to its success. Progress reflections of providers and beneficiaries support further strengthening of what has been implemented, implementation of elements that were paused or adding resources to structural elements that are proving strategic to the transition towards a system's framing of innovation within the ISS.

Annual adaptive regional planning cycles are resulting in consolidation of national priority areas where the number has halved since 2019. Thus, demonstrating progress towards stronger orientation of the network through fewer targeted shared missions. Regional priorities are also observed by beneficiaries and providers to be better aligned with industry funded national flagship research and development investments in mechanisation and in supporting business continuity during pest and disease incursion. This also points to strengthened orientation of the support services with beneficiaries reporting increased relevance and access to research and development investments.

Alignment of research and development activities with nationally consolidated regionally developed priorities also suggest increased coordination in the ISS. Continuity of strong national leadership in governance and coordination is seen by members of the ISS as critical to their observed success of the project and the transition of the ISS towards systems framing of innovation. Thus, demonstrating the importance of adequately resourcing strategic coordination which operates from a systemic farming of innovation.

Despite the cited benefits of structural elements introduced to enhance coordination, these elements were also seen by beneficiaries and providers as requiring further strengthening. For example, the national and regional advisory panels were noted as important elements, yet their role as both orientating and coordinating mechanisms was reported as not yet widely understood across the multi-level, pluralistic and heterogenous delivery partner organisations within the ISS. With delivery partner organisations spanning both the levels of public administration and breadth of industry, public and private organisational types. Additionally, the proposed appointment of leadership within the ISS provider organisations to national priority areas to enhance coordination within missions was paused early in the transition. Whilst beneficiaries and providers of the ISS would consider its reinstatement, supported by consolidation of nationally amalgamated regionally developed priorities, continued progress in those domains would remain important.

Beneficiaries and providers noted the multi-level and pluralistic context in which the ISS is operating and delivering as reasons for the weaker progress in this area. This is observed to be sustained in a strong homogeneity in linear or “pipeline” views of innovation and adoption. This results in a significant coordination burden that cannot be ephemerally borne at any one level or in isolation. This points to strategically recruiting and strengthening continuity of the requisite systems framework of innovation within key coordinating positions to create multi-level system framing niches within and across levels of the ISS. Especially as beneficiary and provider reflections identify new opportunities for greater impact of services through coordination such as the inclusion of other co-located industries.

Whilst orientation is strengthening across the ISS, it follows that an observed comparative lag in the strengthening of coordination that beneficiaries and providers would reflect some resistance in the flow of information in feedback loops such as between the national and regional advisory panels and between those panels and other advisory panels such as those deciding on industry research and development investments. A dedicated reflexive monitoring and evaluation program (Lucas et al., 2024) and the provision of an innovation fund to support short innovation cycles were noted by beneficiaries and providers as supplying concrete opportunities to learn about the importance and value of feedback loops in innovation systems. Especially in relation to tracking towards outcomes, maximising the use of resources, increasing the pace of innovation through unity and clarity and continuous improvement.

Several builds on the elements implemented to enhance feedback loops were identified by providers and beneficiaries. Especially those related to broader rapid digital transformation which is seen as offering great potential to supporting continuous progress and development through faster, stronger and real time feedback loops. Yet beneficiaries and providers reflect that the opportunities identified will prove challenging without further strengthening of orientation and coordination within the ISS.

In summary, progress towards a systemic framing of innovation for greater impact within the ISS of our Australian AKIS is evident. Despite progress, the aspirational systemic innovation framing goals of 2019 remain outstanding, with beneficiaries and providers reflecting it to be in their experience a result of it being a lengthier proposition than typical public administrative and funding cycles and exacerbated by churn in key positions. Whilst

beneficiaries and providers note that churn is not a direct product of short funding cycles, they report it to be related. Further resourcing of several elements aimed at continuity of actors within the ISS were proposed by beneficiaries with the caveat that the impact of such would rest on the requisite strengthening of coordination across multi-level and pluralistic delivery organisations. Hence whilst some beneficiaries and providers propose a longer time frame for the next iteration of ISS the impact of this is seen to be contingent on interrelated continued builds in orientation and coordination.

4. Practical Implications

Purposeful structural experimentation within the ISS of an Australian AKIS provides several insights for practical application of innovation systems theory for sustainable agricultural transitions. The length of transitions in AKIS, in this case institutionalizing systemic framing of innovation, was experienced as longer than what is typically afforded by administrative and funding cycles. Transitions require continuity in strategically placed systems thinking capabilities within the ISS to sustain the multi-level niches capable of supporting a shift towards system thinking and practice across pluralistic actors. Attention should be paid to incentivize learning while doing collaborative innovation cycles to enhance orientation and coordination of pluralistic groups within and across multiple levels of public organization.

5. Theoretical Implications

This reflection on a purposeful attempt to apply a systems framing of innovation to an ISS within an Australian AKIS produced lines for further inquiry. These questions challenge the implicit view that requisite systems framing for sustainability transitions exist or can be quickly institutionalised in the ISS within an AKIS (Charatsari et al., 2024). A corollary of which is how much of the systems framing is required and where it is required to scaffold transitions (Walshok et al. 2013). Which provides a contingent question of whether the potential of digital transformation to accelerate sustainable innovation in agricultural industries could be achieved sooner and more equitably if the required systems framing of innovation was in place (Flemming et al., 2021; Fielke et al., 2019).

6. References

- Charatsari, C., Michailidis, A., Francescone, M., De Rosa, M., Aidonis, D., Bartoli, L., La Rocca, G., Camanzi, L., & Lioutas, E. D. (2024). Do Agricultural Knowledge and Innovation Systems Have the Dynamic Capabilities to Guide the Digital Transition of Short Food Supply Chains? *informations*, 15(22), 321-335. DOI: 10.3390/info15010022
- European Union. (2012). Agricultural knowledge and innovation systems in transition—a reflection paper.
- Faure, G., Knierim, A., Koutsouris, A., Ndah, H. T., Audouin, S., Zarokosta, E., ... & Heanue, K. (2019). How to strengthen innovation support services in agriculture with regard to multi-stakeholder approaches. *Journal of Innovation Economics & Management*, 28(1), 145-169.
- Kenny, S. S., Coutts, J., & Botha, N. (2019) Industry extension strategy.
- Fielke, S. J., Garrard, R., Jakku, E., Fleming, A., Wiseman, L., & Taylor, B. M. (2019). Conceptualising the DAIS: Implications of the 'Digitalisation of Agricultural Innovation Systems' on technology and policy at multiple levels. *NJAS: Wageningen Journal of Life Sciences*, 90(1), 1-11.

- Fleming, A., Jakku, E., Fielke, S., Taylor, B. M., Lacey, J., Terhorst, A., & Stitzlein, C. (2021). Foresighting Australian digital agricultural futures: Applying responsible innovation thinking to anticipate research and development impact under different scenarios. *Agricultural Systems*, 190, 103120.
- Klerkx, L., Van Mierlo, B., & Leeuwis, C. (2012). Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions. *Farming Systems Research into the 21st century: The new dynamic*, 457-483.
- Knierim, A., Boenning, K., Caggiano, M., Cristóvão, A., Dirimanova, V., Koehnen, T., Labarthe, P., & Prager, K. (2015). The AKIS Concept and its Relevance in Selected EU Member States. *Outlook on Agriculture*, 44(1), 29-36. <https://doi.org/10.5367/oa.2015.0194>
- Kountios, G., Kanakaris, S., Moulogianni, C., & Bournaris, T. (2024). Strengthening AKIS for Sustainable Agricultural Features: Insights and Innovations from the European Union: A Literature Review. *Sustainability*, 16(16), 7068. <https://doi.org/10.3390/su16167068>
- Labarthe, P., Caggiano, M., Laurent, C., Faure, G., & Cerf, M. (2013). Prospects for Farmers' Support: Advisory Services in European AKIS (PRO-AKIS): WP2—Advisory Services within AKIS: International Debates. *Deliverable WP*, 2-1.
- Landini, F., Conti, S., & Villalba, A. (2025). Construction of a typology of research-extension-farmer linkage models. *Rural Society*, 1–17. <https://doi.org/10.1080/10371656.2025.2455858>
- Larsen, C. (2025). Monitoring and evaluation to inform co-design of phase 4.
- Lucas, D., Larsen, C., Lang, O., Hassan, Z., Emerick, C., & Hood, O. (2024). National impact, regional delivery – Robust M&E for best practice Australian horticulture industry development. Australian Evaluation Society Conference 2024.
- Mathe, S., G. Faure, A. Knierim, A. Koutsouris, H. Ndah, L. Temple, B. Triomphe, E. Wielinga and E. Zarokosta (2016). "Typology of innovation support services, WP1 AgriSpin, deliverable 1.4." CIRAD, Montpellier, France.
- Mathé, S., Audouin, S., Toillier, A., Temple, L., Ndah, H. T., Knierim, A., ... & Fongang, G. (2023). What are the specificities of agricultural innovation systems in the South: an approach based on innovation support services. INRAE.
- Walshok, M.L., Shapiro, J.D., & Owens, N.J. (2013). *Unravelling the Cultural and Social Dynamics of Regional Innovation Systems*, University of California, San Diego.

Do public policies support knowledge networks? A qualitative analysis of an Italian case

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Short abstract

Agricultural Knowledge and Innovation Systems (AKIS) are considered a key tool for innovation in the agricultural sector. However, the mechanisms through which these networks are formed are not fully defined and it is not clear how stable these networks remain over time. The study arose from the need to understand how agricultural policies in the Italian

context can influence the creation of knowledge networks, with a focus on Measure 2.3 based on the training of consultants of the Rural Development Programme of the Campania Region during the 2014-2020 programming period. The research was conducted through a qualitative approach. Semi-structured interviews were developed and used to investigate the experience of the five beneficiaries of the measure and representing the five productive sectors. The objective is to assess which are the main factors that favour or hinder the creation of knowledge networks and which actors among the public and private sector are most inclined to collaborations. Although the study is focused on a single Italian region, the expected results will provide insight into the critical points of AKIS systems and offer the opportunity to suggest more efficient governance practices for the current and subsequent Common Agricultural Policy (CAP) programming.

1. Purpose

The sustainability of agricultural systems and food security, in terms of both food quantity and the health of food and ecosystems, raise significant concerns, and numerous strategies have been proposed to innovate the food system and address current challenges (Kirova et al., 2019; Herrero et al., 2020; Vågsholm et al., 2020). In this context, knowledge and social innovation can facilitate the transition towards multifunctional agriculture (De Rosa et al., 2023). The transfer of knowledge from the scientific community to the agricultural sector has historically been a cornerstone of the innovation system, supported by policies, programs, and projects aimed at enhancing the competitiveness of the sector and improving rural community life (Gutiérrez Cano et al., 2023). The Agricultural Knowledge and Innovation System (AKIS), defined as a network of actors and organizations interacting for the creation, transformation, transmission, storage, and dissemination of knowledge, was developed to modernize the agricultural sector. In recent years, it has evolved from a traditional linear system into a more dynamic approach, characterized by interactive networks of actors supporting decision-making processes (Kuiper and Röling, 1991; Blix Germundsson, 2021). In Europe, the Common Agricultural Policy (CAP) has allocated significant resources since 2007 to advisory services and consultant training. During the 2014–2020 programming period, extended to 2022, these actions were integrated into rural development goals, making farm advisory services compulsory for member states. Within the Italian National Strategic Plan (NSP), Measure 2, focused on consultant training, remained optional. In Italy, the AKIS framework is critical for innovation adoption (Kountios et al., 2024). Italy integrated Measure 2 into its NSP, structuring it into three sub-measures:

- 2.1: Provision of advisory services;
- 2.2: Support for establishing advisory service;
- 2.3: Consultant training.

However, the implementation of Measure 2.3 faced several challenges throughout Italy. It was adopted by 13 regions but effectively implemented only in Campania, Tuscany, and Veneto, with Campania being the only region to fully complete the measure, for which 1 million euros were allocated. This study aims to analyse and assess whether and to what extent public intervention facilitates the creation of knowledge networks in the agricultural sector, focusing specifically on Measure 2.3 of the Rural Development Plan (PSR) of the Campania region. In particular, the research adopts a qualitative approach to identify key factors that positively or negatively influence the formation and stability of these networks.

2. Design

The study aims to examine the factors characterising the creation of a knowledge network in the Italian agricultural context. The analysis, which started in March 2025, is based on a qualitative approach conducted in two phases: the first phase was dedicated to the study and in-depth analysis of the policies supporting knowledge models, the second phase involved the conduction of semi-structured interviews with the main actors of the Measure 2.3 call for proposals in Campania. The interviewees were representatives of the 5 winning key actors of the tender 3295/A-T/21. Each interviewee belongs to one of the following lots:

- Lot 1 – Animal husbandry and production;
- Lot 2 – Horticulture and fruit growing;
- Lot 3 – Cereal and industrial crops;
- Lot 4 – Mediterranean crops;
- Lot 5 – Rural Tourism and local hospitality systems.

Semi-structured interviews are inspired by the model of Crofts et al. (2008) and the methodological framework developed by Kallio et al. (2016). The interview thus allows for standardised data and the exploration of subjective responses using closed and open questions that can stimulate personal reflections. The interviews are therefore structured in two sections, an initial one in which to collect data on the profile of the interviewee and the organisation of which he or she is a member, and a second section consisting of follow-up questions investigating the experience of Measure 2.3, with questions addressing the opportunities the actors may have taken or the challenges they faced. The planned duration of each interview is about 60 minutes, and they will be conducted in person or by telephone. The sample, although small, is sufficient to collect information from key actors, as the specific objective of the study is not statistical generalisation and being a homogeneous context meaning saturation could be achieved (Hennink et al., 2017). The interviews will be recorded and transcribed using NVivo software. This will be followed by a content analysis phase for both an objective description of the manifest content of the communication and the interpretation of the latent content through the identification of meaning units (Burns and Berelson, 1953). Interpretive categories will be extracted with regard to the criticalities and strengths that have emerged, and a codebook will be developed to classify specific events or recurring conceptual patterns (Coffey et al., 1996).

3. Findings

The analysis of the Measure 2.3 notice revealed elements that could be critical in the formation of knowledge networks, such as the tight timeframe for implementation, the guidelines on training Extended Abstract for the 27th ESEE conference recipients and the monitoring system. These elements may or may not be confirmed in the interviews that are still in the implementation phase. From a preliminary analysis of some data on the partnerships formed, it is possible to state that the networks formed appear highly heterogeneous. The five partnerships formed ranged from 3 to 17 partners; in total, the measure included approximately 47 actors. The partners belong to different categories: research bodies, universities, producer associations, consulting and training companies, social cooperatives, local action groups (LAGs), professionals and local public bodies. The complexity of the actors presents and the different number of actors for each partnership mean that the work and size of the networks are very diverse. Larger partnerships with more mixed partners may have had more opportunities for knowledge exchange or more difficulties in managing the work. Moreover, more balanced teams with partners who already had previous experience in the field of design and training (e.g. universities, training institutions) made

better use of the experience as a first step towards more lasting collaborations, as the variety and density of actors can influence the duration of collaborations (Klerkx and Leeuwis, 2009). Public action may thus have been a major contributor to co-design between different AKIS actors. Structured interviews will shed more light on whether the assumptions produced on the analysis of the call and preliminary data are correct and will provide more clarity on coordination practices and which partners were most active in the cooperation. The interviews will be useful in understanding whether the networks formed may be persistent beyond the date of funding; they may confirm the hypothesis of the existence of common key factors hindering network formation; they may highlight whether there are or which types of actors are most willing to form and develop the network.

4. Practical Implications

The results we expect from the study will allow us to understand how public policies contribute to the creation of knowledge and innovation networks in agriculture, in line with the AKIS approach. In particular, the analysis of the interviews highlighting the types of relationships established under Measure 2.3 and the ways in which they are coordinated, may provide valuable support for the planning of future rural and agricultural development policies and may also suggest improvements for the current 2023-2027 programming focused strongly on networking and the AKIS model. The investigation of the critical issues faced by the partnerships formed, such as obstacles to collaboration or the highlighting of imbalances, may support the creation of more adaptive and inclusive governance models that can enhance the specificities of each sector and territory, also through a greater involvement of local, public and private actors. Although the sample is restricted and focused on Measure 2.3 in Campania, it should be noted that the experience is unique on the Italian territory and therefore the study can contribute in a practical way to the formation of future AKIS networks on the Italian territory.

5. Theoretical Implications

The study contributes to the theoretical debate on knowledge systems and agriculture by offering a real and close-up perspective of concrete experiences and clarifies the role of public intervention in the construction of collaborative networks. The qualitative analysis of partnerships and dynamics in the implementation of Measure 2.3 deepens questions on top-down governance and interactions between public and private actors. It will be important to observe how pre-existing ties can contribute to improvements in AKIS networks and how ex-ante ties are established in response also to public policy definitions of objectives, clarifying the concept of network embeddedness (Howells, 2006). This point will be crucial in understanding whether partnerships are formed through the expression of real needs and free communication or whether they are the result of design constraints. The study aims to contribute to the literature on human and social capital in the agricultural sector and collective learning processes that are a pillar of AKIS models. In summary, the work aims to contribute to a better understanding of AKIS network formation, to discuss the models publicised by public policies on training and collaboration, and to propose reflections on how to better integrate theory and practice to innovate the agricultural sector.

6. References

- Blix Germundsson, L. (2021). What is AKIS?. LTV-fakultetens faktablad, (2021: 11). Burns, T., & Berelson, B. (1953). Content Analysis in Communication Research. *The British Journal of Sociology*, 4(1), 88. doi:10.2307/587175
- Coffey, A., & Atkinson, P. (1996). Making sense of qualitative data: Complementary research strategies. Sage Publications, Inc.

- Crotts, J. C., Pan, B., & Raschid, A. E. (2008). A survey method for identifying key drivers of guest delight. *International Journal of Contemporary Hospitality Management*, 20(4), 462-470.
- De Rosa, M., Olivieri, G., Menna, C., Gandolfi, F., & Del Giudice, T. (2023). Multifunctional farm advisory services in promoting change in agricultural systems: The case of Campania region of Italy. *AIMS Agriculture and Food*, 8(4), 962-977.
- European Commission. (n.d.). Interactive innovation and EIP-AGRI. Research and Innovation. Retrieved February 26, 2025, from https://research-and-innovation.ec.europa.eu/research-area/agriculture-forestry-and-ruralareas/interactive-innovation-and-eip-agri_en
- Gutiérrez Cano, L. F., Zarthá Sossa, J. W., Orozco Mendoza, G. L., Suárez Guzmán, L. M., Agudelo Tapasco, D. A., & Quintero Saavedra, J. I. (2023). Agricultural innovation system: analysis from the subsystems of R&D, training, extension, and sustainability. *Frontiers in Sustainable Food Systems*, 7, 1176366.
- Hennink, M. M., Kaiser, B. N., & Marconi, V. C. (2017). Code saturation versus meaning saturation: how many interviews are enough?. *Qualitative health research*, 27(4), 591-608.
- Herrero, M., Thornton, P. K., Mason-D'Croz, D., Palmer, J., Benton, T. G., Bodirsky, B. L., Bogard, J. R., Hall, A., Lee, B., Nyborg, K., Pradhan, P., Bonnett, G. D., Bryan, B. A., Campbell, B. M., Christensens, S., Clark, M., Cook, M. T., de Boer, I. J. M., Downs, C., Dizyee, K., Folberth, C., Godde, C. M., Gerber, J. S., Grundy, M., Havlik, P., Jarvis, A., King, R., Loboguerrero, A. M., Lopes, M. A., McIntyre, C. L., Naylor, R., Navarro, J., Obersteiner, M., Parodi, A., Peoples, M. B., Pikaar, I., Popp, A., Rockström, J., Robertson, M. J., Smith, P., Stehfest, E., Swain, S. M., Valin, H., van Wijk, M., van Zanten, H. H. E., Vermeulen, S., Vervoort, J., West, P. C., & West, P. C. (2020). Innovation can accelerate the transition towards a sustainable food system. *Nature Food*, 1(5), 266-272.
- Howells, J. (2006). Intermediation and the role of intermediaries in innovation. *Research policy*, 35(5), 715-728.
- Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of advanced nursing*, 72(12), 2954- 2965
- M., Montanari, F., Ferreira, I., Pesce, M., Albuquerque, J. D., Montfort, C., Montfort, R., & Traon, D. (2020). Research for AGRI Committee-Megatrends in the agri-food sector: global overview and possible policy response from an EU perspective.
- Klerkx, L., & Leeuwis, C. (2009). Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological forecasting and social change*, 76(6), 849-860.
- Kountios, G., Kanakaris, S., Moulogianni, C., & Bournaris, T. (2024). Strengthening AKIS for Sustainable Agricultural Features: Insights and Innovations from the European Union: A Literature Review. *Sustainability*, 16(16), 7068.
- Kuiper, D., & Röling, N.G. (1991). *Proceedings of the European Seminar on Knowledge Management and Information Technology*. Wageningen Agricultural University: Wageningen, Netherlands, pp. 8–20.
- Vågsholm, I., Arzoomand, N. S., & Boqvist, S. (2020). Food security, safety, and sustainability—getting the tradeoffs right. *Frontiers in sustainable food systems*, 4, 487217.

Sharing knowledge with farmers: researcher's role in remote areas of Europe

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Short abstract

The paper is about the functioning of AKIS in peripheric regions of Europe and the role that research units and researchers take in these contexts. We investigated four case studies, two in North Eastern Italy, one in central Portugal and one in Southern Portugal. We collected data from existing literature and we interviewed key actors in the AKIS, which helped us draw the AKIS systems and the role of the different actors. We consider the formal AKIS model and adapt it to describe the real situation and show the gaps existing, and who is in direct interaction with farmers. We analyse the changes observed when research teams have an active intervention with different intensity and lengths, and what are outcomes deriving from this intervention. We demonstrate how, in the less favored regions studied, research teams have a key role and change the configuration of the AKIS. This happens when researchers step out of their comfort zone to directly support farmers. These are researchers that engage in participatory processes/local dynamics to support the farmers in knowledge co-construction and innovative solutions, not supported by the formalized AKIS. Different options for researchers are discussed, in face of these new roles in practice.

1. Purpose

The recent orientations and approaches of the Agricultural Knowledge and Innovation Systems (AKIS), aim to accelerate innovation in agriculture. Innovation is conceived as being 'co-produced' by stakeholders who contribute with their unique knowledge to solving a problem or realizing an opportunity (Botha et al 2017). A more systemic and integrated perspective of innovation is emerging in the form of agricultural innovation systems theory: agricultural innovation systems as complex adaptive systems characterized by a large number of actors, diverse interactions and relationships and constantly changing influences emerging from technological, market, policy, cultural and other socioeconomic factors. And innovations are expected to emerge through a co-evolutionary process that combines technological, social, economic and institutional change (Klerkx et al., 2012).

In practice, the conceptualization of the AKIS requires a transformative and global shift in the way knowledge is produced and set out to practitioners. Therefore to understand the processes that can or not support rural innovation requires approaches that reach beyond technology and include social and organisational aspects. One such approach is the relational perspective of organisational innovation systems which by its nature is context dependent (Guerrero-Ocampo et al 2024).

Learnings from local examples are fundamental to assess how the AKIS is functioning in the real world, in different types of contexts, and to reflect upon what the shift to set up the AKIS in practice requires from all those involved. In Southern Europe and particularly in the less favored areas under marginalisation and decay in social capital, the capacity of agents to search for innovation sources and support has shown to be limited (Bernard et al 2023; Guerrero-Ocampo et al 2024). Case studies in these contexts are enriching opportunities to understand limits and potentialities of the approaches set in place.

In this paper we demonstrate how, in less favoured regions of Mediterranean Europe, research teams have a key role in AKIS when they step out of their confort zone to directly

support farmers. And how this partially results of the gaps in the AKIS itself. We describe the real AKIS situations in selected case studies and show the gaps existing. We describe the interactions between the different partners and path dependencies of each partner type, the relationship of the different partners with research, and the roles taken by researchers. And we discuss what are options for researchers, in face of these possible roles in practice.

2. Design

To illustrate the AKIS and the researcher's role, we have selected four case studies, two in Northern Italy and two in Portugal, one in the centre and one in the South.

In these four rural areas research projects based on the multiactor approach and co-construction processes were analysed. The learnings from these projects are foundational for the analysis. With the data collected in these projects we identified the main pressures that the farming systems are subject to, the challenges faced by farmers, and we identified and drew the actual AKIS system functioning in each case study: stakeholders involved, interactions, role of each stakeholder type, gaps. Further, we applied between October 2024 and March 2025, 6 to 8 semi structured interviews to farmers and other actors in each case study region. The interviews were focused on a) adapting the AKIS scheme to the local reality and b) identifying the knowledge needs and knowledge gaps felt by farmers and advisors, and c) their evaluation of the interaction they have with researchers. The interviews were analyzed using a common framework including four questions: 1) What are the respondents' views on the relationship of research with farmers? 2) How do they access knowledge? 3) Success story? Need for knowledge? Future system?

3. Findings

The AKIS in Serra da Estrela, central Portugal, is weak and highly fragmented. Farmers, which are mainly pastoral sheep and goat producers, are in contact only with: 1) producers organizations, which provide the compulsory sanitary control, and no technical support; 2) the staff from these organizations works privately side by side and therefore may provide private technical consultancy if farmers pay individually for that service; 3) the companies which sell production factors and which naturally have a commercial interest in the advisory they provide to farmers. This is the region where AKIS is weaker.

AKIS in the Montado farming in the region of Alentejo, Southern Portugal, is fragmented also as in Serra da Estrela, however farmers are getting support directly from research teams in the Universities and research units, and this is a significant share of the support they receive. Farmers are in contact with: 1) producers organizations, which provide the compulsory sanitary control, and no technical support but often act as intermediaries between the research teams and the farmers, by joining project consortia, organizing events, disseminating initiatives from the research side; 2) private technical advisors who work individually, even though not so frequent in this type of farming; 3) the companies which sell production factors and which naturally have a commercial interest in the advisory they provide to farmers; 4) other companies in the value chain which negotiate with farmers and may influence farmer's decisions; and finally 5) research teams from universities and research units.

AKIS in the Carnia mountains in Friuli Venezia Giulia, Italy, is characterised by time-varying links between institutional and private actors. Farmers are in contact 1) mainly with each other and exchange information, within the space of relations between producers, which are often characterised by the absence of technological innovation; 2) with the health company for veterinary service controls but also for participation in research projects; 3) with the university in a weak manner and mediated by the presence of the health company, because the company size prevents having the strength to have direct contact with the university 4) weak contact with the professional associations; 5) contact with producers' associations to

draw up the applications to receive funding; 6) contact with the malghesi cooperative for the sale and storage of production; 7) contact with wholesalers in the food sector for the sale of production, often at low prices; 8) contact with the region for the financing of the rural development plan 9) weak contact with the regional agricultural development body for support in production.

In the Pianura Friulana farming in North-Eastern Italy, farmers are getting support both from research teams in the Universities and from teams of a public regional center focusing on applied research. Farmers are in contact with: 1) producers organizations either provide the storage and drying of grains, thus having an influence on the types of crops grown in the region and mainly supporting major crops, or they support farmers for yearly declarations of crops in order to get EU subsidies; 2) private consultants who work individually, and are mainly in contact with medium-big sized farms, and are funded through annual calls funded by regional authorities through the advisory system; 3) contractors are managing partially or totally on-farm field operations thus influencing the intensification level, as well as the choice of the crops sown; 4) regional authorities are providing subsidies for different agricultural practices; 5) companies in the value chain that negotiate with farmers and may influence farmer's decisions on crops sown; 6) land reclamation consortia delivering water for irrigation thus contributing to maintain the part of summer crops in the crop rotations; 7) research teams from universities and research units have relationships with farmers are often established in a personal and not on an institutional basis.

The complexity of AKIS systems appears to vary in relation to the marginality of the areas investigated. AKIS systems see the presence of fewer actors in environments that are physically and economically more distant from the more developed centres and with less developed agriculture.

This seems in part to depend on the difficulty for smaller farms to have the "human" strength to be in contact with research centres, both due to the small economic size of the farms and to the fact that they are not attractive to mainstream research. Only the willingness of researchers to go beyond the institutional mandate allows them to maintain a weak link with these realities.

4. Practical Implications

The practical implications are the demonstration of the weakness of the present regional AKIS and the extra-demanding tasks that researchers are faced with. This is relevant for the researchers carrier development and acknowledgment as well as for the policy tools targeting innovation support to farmers. New configurations and benchmarks for research teams.

But also, a clear understanding of the hard conditions for farmers in some of these regions, to be able to modernise their business and adopt innovations: they simply do not have an effective support, or have too many different sources of support, not linked with each other, what leads mismatches in the information received.

5. Theoretical Implications

The theoretical implications are a reconfiguration of the AKIST conceptual system with identification of new roles, where research is called upon new configurations and needs to reconsider its own role in the system.

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6. References

- Bernard, C., X. Poux, I. Herzon, J. Moran, T. Pinto-Correia, D. E. Dumitras, M. Ferraz-de-Oliveira, F. Gouriveau, D. Goussios, M. I. Jitea, Y. Kazakova, R. Koivuranta, F. Lerin, M. Ljung, A. Lomba, V. C. Mihai, M. Puig de Morales Fusté, and G. Vlahos. (2023). Innovation brokers in High Nature Value farming areas: a strategic approach to engage effective socioeconomic and agroecological dynamics. *Ecology and Society* 28(1):20. doi.org/10.5751/ES-13522-280120
- Botha N., Coutts J., Turner J., White T., Williams T., (2017). Evaluating for learning and accountability in system innovation: Incorporating reflexivity in a logical framework. *Outlook on Agriculture*, 46(2): 154-160.
- Guerrero-Ocampo S., Yagüe Blanco J.L., Munoz-Rojas J., Díaz-Puente J., Rivera-Mendez M., Fernández S.M. (2024). Evolution of multi-actor co-innovation partnerships: Key factors in 4 case studies in rural Iberia. *Journal of Rural Studies*, 106: 103194.
- Klerkx L, van Mierlo B and Leeuwis C (2012) Evolution of systems approaches to agricultural innovation: Concepts, analysis and interventions. In: Darnhofer I, Gibbon D and Dedieu B (eds), *Farming Systems Research into the 21st Century: The New Dynamic*. Springer Netherlands, p. 457–483.

Special Session 4A

Transformative approaches in Monitoring, Evaluation, and Learning, enhancing organizational capacities for innovation and systemic change: example from the TAP-AIS project

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Short abstract

This paper presents a renewed approach to Monitoring, Evaluation, and Learning (MEL) dedicated to system-level interventions in the domain of capacity development for agricultural innovation systems (AIS). The AIS-MEL system was designed as a structured, evidence-based approach to support at the same time learning-by-doing, adaptative management, and tracking of capacity changes at both organizational and system levels. Capacity outcomes were collected among a variety of innovation support organizations, multi-actor innovation governance mechanisms and policies.

The paper explores the characteristics and robustness of the MEL system in supporting continuous learning, accountability, and cross-country comparability, in the context of an AIS intervention in nine countries between 2019 and 2024. In four countries, the MEL results demonstrate the linkages between capacity outcome trajectories and changes in innovation governance and policy frameworks. At project level, the MEL system enabled deepening AIS stakeholder engagement and collaboration, adaptative management and refining project scope, and complementary accountability with the funder-owned logframe.

The paper discusses three key elements of AIS-MEL system to effectively contribute to transformative capacity development interventions and AIS changes: pre-defining capacity outcome targets, bundling MEL tools with critical steps of project implementation; equipping AIS actors of change with MEL capacities. Lastly, we propose to further explore the complementarities between AIS-MEL and other M&E approaches to agrifood system transformations.

1. Purpose

Agri-food systems transformation involves changing the way the system functions towards greater efficiency, inclusiveness, resilience, and sustainability. Developing country-level capacities for governing agricultural innovation has become a necessity and a priority to acknowledge all innovation sources and accelerate agri-food system transformation (FAO, 2016). Governing agricultural innovation for sustainable impacts requires understanding of all components that influence, and are influenced by, innovation processes, interactions across societal levels, and the normative and power dynamics that come together to shape the direction and outcomes of innovation processes (de Boon et al., 2022). In this perspective of strengthening national AIS in a transformative way, Toillier *et al.*, (2022) proposed a capacity-oriented assessment approach of agricultural innovation systems, based on continuous iterative learning processes with AIS stakeholders and support to policy making initiatives that

could offer ‘windows of opportunities’ for transformative system-level changes (Douthwaite *et al.*, 2025). In the context of project-based interventions to AIS strengthening, renewed Monitoring, Evaluation, and Learning (MEL) systems, with robust theory of change, appear as one of the key tools to help stakeholders in both learning-by doing, navigating complexity and conducting adaptive management and to contribute to system-level changes over the long term (Douthwaite *et al.*, 2020). Systems-level interventions are known to be very complex, uncertain and difficult to manage. Learning and adaptation are especially key to systems approaches because in complex systems we rarely know in advance the pathways to change, there is no one right answer, and our actions can produce unanticipated change (Patton, 2011). From an institutional perspective, this calls for organizations in charge of leading transformation to invest resources in these renewed “innovation systems monitoring, evaluation and learning” (AIS-MEL) (UNDP, 2023).

This paper presents an overview of the Monitoring, Evaluation, and Learning (MEL) system developed by the Food and Agriculture Organization of the United Nations (FAO) to support capacity development within Agricultural Innovation Systems (AIS) in nine countries between 2019 and 2024. The MEL system was designed to promote continuous learning, facilitate adaptive project management, and enhance the ability to report on project contributions in a structured and evidence-based manner across multiple country contexts. It was developed and implemented as part of the EU-funded project “Developing capacities in agricultural innovation systems: scaling up the TAP Framework (TAP-AIS)”.

Based on this empirical experience, the paper explores two questions with a view to contributing to the growing field of renewal of systems-MEL approaches, their institutionalization and their widespread use in project-based interventions:

- What key elements of agricultural innovation systems change need to be tracked to feed a process of reflection, learning and adaptive management by AIS stakeholders and with what methods?
- What support is needed and what is the country demand for support with AIS-MEL systems?

The paper presents first the ways the MEL system was designed, deployed and critically reviewed to draw lessons about its relevance, robustness and contributions to project-level learning, to project adaptive management and system-level learning and changes. The results combine MEL outputs and outcomes, with a focus on capacity outcome trajectories at project and AIS levels. In the last section, we discuss the theoretical and practical implications of using systems-MEL for project-based AIS interventions. We propose to further explore the complementarities between AIS-MEL and other M&E approaches to agrifood system transformations.

2. Methodology

The ‘AIS-MEL system’, or Monitoring, Evaluation, and Learning (MEL) system for agricultural innovation system, was developed as a comprehensive framework to support the tracking of capacity development within Agricultural Innovation Systems (AIS), at two levels of national AIS, organisations, innovation governance mechanisms and associated policy frameworks.

The organizational level is defined as the network of **organizations** or institutions that deliver innovation support services. The MEL framework assessed their capacities to organize effectively, deliver services, build strategic relationships, and adapt to changing contexts. Strengthening these capacities is essential for improving the performance and responsiveness of AIS.

The system level is where we capture the policy changes and the functional capacities of interconnected actors that govern innovation such as universities, research centers,

extension agencies, public services, and farmer organizations. This included their ability to co-develop shared visions, influence policy, foster inclusive engagement, build innovation networks, and navigate agricultural markets— skills fundamental to modern, demand-driven AIS (Klerkx & Jansen, 2019; Leeuwis et al., 2019).

Implemented across nine countries under the EU-funded TAP-AIS project, the MEL system was designed to foster learning, enhance accountability, and support evidence-based decision-making in complex, multi-stakeholder environments. The system generates a series of interrelated outputs that guide implementation and facilitate comparative analysis across national contexts.

It integrates a set of tools that were progressively deployed along with project cycle: baselines from an action-oriented AIS assessment, country-specific Theory of Change adapted from a standardized ex ante impact pathway, a participatory outcome mapping, the collection of implementation journeys and contribution analysis to track outcome pathways.

The standardized ex-ante impact pathway outlines expected causal links between project interventions and intended impacts. This aligns with theories of change and results-based management (Kushner et al., 2007), ensuring a shared reference for all participating countries.

The baselines produced from the action-orientated assessment of the AIS in each country (FAO, 2022), helped to capture the initial status of the structures, functions, capacities and enabling environment of the national AIS, to create shared understanding of strengths and weaknesses, and to develop a joint vision of the necessary changes.

These results are translated into country-specific Theories of Change (ToC), reflecting local priorities, assumptions, and capacity needs, co-developed with stakeholders to promote ownership and contextual relevance, aligning with participatory evaluation approaches advocated by Scriven (1991) and Woolcock (2001).

Outcome maps and progress markers define measurable intermediate changes in stakeholder behaviours, attitudes and practices—key indicators of effective capacity development interventions (Klerkx & Gildemacher, 2012; Leeuwis & van den Ban, 2004).

Contribution analysis diagrams are used to trace evidence-based links between project outputs and observed outcomes, offering a structured method to assess contribution in dynamic systems where attribution is complex (Mayne, 2001). Final customized impact pathways reflect the actual evolution of change, informed by continuous monitoring and learning.

During MEL system deployment and project cycle implementation, MEL country teams were themselves continuously trained, supported and engaged in internal reflection and evaluation processes of the project. They shared their insights into the practical challenges of the MEL systems MEL system robustness and their demands for upgraded capacities for systems-MEL.

3. Findings

3.1 System-level changes detected by the MEL system

This section presents a comparative analysis of the outcomes achieved by the TAP-AIS project in four countries, namely Malawi, Pakistan, Burkina Faso and Colombia where the MEL system was applied more rigorously. Similar findings could be observed in the other 5 countries, but lack of complete datasets did not allow for a comprehensive MEL analysis and critical review. In those four countries, the MEL results demonstrate the linkages between capacity outcome trajectories and changes in innovation governance and policy frameworks. In Pakistan, coordinated efforts led to successful donor proposals and policy recommendations for smallholder mechanization. In Malawi, capacity-building contributed to a revised extension policy and integration of AIS thinking into the national agriculture policy and ICT innovations.

In Colombia, organizational strengthening through Sustainable Production Nodes advanced agroecological transitions, producer-government collaboration, and educational support. In Burkina Faso, multi-level capacity development facilitated multi-stakeholder engagement to gain buy-in and overcome resistance to a new inter-sectoral coordination structure of the national agricultural innovation system.

While the TAP-AIS project shares a common overarching goal – strengthening agricultural innovation systems for agrifood system transformation – the specific interventions and targeted outcomes varied across the four countries, reflecting distinct agricultural contexts and national priorities.

This section analyses project outcomes within a common framework, focusing on three key domains: (1) enhanced organizational capacities, (2) improved multi-actor innovation governance mechanisms, and (3) changes in policies and regulations.

Enhanced Organizational Capacities

In Malawi, the emphasis was on enhancing the ability of boundary partners (Department of Extension Services, Department of Research, The National Fertilizer Association, University of Lilongwe and the Agriculture Commodity Exchange) to organize internally, deliver support services, and facilitate AIS activities. These improvements were linked to targeted training programs, strengthened partnerships, and the provision of resource support. Similarly, in Pakistan, the project focused on improving the skills of organizations in project design, proposal development, and resource mobilization. As a result, these organizations demonstrated a greater ability to secure funding and implement innovative projects. In Colombia, this translates in farmers associations able to improve productivity and increase sales prices.

Improved Multi-Actor Innovation governance Mechanisms

Fostering effective collaboration among diverse actors was a central goal across all TAP-AIS countries. In Pakistan, this translated to enhanced support for farmers in adopting agricultural machinery through improved linkages between government agencies, research institutions, private sector companies, and NGOs. Similarly, in Malawi enhanced capacity in visioning and implementation with strong partnership with public sector led to a new extension policy.

Changes in Policies and regulations

In all the countries the project sought to influence the policy environment to create more supportive frameworks for agricultural innovation. In Pakistan, this involved policy dialogues that led to concrete recommendations for strengthening agricultural mechanization. In Malawi, efforts resulted in a new national extension policy that integrates AIS principles. In Colombia this translated to the implementation of CAMPO Innova tool as part of the public agricultural extension service to benefit 270.000 producers. In Burkina Faso, the project achieved the establishment of the “Cellule de Coordination du Système National d’Innovation Agricole (CC-SNIA)” as an inter-ministerial coordination body that will help strengthen the national agricultural innovation system. The policy change is of high-level nature, involving top government structures or national/regional policies. There has been some official recognition which demonstrate a potential for wide-ranging or transformative impact

Project contributions to changes

Each country team focused on specific areas of changes: national-level and inter-sectoral AIS strengthening in Malawi and Burkina Faso, sectoral areas in other countries: innovation for agricultural mechanization in Pakistan, innovation for dairy production/agroecology in Colombia. This explains the various capacity outcomes of the project and captured by the MEL system.

Variety in project contributions to tangible policy outcomes such as new policies and technologies obtained in different countries is more difficult to explain because it has multidimensional causes - e.g. misalignment between project intervention strategy and stakeholders' expectations; lack of time and resources; unexpected events that jeopardize project implementation.

3.2 MEL system in support to project learning and adaptative management

The MEL system played a crucial role in project learning and adaptative management.

Despite the common overall goal of “strengthening national AIS for agrifood system transformation”, each country project team had to create the most relevant intervention strategy to generate impacts, considering context, AIS stakeholders needs, expectations and capacities in place to transform themselves.

By linking monitoring with learning, the TAP-AIS MEL system has contributed to more reflective and adaptive processes among national partners, helping them to design and implement capacity development strategies grounded in real-time evidence. This experience underscores the importance of embedding participatory MEL approaches in AIS strengthening to enable systemic change, foster collaboration, and support innovation in agrifood systems. By enabling comparability of results and promoting accountability among stakeholders, the MEL system contributes to more transparent, participatory, and impact-oriented implementation processes.

Utilizing evidence gathered through outcome harvesting methodologies, this analysis identifies key trends, cross-cutting themes, and context-specific variations in project impact across the four case study countries.

Importantly, the MEL system functions not only as a mechanism for assessing results but also as a learning and capacity development tool, fostering cross-country exchange and reflection. It provides valuable insights into how AIS interventions can influence institutional change, innovation processes, and policy development in diverse agricultural and rural development settings.

4. Practical Implications

The insights derived from the cross-national analysis of the TAP-AIS project have significant implications for practitioners and development partners engaged in advancing MEL systems for supporting transformative interventions in agricultural innovation systems, and in agrifood systems more broadly.

From the TAP-AIS experience we identified the **four functionalities** of the MEL system with respect to the overarching goal of strengthening AIS:

Firstly, support to **context-specific adaptation of a generic theory of change** is essential. The varied outcomes across Malawi, Pakistan, Burkina Faso and Colombia demonstrate that effective AIS interventions must be rooted in a thorough understanding of capacity development needs and entry points to develop those capacities in specific contexts of local agricultural, social, and institutional environments. Tailoring strategies to address unique national priorities enhances relevance and impact.

Secondly, the MEL system has **to target pre-identified capacities to be developed in organizations**, in order to be more intentional in project activities. Targeted training, resource mobilization, and partnership building empower key actors—be they farmers, research institutions, or government agencies— can be better designed and adjusted with the concerned actors once capacity outcomes are explicitly targeted, in linkage with system-level

changes. It helps to make sense to organisational level interventions and to get the buy-in of organization leaders.

Thirdly, the MEL system has **to target pre-identified capacities for upgraded multi-actor innovation governance**. Establishing robust platforms for dialogue among farmers, private sector entities, research institutions, and policymakers facilitates the co-creation and adoption of innovative solutions, fostering inclusive and resilient agricultural systems.

Lastly, the MEL system has to support **strategic policy engagement** which amplifies the impact of technological and organizational advancements. Evidence-based policy dialogues, exemplified by successful policy reforms in the studied countries, are instrumental in creating enabling environments for innovation, scaling, and sustainability.

In order to fulfil these functions, we identified three key managerial elements of AIS-MEL systems to effectively contribute to transformative capacity development interventions and system changes: pre-defined capacity outcome targets, bundled MEL tools with critical steps of project implementation; equipping AIS actors of change with MEL capacities. In the different countries, the list of pre-identified capacities to be developed at the different level constituted a roadmap that help project managers to refine the project intervention strategy. The outcome mapping exercise triggered engagement of key AIS stakeholders when project started the implementation of capacity development activities. It also helped to identify windows of opportunities for policy changes that were not in place when the project started. Lastly, the more MEL experts were equipped with tools and best practices, the more they were able to actively support project managers for more efficient project implementation.

In sum, these lessons underscore the necessity of a systems-MEL based on tailored, and participatory tools in support to the project intervention strategy, i.e. in designing and implementing agricultural innovation interventions at the international level.

5. Theoretical Implications

The study underscores the importance of contextual adaptation within systemic frameworks. While AIS theory emphasizes multi-actor collaboration and capacity development, these findings demonstrate that the specific paradigms of actors, institutions, and policies varies significantly across country contexts. This highlights the need for flexible, adaptable models rather than one-size-fits-all solutions.

Secondly, the results reinforce the central role of capacity development as a catalyst for systemic change. The evidence suggests that strengthening organizational capabilities not only facilitates technological adoption but also fosters a culture of innovation, aligning with theories that link human and social capital to system resilience and productivity (Argyris & Schön, 1996; Klerkx et al., 2012).

Thirdly, the analysis illustrates the interplay between organizational capacities, multi-actor collaborations, and policy environments, supporting integrated systems theories that posit innovation as a dynamic and multi-layered process. It confirms that policy reforms and institutional support are critical enabling factors for the sustainability and scaling of innovations.

Lastly, the observed variations emphasize the importance of contextual factors and local agency within AIS theory, advocating for nuanced models that account for country-specific dynamics, power structures, and socio-economic conditions.

In conclusion, these empirical insights advance the theoretical understanding of how systemic change occurs in diverse agricultural and socio-economic contexts, emphasizing the need for flexible, context-sensitive frameworks that integrate organizational, collaborative, and policy dimensions of innovation.

6. References

- Agrinatura and FAO, 2019. *Monitoring, Evaluation and Learning – Concepts, principles and tools*. Paris
- Argyris, C., & Schön, D. A. (1996). *Organizational Learning II: Theory, Method, and Practice*. Reading, MA: Addison-Wesley.
- Douthwaite, B., Ahmad, F., & Shah, G. M. (2020). Putting theory of change into use in complex settings. *Canadian Journal of Program Evaluation*, 35(1), 35-52.
- Douthwaite B., Mathe S., & A. Toillier, 2025. Actionable learning from a review of DeSIRA projects' contributions to policy changes. Agrinatura, CIRAD, Montpellier. <https://doi.org/10.19182/agritrop/00235>
- FAO. 2022. Assessing agricultural innovation systems for action at country level - A preliminary framework. Rome. <https://doi.org/10.4060/cb0614en>
- FAO, 2022. A Preview of Action-Orientated Assessment of Agricultural Innovation Systems. <https://openknowledge.fao.org/server/api/core/bitstreams/cb54498d-9e6d-4673-b051-6c621c17e127/content>
- FAO. 2023. *Comment créer un environnement plus favorable à l'innovation agricole au Burkina Faso? Une approche par le renforcement des capacités du système national d'innovation agricole*. Rome. <https://doi.org/10.4060/cc2700fr>
- Klerkx, L., & Gildemacher, P. R. (2012). Strengthening Innovative Capacities of Small-Scale Farmers: The Role of Facilitating Agents in the Dutch Agricultural Innovation System. *International Journal of Agricultural Resources, Governance and Ecology*, 9(2), 165–181. <https://doi.org/10.1504/IJARGE.2013.051977>
- Klerkx, L., & Jansen, J. (2019). Managing Complexity in Agricultural Innovation Systems: A Multi-Actor Perspective. *The Journal of Agricultural Education and Extension*, 25(2), 165–177. <https://doi.org/10.1080/1389224X.2019.1573914>
- Kushner, J., Leeuwis, C., & Klerkx, L. (2007). Results-Based Management and Monitoring and Evaluation for Agricultural Innovation: An Introduction. In *Results-Based Management in Agricultural Development* (pp. 17-34). FAO and CGIAR Science Council
- Leeuwis, C., & van den Ban, A. (2004). *Communication for Rural Innovation: Rethinking Agricultural Extension*. Blackwell Publishing.
- Leeuwis, C., Klerkx, L., & van den Ban, A. (2019). Facilitating Agricultural Innovation: How to Engage Stakeholders and Foster Adaptive Capacity. *Development Policy Review*, 37(3), 389–406. <https://doi.org/10.1111/dpr.12283>
- Mayne, J. (2001). Addressing attribution through contribution analysis. *Canadian Journal of Program Evaluation*, 16(1), 1-24.
- Patton, M. (2011). *Developmental Evaluation: Applying Complexity Concepts to Enhance Innovation and Use*. New York: Guilford.
- Scriven, M. (1991). *Evaluation Thesaurus* (4th ed.). Sage Publications.

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- Woolcock, M. (2001). The From Yale to the World: Building a Knowledge Economy in Developing Countries. *The World Bank Research Observer*, 16(2), 219-239. <https://doi.org/10.1093/wbro/16.2.219>
- Sempore A., Toillier A., Gnoumou M., Segda Z., Nikiema L., & R. Kiogo, 2025. Toward governance of the national agricultural innovation system in Burkina Faso: an interministerial coordination cell to shape the directions and outcomes of innovation , in: Guillonnet R. (ed.), Ramirez R. (ed.), Triomphe B. (ed.), Toillier A. (ed.), Henriquez P.(ed.), Dolinska A. (ed.), Perez M. (ed.). 2025. Pathways to agrifood system transformation: From Local Innovation to Policy Changes. Stories of change across Africa, Asia and Latin America from the DeSIRA initiative. Paris : CIRAD, 96 p. <https://doi.org/10.19182/agritrop/00238>
- Toillier A., Guillonnet R. Bucciarelli M. & Hawkins R., 2020. Developing capacities for agricultural innovation systems: lessons from implementing a common framework in eight countries. Rome, FAO and Paris, Agrinatura. <https://doi.org/10.4060/cb1251en>
- Toillier, A., Mathé, S., Saley Moussa, A., & Faure, G. (2022). How to assess agricultural innovation systems in a transformation perspective: a Delphi consensus study. *The Journal of Agricultural Education and Extension*, 28(2), 163-185.
- UNDP. 2023. How do we measure systems change? By Søren Vester Haldrup.

Session 5A

EXTENSION AND ADVISORY SERVICES: PRACTICES, ACTORS, AND IMPACTS

Disputing the Agenda? Coexistence of Different Ideologies in Brazilian Rural Extension

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Short abstract

Rural extension policies in Global South countries face significant challenges due to the limited capacity of governments to fund these services. As a result, multilateral organizations have often taken on the role of financing large-scale rural extension projects, promoting their own agendas. The coexistence of different ideological approaches shaping the funding and implementation of significant rural extension interventions remains an underexplored topic in academic literature. While a multi-source funding system can enhance rural extension efforts and reach a larger number of farmers, there is a lack of coordination and potential conflicts between differing agendas. This study examines the coexistence of two major rural extension strategies in Brazil, each rooted in distinct ideological frameworks: the National Policy for Technical Assistance and Rural Extension (PNATER), funded by the federal government, and the Productive Alliances (AP) strategy, financed by the World Bank. Using secondary data and semi-structured interviews, our research explores the dynamics between these two approaches. Our findings reveal a complex scenario in which, on the one hand, stakeholders recognize various benefits arising from the coexistence of these strategies. On the other hand, ideological discrepancies between the agendas hinder more effective dialogue and the construction of a consensus that aligns with national interests.

Keywords: Public policies, Family Farming and World Bank.

1. Purpose

Rural extension policies in the Global South face significant challenges, particularly due to the fiscal constraints faced by governments (Fontan Sers & Mughal, 2019; Hu et al., 2012; Lin et al., 2022). In this context of budget limitations, implementing public-funded rural extension projects, often seen as high-cost initiatives, has led local governments to seek partnerships with multilateral organizations to secure funding.

Multilateral organizations have increasingly taken on the role of funding large rural extension projects (Saliu & Age, 2009), being the World Bank's Productive Alliances (PA) strategy a prominent example. The PA aims to integrate smallholder farmers into market systems and has been implemented in ten Latin American countries—most notably in Brazil, which has received the largest share of financial resources under the strategy (World Bank, 2016).

On the other hand, Brazil has its own National Policy for Technical Assistance and Rural Extension (PNATER), which was developed in dialogue with civil society and is funded by the federal government. PNATER focuses on strengthening family farming, guided by

agroecological principles and a sustainable rural development strategy, marking a clear contrast to the market-oriented approach of the PA.

The coexistence of multiple funding sources expands the reach of rural extension efforts, but it also generates ideological conflicts, overlapping initiatives, and a lack of coordination—ultimately undermining the efficiency and consolidation of a cohesive national rural extension strategy.

This paper examines the interaction between PNATER and the PA initiative, exploring their distinct ideological frameworks and how they are perceived by participants involved in Brazil's public rural extension.

2. Design

This study employed three research methods: document analysis, secondary data collection, and semi-structured interviews. The documents analyzed included execution reports, technical notes, scientific articles, and legislative materials. These documents were used to identify the ideologies of the research objects (PNATER and PA) by analyzing their guidelines, objectives, methodologies, and target audiences. Secondary data collection was used to quantitatively assess the research objects (e.g., budget and years of operation). The secondary data collected covers the years 2011 to 2020. Furthermore, twelve semi-structured interviews were conducted with stakeholders engaged in PNATER and PA (e.g., policymakers, civil society representatives, academic researchers, and extension agents) between July and November 2024. The insights gathered from the interviews were used to understand how the ideologies and agendas of the research subjects were operationalized. The data were analyzed using descriptive statistics and discourse analysis.

3. Findings

Table 1 highlights the main differences between PNATER and PA. Brazil has a decentralized and widespread public system that provides rural extension services, **consisting of over 20 state-level public extension companies, which** lack sufficient resources to deliver services at the required quality and scale. The PA strategy forms partnerships with state governments and their public rural extension companies to carry out its activities, making use of existing public infrastructure. As shown in Table 1, the World Bank's investment in PA in Brazil exceeded federal public investment in rural extension by approximately one-third.

Table 1: Key Characteristics of PNATER and PA

Characteristics	PNATER	PA
Primary Objective	Promote sustainable rural development	Integrate farmers' production into dynamic agricultural value chains
Principles	Adoption of participatory methodologies; Contribution to national food and nutrition security; Application of agroecological farming principles.	Integration of production into markets based on different realities; Increased competitiveness; Encouragement of entrepreneurship among producers.
Budget (2011 to 2020)	\$1.071.022.457,89 ¹	\$1.588.000.000,00 ²
Target Audience	Family farmers and medium-sized farmers	Small and medium-sized farmers "in transition" ³

¹ Values adjusted for December 2023 using the IPCA-E index and converted to USD as of December 30, 2023.

² Values adjusted for December 2023 using the CPI index.

³ Farmers seeking to increase their productive and entrepreneurial capacities to integrate into modern agri-food systems (World Bank, 2016).

Methods of Implementation	Public calls to contract state-owned companies, private entities, and civil society organizations to provide extension services	Agreements with state-owned providers
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Source: Prepared by the author based on Brasil (2010), Ministério da Economia (2025) e World Bank (2016).

PNATER and PA are based on divergent views of rural extension. Within the scope of PNATER, rural extension is seen as a crucial activity for promoting a new production paradigm, rooted in social participation, food and nutritional security, and agroecology as the foundations for sustainable rural development. On the other hand, PA focuses on the economic dimension, establishing partnerships with public extension agencies to integrate family farming production into market systems. This ideological divergence is reflected in their target populations: while PNATER serves all small and medium-scale farmers, PA specifically targets market-oriented farmers.

Despite the differences, the interviewees recognize the important role of the World Bank in Brazilian rural extension. For instance, Interviewee 1 emphasized: *"... the World Bank was fundamental in influencing rural extension. And now in the Northeast, the World Bank is again the one holding up the rural extension."* Regarding PA, they highlight its contribution to community organization, environmental preservation, and the agro-industrialization of family production. Furthermore, they note that the World Bank's actions align with the principles of PNATER: *"If it included an agroecological vision... I think it would be a program that would strongly support an extension policy, very similar to PNATER"* (Interviewee 3).

PA has also contributed to restructuring public rural extension companies, which face financial and infrastructure challenges: *"... the possibility of reforms, which for many years we couldn't secure funding for. Also, vehicles, computers, all the necessary infrastructure"* (Interviewee 2).

4. Practical and theoretical Implications

PA is characterized as a process of Policy Transfer, where a policy is developed in one place and used to develop another policy in a different location (Dolowitz & Marsh, 2000). Agreements between national governments and multilateral organizations for Policy Transfer processes can help mitigate the political and economic costs involved in formulating and implementing public policies (Dolowitz & Marsh, 2000). This factor is particularly relevant for rural extension policies, which, as previously mentioned, are costly public services for governments. On the other hand, the involvement of multilateral organizations as agents of Policy Transfer can diminish the importance of state-led policies (Prince, 2012). The transfer of certain policy models at a faster pace than conventional formulation and implementation processes, along with larger financial resources, can undermine local public policies. Additionally, Policy Transfer carries ideologies that influence the execution of its actions. These ideologies may conflict with national governments, potentially even impacting democratic processes in the countries involved (Prince, 2012).

In the case analyzed in this paper, we observe that the ideologies of the policies differ substantially in their documents. Furthermore, PA received significantly more funding to carry out its actions in Brazil compared to PNATER. However, in practice, the interviewees highlighted that the actions of the World Bank align closely with PNATER and contribute to the resilience of rural extension in the country.

5. References

Dolowitz, D. P., & Marsh, D. (2000). Learning from abroad: The role of policy transfer in

-
- contemporary policy-making. *Governance*, 13(1), 5–23. <https://doi.org/10.1111/0952-1895.00121>
- Fontan Sers, C., & Mughal, M. (2019). From Maputo to Malabo: public agricultural spending and food security in Africa. *Applied Economics*, 51(46), 5045–5062. <https://doi.org/10.1080/00036846.2019.1606411>
- Hu, R., Cai, Y., Chen, K. Z., & Huang, J. (2012). Effects of inclusive public agricultural extension service: Results from a policy reform experiment in western China. *China Economic Review*, 23(4), 962–974. <https://doi.org/10.1016/j.chieco.2012.04.014>
- Lei N°12.188, de 11 de Janeiro de 2010. https://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12188.htm
- Lin, Y., Hu, R., Zhang, C., & Chen, K. (2022). The role of public agricultural extension services in driving fertilizer use in rice production in China. *Ecological Economics*, 200(September 2021), 107513. <https://doi.org/10.1016/j.ecolecon.2022.107513>
- Ministério da Economia. (2025). *Orçamentos Anuais - Atos Normativos*. Orçamento Público. <https://www.gov.br/economia/pt-br/assuntos/planejamento-e-orcamento/orcamento/orcamentos-aneais>
- Prince, R. (2012). Policy transfer, consultants and the geographies of governance. *Progress in Human Geography*, 36(2), 188–203. <https://doi.org/10.1177/0309132511417659>
- Saliu, O. J., & Age, A. I. (2009). Privatization of agricultural extension services in Nigeria. Proposed guidelines for implementation. *American-Eurasian Journal of Sustainable Agriculture*, 3(3), 332–339.
- World Bank. (2016). *Linking Farmers to Markets through Productive Alliances* (Issue November). The World Bank. <https://doi.org/10.1596/25752>
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‘More than cocoa’: Analysing agricultural extension and advisory services for non-cocoa tree crops in Ghana

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Short abstract

Tree crops hold significant potential to contribute to multiple Sustainable Development Goals. However, realizing this potential requires an effective extension service. In this study, we examine the current state of Ghana’s tree crop extension system by combining semi-structured expert interviews and Net-Mapping with a quantitative assessment of farmers’ satisfaction with the services they receive. Results highlight the importance of the national extension system and farmers’ high level of trust in public (government) extension officers despite perceived deficiencies in technical knowledge regarding tree crops. Past political priorities focused on food crops, marginalizing support to tree crop farmers. Different actors (private sector, NGOs, international development corporations) have stepped in to cover part of the extension demand for the crops. However, access to agro-climatic information is found to be very limited, even though farmers express high interest in such services. E-extension is limited in its reach. Combining top-down and bottom-up analysis allowed us to develop a holistic understanding of extension service provision for local tree crops (cashew, coconut, mango, oil palm, rubber, and shea). The model can be replicated for quick assessments in

similar contexts and allows establishing a solid bottom line for improving AKIS performance through private or public sector interventions.

1. Purpose

Ghana's agricultural export earnings strongly depend on cocoa, but lately the country is turning to a more diversified tree crop strategy, materializing in the newly established Tree Crop Development Authority (TCDA) under the Tree Crops Development Authority Act, 2019 (Act 1010). The TCDA is responsible for regulating and developing six selected tree crops: cashew, oil palm, rubber, shea, mango and coconut. Tree crops have the potential to contribute to multiple sustainable development goals, including carbon sequestration, biodiversity conservation and sustainable incomes. However, for effective crop management and advancing towards sustainable development, having an effective extension service in place is crucial.

In this study, Agricultural Knowledge and Innovation System (AKIS) (Klerkx et al., 2012; Röling & Engel, 1991) serves as the analytical lens to examine how extension is currently structured for different tree crops, and to assess its performance. Special attention is given to variations across crop-specific extension systems, with a focus on identifying institutional gaps and redundancies. Additionally, the analysis examines the current utilization—or lack thereof—of e-extension platforms and climate information services within extension activities.

2. Methodology

The empirical basis of this study consists of semi-structured interviews with key tree crop specialists (stakeholders) from the public administrative and research system, complemented by selected key-informants from NGOs and the private sector. Interviewees were selected through purposive sampling. To map institutional relationships and influence dynamics, the Net-Map method (Schiffer & Waale 2008) was applied. Net-Map combines qualitative interviewing with participatory network mapping, enabling the visualization of actor constellations, information flows, and perceived levels of influence within extension-related governance structures. The resulting maps were analyzed to identify coordination bottlenecks, central actors, and missing linkages within each crop-specific AKIS.

Complementary to this top-down perspective gained through the stakeholder interviews, a bottom-up approach was incorporated through structured surveys with farmers engaged in tree crop production. The aim was to capture first insights regarding on-the-ground realities and assess how well the institutional arrangements identified in the AKIS analysis translate into effective service delivery at the farm level.

Interviews and surveying were conducted between October and December 2024. For the stakeholder interviews, we conducted a total of 19 interviews, with at least two interviews per value chain. Each interview lasted about 1.5 to 2 hours.

Field survey data was collected in December 2024, sampling farmers from major production regions, including Eastern, Greater Accra, Western, Bono, Northern, Upper West. A total of 268 respondents participated in the survey, comprising 61.3% males and 38.7% females. The majority of the farmers were above 50 years old (47.3%), followed by those aged 41–50 years (21.2%). In terms of educational attainment, nearly half (49.7%) had only primary education, while 20.4% had reached secondary education, and 12.5% had attained tertiary education. Notably, 17.4% of respondents had no formal education at all. This educational profile has important implications for the effectiveness of agricultural extension services and the adoption of new technologies (Ofosu-Ampong et al., 2024). Most of the farmers had over 16

years of farming experience, and for 89%% of them, farming served as the primary source of household income.

All interviews were carried out with informed consent, and participants' identities were anonymized to ensure confidentiality and ethical compliance. The results from the expert interviews and field surveys were fed back to stakeholders as part of a consultative forum that took place in Accra from 16th-17th April 2025.

3. Findings

3.1 Sector organization

In Ghana, there are four major public actors that act on the tree crop sector. Firstly, the Ministry of Food and Agriculture (MoFA) as the public ministry, which groups the content directorate (Directorate of Crop Services, DCS) and the household farm extension focused directorate (Directorate of Agricultural Extension Services (DAES)). Given the structure of Ghana organized into regions, MoFA and its directorates are represented through federally organized Agric Directorates throughout the country. Secondly, TCDA regulates and develops the production, processing and marketing of six tree crops; while the Ghana Export Promotion Authority (GEPA) - a third force – facilitates export of different non-food and food products, among these tree crops. For cocoa (beyond the scope of this article), the regulatory authority is COCOBOD, supported by its research arm, the Cocoa Research Institute of Ghana (CRIG), and its extension wing, the Cocoa Health and Extension Division (CHED). Beyond cocoa, CRIG also leads research on cashew and shea, while coconut, oil palm, and rubber fall under crop-specific programs within the Council for Scientific and Industrial Research (CSIR). Mango lacks a dedicated program and is instead addressed within CSIR's broader horticulture research portfolio, coordinated by the Crop Research Institute (CSIR-CRI).

We will now summarize major findings for each of the six tree crops in TCDA's mandate, namely cashew, coconut, mango, oil palm, rubber, and shea.

- **Cashew** has seen 15+ years of support as part of a regional value chain development initiative by international donor organization such as GIZ or USAID, which also implemented a dedicated extension training program (Cashew Master Training Program).
- **Coconut** has seen very little attention in the past, and even NGOs like Solidaridad are only recently extending to the sector. However, for research there is a dedicated sub-institute within the Oil Palm Research Institute (CSIR-OPRI) that carries out dedicated research on coconut and whose competence has also helped to mitigate the impacts from the Cape Saint Paul Wilt Disease, a phytoplasma related disease of major importance to the sector.
- **Mango** is a sector that is dominated by private sector actors. The crop is widely farmed throughout the country and across region but with a clear differentiation between domestic and export orientated market, the latter profiting from a niche for export during international 'lean time' in mango harvest.
- **Oil Palm** profits from a long history of public engagement and a well-established crop-specific research institute (CSIR-OPRI). Additionally, there has also been considerable activity from the NGO sector (for example Solidaridad).
- **Rubber** has for long been dominated by a quasi-monopoly of GREL (Ghana Rubber Estate Limited) which used to be public and was then privatized. However, since post COVID-19 there has been considerable market liberalization, and a great diversification of actors involved. Little NGO-related activity has taken place for market support in the sector, and there is only a rather recent branch of CSIR, carrying out dedicated research on rubber in its own research complex.

- For **shea**, research is organized under CRIG and there is very visible NGO activity in the sector, (e.g. Global Shea Alliance) but much of this work is rather focused on village crafted segments while a considerable market share is channeled through company tightly controlled sales channels (Lovett & Denzil 2018). With the crop being farmed in parklands that spread throughout the landscape and where management and economic use of the crop crosses the administratively demarcated lines of private land ownership, this adds an additional layer of complexity through the issue of land tenure which already is present at base for any of these tree crops, while also highlighting cultural and geographic differences between Ghana's north and regions further south.

3.2 Extension provision

Extension support is provided by DAES through the public, household focused system and DAES extensionists are pointed out as major point of information across all of the crops. At the same time, the extension provision was judged to be limited in reach and thematic depth, even though in focal regions of production support is regarded to be of higher quality. As described above, for some crops private sector, NGOs, or the national research institutes have stepped in to provide extension, but with rather localized results.

The literature and interviews reveal two major structural challenges limiting the capacity of Ghana's public extension system. Firstly, past political priorities have focused heavily on food and staple crops rather than tree crops. Secondly, the extension system suffers from public funding challenges and a high reliance on external financing, such as support from development cooperation, often resulting in discontinuities. Operationally, the extension system faces further challenges through the high farmer to extensionists ratio and then also confirmed in the survey as well as shortages of materials and transport to reach remote areas. Different coping strategies were observed, where actors tried to navigate and overcome these challenges in the system:

- Some farmers have begun bypassing the traditional system altogether by reaching out directly to research institutes specializing in their crop of interest. Recognizing this demand, several research institutes have established their own paid training programs, allowing farmers to access more specialized knowledge and support.
- Large sector initiatives have emerged to fill knowledge gaps and provide alternative extension services, particularly for newly introduced crops or efforts to professionalize specific sectors (cashew, rubber).

3.3 Complementary survey results

The survey results confirmed general trends in regard to trust in the public extension system. However, they remained inconclusive on other aspects such as predominant extension actors and variations in service delivery across geographies, among others. This is probably due to the limited sample size, but to our knowledge no large-scale surveys have been conducted to date that would provide a comprehensive coverage of the geographical variability within each value chain's production systems. Of the 268 farmers surveyed, 56% reported that they are receiving agronomic extensions while 44% report they do not. Responses were highest for farmers in cashew, shea and mango and lowest for coconut, and rubber, whilst oil palm was rather at par.

Regarding information needs, within the sample there was a clear preference for climate information or weather forecasts with mean value of 60% of farmers preferring this type of information. Other predominant interests in information were pest and disease control (especially mango, rubber, coconut and oil palm farmer), planting (cashew farmer), and pruning (cashew farmer). Additionally, mango and shea farmers in the sample also showed high interest in marketing and shea farmers additionally in seeds and varieties.

In regards to e-extension, for the farmers in the sample, classical mediums persist to be the most preferred systems for the reception of information, with a mean of over 60% of farmers naming radio as preferred method alongside SMS (50%), which was only lower for cashew farmers who responded to mostly prefer delivery through the news.

4. Limitations

The breath of study necessarily resulted in less interviews per value chain, and especially the private sector might be underrepresented (even though several of TCDA's value chain specialists previously had worked in the private sector). The same applies to the farmer interviews: while the sample size provides an initial indication, it does not capture the full diversity across geographical regions. Moreover, the emphasis on major production areas likely leads to an overestimation of the quality of tree crop extension service delivery in more remote locations. Lastly, the study took place prior to the 2024 Ghana presidential election with a following change in government and where at time of writing the political strategy of TCDA is still under reorientation.

5. Practical Implications

The results highlight the diversity of approaches across crops and confirm the pluralistic nature of the local AKIS that had been highlighted in previous studies on non-tree crops in Ghana (Davis, 2020; McNamara et al., 2014; Moore et al., 2015). By providing extension services directly to farmers, CSIR institutes move beyond their traditional research mandate to address needs explicitly expressed by local farming communities. This direct engagement not only enhances the relevance and responsiveness of their work but also offers valuable insights that can help counter the top-down nature of agricultural extension noted in previous studies (McNamara et al., 2014). Moreover, such interaction may partially compensate for the lack of feedback mechanisms within the Research-Extension Linkage Committees (RELCs). However, this approach also risks excluding less resourceful farmers who may not have equal access to these direct services. Current knowledge of extension service staff is perceived to be adequate by farmers but insufficient by experts. Expert interviews also pointed to issues around land ownership and performance differences whether land-owners or care takers are reached through the extension service, but this was not further evaluated.

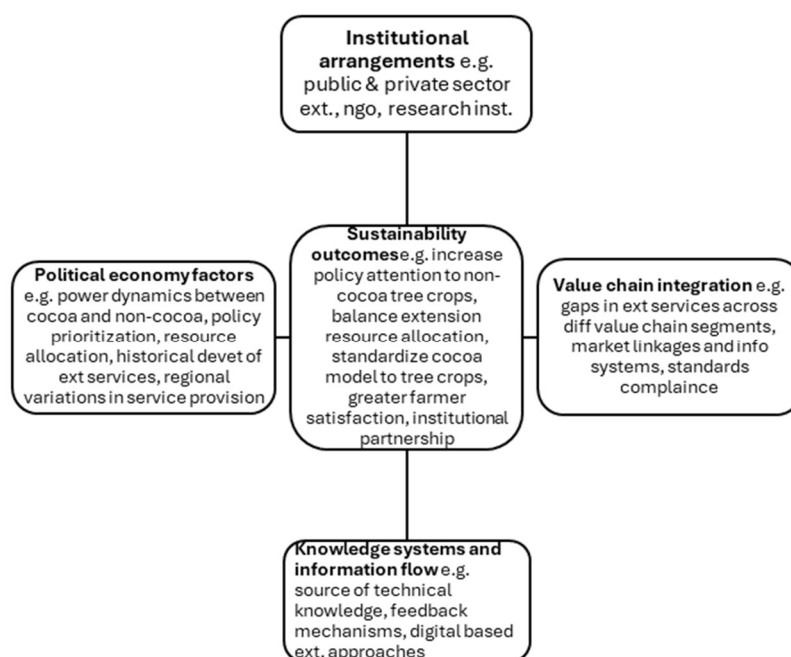


Figure 1: Sustainability framework for non-cocoa tree crops

Furthermore, based on the study findings, we propose a sustainability framework for non-cocoa tree crops (Fig. 1) that integrates institutional arrangements, knowledge systems, value chain support, and political economy considerations to enhance the effectiveness and sustainability of extension services. The model establishes regional multi-stakeholder platforms where public extension agents, private sector technical officers, NGOs, researchers, and farmer organizations collaborate to deliver tailored services. Digital knowledge management systems bridge traditional and scientific knowledge while enabling real-time farmer feedback. Extension services cover the entire value chain—from production to market access—with certification support enhancing crop value. The framework also calls for policy reforms to ensure equitable resource allocation between cocoa and non-cocoa sectors, supported by evidence-based advocacy. Implementation should begin with phased district-level pilots, with sustainability ensured through formal institutional agreements, dedicated budget lines, and performance-based partnerships that strengthen coordination, improve farmer satisfaction, and support household income diversification.

6. Theoretical Implications

Our mixed method study is the first of its kind that assesses the extension model for Ghanaian tree crops beyond cocoa in an integrated way. Methodologically, combining top-down and bottom-up analysis allows us to develop a holistic understanding of extension service provision for TCDA's mandate crops (cashew, coconut, mango, oil palm, rubber, and shea) and then contrast these findings with voices from the ground. The methodology can be replicated for quick assessments in similar countries and allows to establish a first bottom-line when extension systems are to be extended to new mandate crops or the current performance needs to be evaluated. However, larger sampling approaches or a higher number of regional farmer and extensionists focus groups is recommended to enable local knowledge networks and a stronger feedback loop into the extension system.

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7. References

- Davis, K. E. (2020). Chapter 3: Comparison of national extension systems: Application of the best-fit framework. In *Agricultural extension: Global status and performance in selected countries: Vol. Part 1: Global Assessment of Extension Characteristics* (0 ed., pp. 53–95). International Food Policy Research Institute. https://doi.org/10.2499/9780896293755_03
- Klerkx, L., van Mierlo, B., & Leeuwis, C. (2012). Evolution of systems approaches to agricultural innovation: Concepts, analysis and interventions. In I. Darnhofer, D. Gibbon, & B. Dedieu (Eds.), *Farming systems research into the 21st century: The new dynamic* (pp. 457–483). Springer Netherlands. https://doi.org/10.1007/978-94-007-4503-2_20
- Lovett, P., & Denzil, P. (2018). *Agroforestry shea parklands of sub-saharan africa: threats and solutions* (Leveraging Agricultural Value Chains to Enhance Tropical Tree Cover and Slow

-
- Deforestation (LEAVES), p. 54). PROFOR. <https://www.profor.info/content/agroforestry-shea-parklands-sub-saharan-africa-threats-and-solutions-0>
- McNamara, P., Ferguson, O., & Dale, J. (2014). *Strengthening pluralistic agricultural extension in Ghana*. UIUC, WI, CRS. <https://reliefweb.int/report/ghana/strengthening-pluralistic-agricultural-extension-ghana>
- Moore, D. A., Ferguson, O., & Lolig, V. (2015). *Assessment of extension and advisory services in Ghana's Feed the Future zone of influence*. Feed the Future. <https://meas.illinois.edu/wp-content/uploads/2016/07/MEAS-EVAL-2015-Ghana-ZOI-Moore-et-al-July-2015.pdf>
- Ofosu-Ampong, K., Muller, A., & Abera, W. (2024). Behavioural change to promote the adoption of agronomic solutions. <https://hdl.handle.net/10568/159345>
- Röling, N. G., & Engel, P. G. H. (1991). The development of the concept of agricultural knowledge and information systems (AKIS): Implications for extension. In *Agricultural extension: Worldwide institutional evolution and forces for change* (pp. 125–139). Elsevier. <https://research.wur.nl/en/publications/the-development-of-the-concept-of-agricultural-knowledge-and-info>
- Schiffer, E., & Waale, D. (2008). *Tracing power and influence in networks: Net-map as a tool for research and strategic network planning* (772; IFPRI Discussion Paper, p. 17). International Food Policy Research Institute (IFPRI). <https://hdl.handle.net/10568/17071>
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What influences the choice of advisory services of Italian farmers?

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Short abstract

In a context marked by numerous challenges, the agricultural sector is also required to undergo changes and adaptations. Advisory services represent an effective tool to support farms in the processes of ecological transition, innovation, and adaptation to new global markets. However, the planning of technical assistance programs requires a clear understanding of the needs of agricultural enterprises across different territories and sectors. This study is conducted within the framework of Measure SRH01, focused on the provision of advisory services, under the 2023–2027 CSR of the Campania Region in Italy. The objective is to analyse how farms request certain types of advisory services over others, based on their structural characteristics and geographic location with respect to urban centres and rural areas. The sample consists of 681 farms, and the analysis was carried out using a Multivariate Probit Model, based on the types of advisory services requested, which were grouped into thematic macro-categories. The study aims to contribute to the improvement of agricultural policies by promoting governance that is more responsive to territorial specificities and by enhancing the understanding of Agricultural Knowledge and Innovation Systems (AKIS).

1. Purpose

Innovation in the agricultural sector is one of the key strategies for improving food production in terms of multifunctionality and sustainability, and this depends on the choices that farmers make in farm management. Agricultural Advisory services (AAS) are relevant to farmers' decision-making through the transfer of knowledge that enables them to make informed decisions (Ingram & Morris, 2007). AAS are defined as co-creation activities between farmers and advisors of solutions suitable for the farm, thus increasing the knowledge and skills of farmers themselves and are a key component of Agricultural Knowledge and Innovation Systems (AKIS) (Birner et al., 2009; Labarthe et al., 2013). Since the 1990s, AAS have undergone a transition phase moving from the public to the private sector and this has raised major questions about access to and quality of advice (Prager et al., 2016; Prager et al., 2017; Ingram et al., 2022). In Europe, although there has been privatisation of farm advisory services, policies have been geared towards ensuring access for all farmers, promoting knowledge and innovation in rural areas. In fact, since 2007, all European Union (EU) member states are required to establish a Farm Advisory System (FAS) (EC European Council 2003). Concerning the current programming period 2023-2027, the EU has emphasised the importance of interactions between the different actors dealing with knowledge in agriculture, through the creation of services provided by experts, in relation to the needs and interests of the Agricultural Knowledge and Innovation Systems (AKIS) actors operating in rural areas and with businesses (Van Oost, 2017). AAS are therefore considered, among other tools, a priority for strategy implementation and the identification of business needs (Menna et al., 2020). In Italy, technical assistance is included in the CAP Strategic Plan (SPP 2023-2027) and is divided into six interventions for the exchange and dissemination of information:

- SRH01 - provision of advisory services;
- SRH02 - training of advisors;
- SRH03 - training of farmers;
- SRH04 - information activities;
- SRH05 - demonstration actions in agricultural, forestry and rural areas;
- SRH06 - back-office services for AKIS.

It is left to the regions to manage the individual interventions through the Complement of Rural Development 2023-2027 (CSR 2023-2027). The Campania region has activated the intervention SRH01 that has as direct beneficiaries the accredited advisory bodies and as indirect beneficiaries the farmers receiving the advice. The budget for the intervention is approximately € 600,000.00 and in the first phase there was a fair participation of businesses throughout the territory. To date, on the farmer's side, there is a lack of knowledge about the opinions and motivations of farmers to subscribe to advisory services (Krafft et al., 2022). The objective of the study is to understand the strategic role of agricultural advisory services in Campania and to investigate whether the choice between different types of advisory services is influenced by factors such as the geographical location of the companies, the production system, company size and other structural factors.

2. Design

The study on the factors influencing farmers' choices regarding AAS considers both structural and contextual variables of the farms included in the sample. Economic size is a key factor that determines a farm's capacity to invest in innovation and sustainability (Ren et al., 2019). Geographical location also affects knowledge networks and the opportunities accessible to a farm, generating differentiated needs (Pascucci and De Magistris, 2012). Data were collected within the monitoring framework of measure SRH01 and refer to the 2024 reference year.

Location data were integrated using ISTAT datasets. The variables of interest include geographical location (coded as a categorical variable according to the zoning criteria defined by the Strategic Plan for the CAP), productive orientation (coded as 8 dummy variables), utilized agricultural area (UAA), number of livestock units, number of employees, and farm type. The AAS types included in the funding call were grouped according to the Oslo Manual classification (OECD/Eurostat, 2018) and categorized into four dummy variables representing the types of innovation: product innovation, process innovation, marketing innovation, and organizational innovation. The underlying assumption is that farmers choose AAS based on the perceived benefits they can derive from them. The proposed analytical framework is a Multivariate Probit Model (MVP), based on a multivariate normal distribution. This model accounts for multiple, potentially correlated binary outcomes and estimates simultaneously both the effect of explanatory variables and the correlation structure of the error terms (Greene, 2003; Belderbos et al., 2004; Mullahy, 2017). The empirical specification of the model is as follows:

$$Y_{ic}^* = \alpha_c + X_i \beta_c + \varepsilon_{ic}, C = 1, \dots, 4$$

$$Y_i = 1 \text{ if } Y_i^* > 0, 0 \text{ otherwise}$$

where Y_{ic}^* denotes the latent variable, with i indexing the individual farm and c indicating the category of agricultural advisory service (AAS). X_i is the vector of farm-level characteristics, and β_c is the vector of parameters to be estimated for each category. The error term ε_{ic} is assumed to follow a multivariate normal distribution. Four equations are estimated jointly, one for each AAS category.

3. Findings

The sample consists of 681 farms distributed across the provinces of the Campania region. The highest concentration is observed in the province of Salerno (43%), while the remaining portion is evenly distributed across the provinces of Naples (11%), Caserta (12%), Avellino (16%), and Benevento (17%). Some farms have opted for more than one type of advisory service, resulting in a cross-sectional dataset with 1,192 observations. Geographical location data show that 6% of the farms are located in urban areas, 18% in rural areas characterized by intensive and specialized agriculture, 40% in intermediate rural areas, and 35% in rural areas with overall development constraints. The database is still under construction, and therefore no further statistics on structural farm characteristics can yet be provided. Regarding the types of AAS requested, almost the entire sample reported having received consultancy related to process innovation (96%); 84% received organizational innovation consultancy; 30% sought consultancy related to product innovation; and 15% requested consultancy related to marketing innovation. Approximately 28 consultancies were excluded from the analysis because they could not be classified under any of the four innovation categories. However, their exclusion does not raise significant statistical concerns, as they represent less than 5% of the sample. The results of the multivariate probit model (MVP) are not yet available, as the empirical estimation has not been completed. Nonetheless, we can formulate some hypotheses. It is expected that structural characteristics will influence the choice of AAS. In particular, farms with greater utilized agricultural area (UAA) and a larger workforce may be more inclined to adopt organizational innovation services, while productive orientation and geographical location may condition the adoption of product or marketing innovation consultancies. Furthermore, we hypothesize a complementarity between process and product innovation consultancies, and possible substitutability between marketing and organizational innovation consultancies.

4. Practical Implications

Although precise results are not yet available, we are confident that this study can contribute meaningfully to the organization of public policies and the design of advisory services. The underlying hypothesis—that structural characteristics and geographical location influence farms' innovation related needs—can provide important insights for policymakers seeking to better target their support to the agricultural sector. Understanding how farms choose advisory services, and thereby identifying their specific needs, may enable the development of differentiated strategies, whether in terms of outreach efforts or the allocation of financial and institutional resources. Moreover, information on the complementarity or substitutability of various AAS categories may support the design of integrated service packages, fostering the development of tools that enhance both the effectiveness and the dissemination of innovations. In essence, this study aims to support the improvement of agricultural policy at both local and national levels, contributing to the planning of more inclusive, targeted, and sustainable support instruments for innovation in agriculture.

5. Theoretical Implications

This study contributes to the theoretical debate on innovation adoption in agriculture, the Agricultural Knowledge and Innovation System (AKIS), and the role of the public sector in supporting farm development. It adopts a multidimensional perspective, made possible by the classification of advisory services into four innovation categories as defined in the Oslo Manual (OECD/Eurostat, 2018). Unlike other studies that approach innovation adoption and advisory uptake using binary-choice models, this research employs a multiple and potentially interdependent choice framework, applied not to a hypothetical choice experiment but to a real-world case study: the implementation of measure SRH01 in the Campania region. The use of the Multivariate Probit (MVP) model, and the underlying hypothesis of complementarity and substitutability among different types of advisory services, is well suited to the complex reality in which innovation takes shape as a combination of external knowledge inputs. Furthermore, the study is consistent with both innovation adoption theory and farm heterogeneity theories, recognizing that farms are highly diverse entities whose decisions are shaped by the resources they can access and the constraints they face. Finally, by classifying advisory services based on the type of innovation they can trigger within farms, the study also seeks to stimulate critical reflection on the evolving concepts of advisory service and innovation in the agricultural sector.

6. References

- Birner, R., Davis, K., Pender, J., Nkonya, E., Anandajayasekeram, P., Ekboir, J., Mbadu, A., Spielman, D. J., Horna, D., Benin, S., & Cohen, M. (2009). From best practice to best fit: A framework for designing and analyzing pluralistic agricultural advisory services worldwide. *Journal of agricultural education and extension*, 15(4) 341-355.
- Belderbos, R., Carree, M., Diederer, B., Lokshin, B., & Veugelers, R. (2004). Heterogeneity in R&D cooperation strategies. *International journal of industrial organization*, 22(8-9), 1237-1263.
- EC (European Council), 2003. EC Regulation n 1782/2003 of 29 September 2003 establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers. *Official J. L 270* (21), 1–69.
- Greene, W. H. (2003). *Econometric analysis*. Pearson Education India.
- Ingram, J., & Morris, C. (2007). The knowledge challenge within the transition towards sustainable soil management: an analysis of agricultural advisors in England. *Land Use Policy*, 24(1) 100-117.

-
- Ingram, J., Mills, J., Black, J. E., Chivers, C. A., Aznar-Sánchez, J. A., Elsen, A., Frac, M., López-Felices, B., Mayer-Gruner, P., Skaalsveen, K., Stolte, J., & Tits, M. (2022). Do agricultural advisory services in Europe have the capacity to support the transition to healthy soils?. *Land*, 11(5) 599.
- Istituto Nazionale di Statistica [ISTAT]. (2024). *Annuario statistico italiano 2024 (Capitolo 13: Agricoltura)*.
- Krafft, J., Höckert, J., Ljung, M., Lundberg, S., & Kolstrup, C. L. (2022). Delivering too much, too little or off target—possible consequences of differences in perceptions on agricultural advisory services. *Agriculture and Human Values*, 1-15.
- Labarthe, P., Caggiano, M., Laurent, C. E., Faure, G., & Cerf, M. (2013). Concepts and theories available to describe the functioning and dynamics of agricultural advisory services (Doctoral dissertation, European Union's Seventh Framework Programme for research, technological development and demonstration under).
- Menna, C., Gandolfi, F., Passari, M., Cannellini, M., Trentin, G., Del Giudice, T., Cavallo, C., & Cigliano, I. (2020). Farm advisory services and knowledge growth in Italy: comparison among three regional intervention models. *Italian Review of Agricultural Economics*, 75(1) 61-70.
- Ministero dell'Agricoltura, della Sovranità Alimentare e delle Foreste. (2024). *Italy - Rural Development Programme (National) (Versione 13.0). Programma di Sviluppo Rurale Nazionale 2014-2022*.
- Mullahy, J. (2017). Marginal effects in multivariate probit models. *Empirical economics*, 52, 447-461.
- OECD/Eurostat (2018), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation*, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris, <https://doi.org/10.1787/9789264304604-en>.
- Pascucci, S., & De Magistris, T. (2012). Factors affecting farmers' likelihood to use advisory and extension services. *New Medit: Mediterranean Journal of Economics, Agriculture and Environment= Revue Méditerranéenne d'Economie Agriculture et Environment*, 11(3), 2.

Session 6A

CO-CREATION OF KNOWLEDGE AND INTERACTIVE INNOVATION IN AKIS

Insights from Evaluating Swedish EIP-Agri Projects 2017–2024: Challenges, Outcomes, and Lessons Learned

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Short Abstract

The European Innovation Partnership on Agriculture (EIP-Agri) has been implemented across EU member states to promote "open innovation" by bridging research and practice to solve practical problems in agriculture. However, open innovation is inherently difficult to evaluate, and establishing reliable, comparable data across member states remains a significant challenge. This study presents selected results from the evaluation of 91 Swedish EIP-Agri projects conducted between 2017 and 2024, with a focus on identifying success factors and reflecting on measurement issues and sampling bias. Key findings highlight: (i) the difficulty of defining "innovation" and innovation outcomes within an open innovation framework; (ii) the limited reliability and validity of data regarding participant roles and project context; and (iii) correlations between specific success drivers such as stakeholder collaboration and market awareness and perceived project success. The study underscores the need for more consistent evaluation methods across the EU. While national differences are inevitable, a shared set of indicators would support benchmarking, mutual learning, and theoretical development. Presenting and comparing existing evaluations is a necessary step toward this goal. The study concludes with a call for further research to develop robust methodologies for evaluating EIP-Agri projects.

1. Purpose

The European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-Agri) has been widely implemented across EU member states. Its primary aim is "to stimulate innovation and improve the exchange of knowledge" (Regulation EU 2021/2115). Within the EIP-Agri framework, innovation is defined as a new idea that is widely adopted and proves its usefulness in practice (European Commission, 2014; 2023). Unlike traditional innovation models where development is typically conducted internally by an inventor or organization, EIP-Agri is based on the principles of open innovation (Chesbrough, 2003). This approach posits that innovation processes and outcomes can be improved through the inclusion of external inputs and broader competencies (Chesbrough, 2003; Enkel et al., 2009). By facilitating collaboration among stakeholders such as advisors, researchers, and prospective users, EIP-Agri aims to accelerate diffusion and enhance the market relevance of innovations (European Commission, 2014; 2023; EU SCAR AKIS, 2019).

The implementation of EIP-Agri in Sweden is grounded in the Rural Development Programme (RDP) 2014–2020, and is further guided by the CAP Strategic Plan for 2022–2027. EIP-Agri funding is administered by the Swedish Board of Agriculture, which is responsible for decision-making and overall program management. Between 2014 and 2021, approximately €39 million were allocated to EIP-Agri projects in Sweden. For the 2023–2027 period, an additional

€45 million has been earmarked. Previous evaluations of the Swedish EIP-Agri program have identified several administrative challenges. Criticism has focused on bureaucratic procedures, weak integration with other innovation and research initiatives, and difficulties in evaluating program outcomes due to the broad and overlapping range of goals at multiple levels. These goals were not easily measurable using the available database information (Eckerberg et al., 2021; 2023).

Several evaluation studies have also been conducted at the EU (Knotter et al., 2018; European Commission, 2016, 2021, 2024) and national levels (e.g., Arzeni et al., 2022; Tefi and Griffiths, 2024) to assess the outcomes of EIP-Agri projects. However, these evaluations vary considerably in focus areas, data collection methods, target groups, and analytical approaches. These discrepancies are partly attributable to differences in how member states have implemented the program, as well as to varying evaluation objectives. These variations notwithstanding, both the EU and its member states hold a fiduciary responsibility to ensure that public funding allocated to EIP-Agri is meeting its intended objectives. Consequently, there is a need for the establishment of at least a core set of common evaluation metrics to facilitate comparison, generalization, and theoretical development which promotes joint learning and benchmarking.

Jensen (2022) emphasizes the importance of continued monitoring of funded projects to better understand the long-term impacts of their innovative ideas. Carrasco-Carvajal et al. (2023) argue that while measuring innovation outcomes is inherently complex, assessing open innovation poses even greater difficulties due to its collaborative and dynamic nature. Nonetheless, reporting, synthesizing and critically examining existing EIP-Agri evaluations is a vital step toward developing standardized evaluation approaches, even if clear methodological consensus has yet to emerge.

In response to this need, the present study contributes by discussing selected outcomes and evaluation measures of Swedish EIP-Agri projects completed between 2017 and 2024. It also explores the challenges associated with generating reliable and valid data based on these measures in the context of open innovation.

2. Design

In 2024, data were collected on 66 of the 91 completed Swedish EIP-Agri projects through a mixed-methods approach, consisting of a web-based survey and in-depth interviews. The survey targeted Operational Group (OG) managers, while interviews were conducted with a purposive sample of six OG managers (Blix Germundsson et al., 2025). To investigate differences in OG and individual outcomes, the evaluation employed a fuzzy front-end framework. This framework focused on the early phases of the innovation process, such as stakeholder collaboration, integration of external knowledge, and market understanding, where ideas are formed, stakeholder collaboration is initiated, and strategic planning begins that may account for variations in open innovation outcomes (Koen et al., 2001). The survey was designed to understand factors that influenced key outcomes at three levels: i) program-level, ii) OG-level, and iii) individual-level (Figure 1).

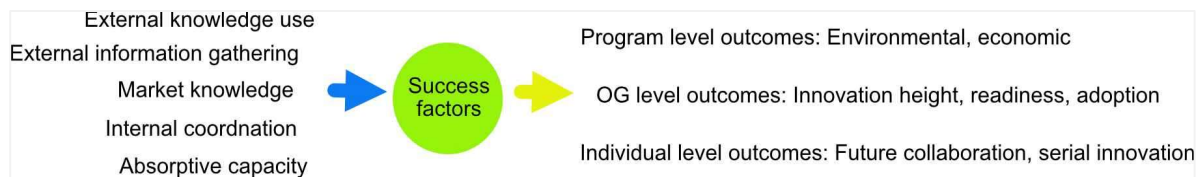


Figure 1: Conceptual model driving the evaluation of Swedish EIP-Agri outcomes

For the quantitative analysis, data collected via the web survey were first examined using principal component analysis and reliability testing to identify latent factor structures and reduce data dimensionality. Subsequently, descriptive statistics and non-parametric correlation analyses were conducted to explore relationships between key success factors and desired project outcomes.

3. Findings

The main findings from the Swedish evaluation of EIP-Agri projects are organized around three central questions: i) What constitutes the innovation? ii) Who were the respondents, and what potential biases were present? iii) What drivers of success were identified?

What constitutes the innovation? The study found that the measures used to capture the innovation concept and context were often unreliable. In an open innovation setting, multiple interpretations of what constitutes “the innovation” may coexist even within the same operational group. For instance, one OG manager, whose group developed a novel food product, stated that the true innovation lay in the revival of the crop production system required to create the product. Furthermore, differing views on the type of innovation were observed: what one participant viewed as a product, another might classify as a service, depending on the business model applied. Attempting to manage this ambiguity, survey respondents were asked an open-ended question to describe the key innovation developed in their project. However, their description of the innovation regularly conflicted with what the research team believed the innovation to be and even within the project, descriptions of the innovation varied among participants. As a result, it was not possible to reliably characterize the type of innovation studied. To work around this challenge, respondents were instructed to keep the innovation they described in mind when answering subsequent questions about innovation outcomes. In this way, even if the actual innovation was not reliably captured, the process of working with the innovation in mind could be used to understand outcomes.

Similar reliability issues were encountered with variables such as the OG manager's role and the project's innovation subsector. Because of the low reliability, these variables were not used in subsequent modelling.

Who were the respondents, and what potential biases were present? A key methodological challenge was addressing respondent bias. As in other EIP evaluations across the EU, Italy, and Wales, surveys were distributed primarily to OG managers and participants who had received EIP funding. (Notably, the Welsh study was the only one to include respondents who had applied for but not received funding, Tefi and Griffiths, 2024). In Sweden, OG managers were asked to forward the survey to their group members. As a result, the response distribution was uneven; many OGs yielded no participant responses, while others provided up to four. This lack of clarity regarding the total sample size, combined with the low and uneven response rates, rendered the OG participant dataset unsuitable for modelling and with the exception of reporting selected descriptive statistics, their responses were not used in further analysis.

While the response rate among OG managers was relatively high (66 complete responses out of 91 projects), concerns about bias and reliability remained. In a few cases, two individuals from the same OG submitted responses in the role of manager. When this occurred, only the most complete or the earliest response was retained. Additionally, the study found that certain organizations or individuals were involved in multiple OGs. This suggests that EIP-Agri funding may hold significant financial value for some actors, potentially creating incentives that bias responses. Furthermore, without an overview of the total composition of OG groups, it is plausible that OG managers selectively forwarded the survey to group members they anticipated would respond favourably.

What drivers of success were identified? Figure 2 presents all statistically significant correlations between success drivers and success indicators identified in the analysis. When success was defined in terms of Innovativeness, respondents who reported higher levels of intellectual property activity, greater market and customer awareness, and enhanced search capabilities tended to report greater success. In contrast, when examining Innovative Culture, a different set of factors was associated with positive outcomes: likelihood of innovation adoption, use of external knowledge support, strong internal coordination and communication, and absorptive capacity. The inverse also held true—projects scoring lower on these variables were less likely to be considered successful.

Success drivers	Success indicators
Intellectual Property Activity; Market & customer awareness; Search capability	Innovativeness
Innovativeness; Innovation readiness; Adoption likelihood; Intellectual property activity; Competitive advantage (operational efficiency and growth); Competitive advantage (national/international)	Goal achievement
Intellectual property activity; External knowledge support utilization	Innovation readiness
Innovation readiness; Innovativeness; Intellectual property activity; Competitive advantage (operational efficiency and growth); Competitive advantage (national/international); Competitive advantage (market expansion & customer engagement)	Adoption likelihood
Market & customer awareness; Intellectual property activity; Innovativeness	Competitive advantage (index)
Intellectual property activity; Market & customer awareness;	(Decreased) Development time
Adoption likelihood; External knowledge support utilization; Internal coordination & communication; Absorptive capacity	Innovative culture

Figure 2: Significant correlations between individual success drivers and success indicators (Kendall's τ_b ; $p \leq 0.05$) (Blix Germundsson et al., 2025).

4. Practical Implications

Evaluations of the EIP-Agri program across EU, national, and regional levels exhibit considerable variation in their focus areas, data collection methods, target populations, and analytical approaches. The lack of harmonisation limits the potential for cross-case comparison, joint learning, and theoretical development. Given the inherent complexity of open innovation, it is particularly challenging to evaluate its outcomes in a standardised manner. However, presenting and critically discussing existing evaluations is a crucial step toward the establishment of more consistent evaluation frameworks. Even in the absence of definitive solutions, shared practices and metrics can contribute to enhancing the quality and comparability of future evaluations. This study contributes to that effort by presenting selecting findings, methodologies and reflections from the evaluation of Swedish EIP-Agri projects conducted between 2017 and 2024. It also underscores the practical difficulties of

collecting reliable and valid data in an open innovation environment, especially when involving diverse stakeholders and complex innovation dynamics.

5. Theoretical Implications

The challenges identified in the Swedish EIP-Agri evaluation also echoed in similar studies across other EU contexts. There appear to be persistent issues related to the reliability and validity of evaluation data in particular related to capturing the context of innovation. The heterogeneity in existing approaches underscores the need for greater standardization in order to support the development of a coherent body of knowledge on open innovation in EIP-Agri. To the best of our knowledge, at present, no formal guidelines exist for the evaluation of open innovation within the EIP-Agri framework. This represents a significant gap in both policy and academic literature. There is a clear need for future research to develop methodologies and conceptual frameworks tailored to the unique characteristics of open innovation in this domain. We therefore call on the academic community, along with EU institutions and member states, to support the development of such guidelines. Doing so would facilitate evidence-based policymaking, enhance mutual learning across regions, and contribute to the theoretical advancement of innovation studies within the EIP-Agri context.

6. References

- Arzeni, A., D'Oronzio, M., Giarè, F. (2022). Il modello pei-agri in Italia, I risultati dell'indagine sui Gruppi Operativi [Eng. The EIP-Agri model in Italy - results of the survey on the Operational Groups.] Rete Rurale report. https://www.innovarurale.it/sites/default/files/2022-11/il_modello_pei_agri_in_italia_def_questionario.pdf
- Blix Germundsson, L., Hunter, E., Norrman, C. (2025). *Utvärdering av slutrapporterade EIP-Agri projekt. Om öppen innovation inom jordbruk, trädgård och rennärning.* [Eng. Evaluation of finalised EIP-Agri projects. On open innovation in agriculture, horticulture and reindeer herding.] Alnarp, Swedish University of Agricultural sciences. <https://pub.epsilon.slu.se/36448/1/blix-germundsson-l-et-al-20250210.pdf>
- Carrasco-Carvajal, O., Castillo-Vergara, M., Garcia-Perez-de-Lema, D. (2023). Measuring open innovation in SMEs: an overview of current research. *Review of Managerial Science*, 17(2), 397-442.
- Chesbrough, H. W. (2003). Open Innovation: The New Imperative for Creating and Profiting from Technology. *Harvard Business School*.
- Eckerberg, K., Bjärstig, T., Miljand, M. (2021). *Genomförande av innovationsstöd i landsbygdsprogrammet 2014 – 2020. Slutrapport för en löpande lärande utvärdering av EIP-Agri.* [Eng. Implementation of innovation support in the Rural Development Programme 2014 – 2020. Final report for a continuous learning evaluation of EIP-Agri] Evaluation report 2021:6. Jönköping, Swedish Board of Agriculture. <https://webbutiken.jordbruksverket.se/sv/artiklar/utv216.html>
- Eckerberg, K., Bjärstig, T., Miljand, M. (2023). Steering 'green' innovation policy toward sustainability? Lessons from implementing EIP-AGRI in Sweden. *Environmental Innovation and Societal Transitions*, 48, 100732. <https://doi.org/10.1016/j.eist.2023.100732>
- Enkel, E., Gassmann, O., Chesbrough, H. (2009). Open R&D and open innovation: exploring the phenomenon. *R&D Management*, 39(4), 311-316.
- EU SCAR AKIS. (2019). *Preparing for future AKIS in Europe.* European Commission.
- European Commission (2014). *Guidelines on programming for innovation and the implementation of the EIP for agricultural productivity and sustainability, programming period 2014-2020.* https://eu-capnetwork.ec.europa.eu/publications/guidelines-programming-innovation-and-implementation-eip-agricultural-productivity-and_en

-
- European Commission (2016). *Evaluation Study of the Implementation of the European Innovation Partnership for Agricultural Productivity and Sustainability*. https://ec.europa.eu/eip/agriculture/sites/default/files/evaluation_study_of_the_implementation_of_the_eip-agri_v2.0.pdf
- European Commission (2021). *Evaluation support study on the CAP's impact on knowledge exchange and advisory activities*. Publications Office of the European Union. <https://op.europa.eu/en/publication-detail/-/publication/67034571-7718-11eb-9ac9-01aa75ed71a1/language-en> 15
- European Commission (2023) *Guidelines for data on European Innovation Partnership (EIP) Operational Groups (OGs)*. <https://sfc.ec.europa.eu/system/files/documents/documents/eip-og-data-guidelines-v3-20231017.pdf>
- European Commission (2024). *Study on outcomes achieved by EIP-AGRI Operational Group projects under the CAP*. European Commission. https://eu-cap-network.ec.europa.eu/publications/study-outcomes-achieved-eip-agri-operational-group-projects-under-cap_en
- Jensen, I. (2022) *Innovationsstöd i landsbygdsprogrammet 2014 – 2022. En uppföljning av stöd inom det europeiska innovationspartnerskapet för produktivitet och hållbarhet inom jordbruket*. [Eng. Innovation support in the Rural Development Programme 2014 – 2022. A follow-up of support within the European Innovation Partnership for Agricultural Productivity and Sustainability.] Follow-up report 2022:4. Jönköping, Swedish Board of Agriculture. <https://webbutiken.jordbruksverket.se/sv/artiklar/upp224.html>
- Knotter, S., Kretz, D. and Zeqo K., Operational Groups Assessment 2018, Final report for EIP-AGRI, Agriculture & Innovation delivered by IDEA Consult nv, 2019. https://eu-cap-network.ec.europa.eu/publications/eip-agri-operational-groups-assessment-2018_en#section--resources
- Koen, P., Ajamian, G., Burkart, R., Clamen, A., Davidson, J., D'Amore, R., ... Wagner, K. (2001). Providing clarity and a common language to the “fuzzy front end”. *Research-technology management*, 44(2), 46-55
- Tefi, I and Griffiths, E. (2024). *European Innovation Partnership Wales evaluation, final report*. Cardiff, Welsh Government. <https://www.gov.wales/sites/default/files/statistics-and-research/2024-10/european-innovation-partnership-wales-evaluation-final-report-468.pdf>

How AKIS players deal with the idea that farmers know best: attempts to redefine modes of knowledge production and dissemination in France

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Short abstract

The transfer-of-technology model which has served industrial and green revolution agriculture misfits the transition towards agroecology. Starting in 2012, the French government began promoting agroecology. This political shift aimed to reform the Agricultural Knowledge and Innovation System (AKIS) in France. It encouraged a “farmer first” approach, valuing farmers' knowledge. This new direction led to a redistribution of epistemic authority, which had previously been concentrated in historical institutions such as the Chambers of Agriculture. As agricultural advisory services became increasingly subject to competition (market and project-based logics), the Chambers repositioned themselves. They reinvested in back-office functions to ensure the reliability of knowledge produced through bottom-up approaches. They also sought to update the skills of front-office staff, represented by agricultural advisors. The roles of agricultural development professionals began to change. They now included tasks such as networking, formalizing practices, and disseminating knowledge. This strategic repositioning partly revived diffusionist logics based on centralization. However, it also generated operational tensions, especially regarding the meaning of work, professional recognition, and the match between required skills and the demands of agroecological transitions.

1. Purpose

Agricultural advisory actors form part of an Agricultural Knowledge and Innovation System (AKIS) (Leeuwis, 2004; Sutherland et al., 2023). This system brings together a wide range of actors involved in the production of agricultural knowledge: universities, research institutes, experimental stations, farmers, agri-food companies, specialized journals, agricultural schools, and others. Within this system, advisory work has long followed a “technology transfer” model. Knowledge generated by researchers was disseminated to farmers or passed on from “pioneers” to others (Girard, 2014). This linear view of innovation is increasingly challenged, especially in the face of the complex and diverse problems posed by agroecology (Meynard, 2017).

In France, the current organization of agricultural development and advisory services stems from the modernization of agriculture in the 1960s (Vedel, 2008). It follows a Fordist logic of knowledge production, structured like a chain: researchers produce knowledge, technical institutes and Chambers of Agriculture adapt it, and farmers apply it (Girard, 2014). In this model, epistemic authority is held by technoscientific actors—mainly researchers, engineers, and advisors (Compagnone, 2022).

Agroecology legitimizes the participation of new actors—including farmers themselves—as co-producers of knowledge (Utter et al., 2021). Epistemic communities—groups with recognized expertise and authority in knowledge production—can emerge and produce distinct forms of knowledge (Meyer & Molyneux-Hodgson, 2011). As a result, epistemic

authority is becoming more dispersed (Compagnone, 2022). This study examines how agricultural development in France is evolving to integrate this dispersion of authority and the new forms of knowledge it brings. More specifically, we analyze (1) how development actors renegotiate their roles in the production and sharing of knowledge, and (2) how professional roles, especially that of the agricultural advisor in the Chambers of Agriculture, are being redefined.

2. Design

This study focuses on the creation, from 2016 onward, of Innovation and Research & Development (IRD) units within the Chambers of Agriculture in France. These new units introduced new roles and tasks to strengthen the skills of agricultural advisors. One of these new knowledge management functions to integrate farmer-led innovation within the AKIS. Our analysis is based on institutional document review (laws, reports...), around thirty interviews conducted between 2022 and 2023 with actors involved in structuring these new services, and participant observation during ten professional events focused on the structuration of knowledge transfer and IRD units. Our analytical framework traces the main steps in the emergence of these new roles within the Chambers of Agriculture. It also seeks to highlight the controversies related to the redefinition of the Chambers' role in the agricultural development landscape.

3. Findings

Farmers' experiences as sources of knowledge to support agroecology

In 2012, France adopted a public policy promoting agroecology, framing it as an “overarching reference” (Lamine et al., 2019). This policy aimed to reorganize the agricultural development system by integrating farmers' experiential knowledge into processes of knowledge production and sharing (Compagnone et al., 2018). The 2014 Agricultural Orientation Law gave this ambition a legal foundation. It created the “Groupements d'Intérêt Économique et Environnemental” (GIEE), which recognized collective action as a lever for agroecological innovation. This policy was led by the Minister of Agriculture at the time, Stéphane Le Foll. He promoted a “pragmatic” approach. According to him, the idea was to learn from pioneers in order to foster collective dynamics. The aim was to demonstrate the benefits of systemic change, starting from successful local initiatives and scaling them up. This logic was framed as “massification” (Le Foll, 2013; Slimi et al., 2025). Before this political shift, farmers' experiences were not widely considered legitimate sources of knowledge in debates on the greening of agriculture. Yet the idea that “farmers know best” had existed in academic spheres since the 1980s, notably in the work of Robert Chambers (Salembier et al., 2021). This school of thought argued that agroecological transition requires a shift from input-intensive to knowledge-intensive agriculture (Duru et al., 2015). Recognition of farmers' knowledge also existed in non-institutional networks, such as those promoting conservation agriculture. These networks inspired Minister Le Foll.

Implementing agroecology involved a dual imperative: supporting grassroots innovations and ensuring their wide dissemination. This compromise structured the governance of the GIEE and, more broadly, agricultural development. From 2014, the Chambers of Agriculture were assigned a new mission: to coordinate the out-scaling of GIEE projects, in partnership with other development organizations. The task was to support, connect, and give visibility to GIEE initiatives in all their diversity. The goal was to foster experience sharing beyond the initial collectives. It also aimed to make the knowledge produced useful to all actors in agricultural development, including those in R&D. Nationwide, this coordination was based on roadmaps co-constructed by regional Chambers and state services. In Occitanie, this roadmap included

support actions for knowledge management (seminars, webinars, etc.), where facilitators discovered tools to highlight group experiences (guides, newsletters, resource centers). Some tools were mandatory, such as the R&D Agri platform and the website collectifs-agroecologie.fr, where outputs from collectives (factsheets, testimonials, CASDAR deliverables) had to be listed and made accessible.

Knowledge quality within a distributed knowledge system

With the promotion of agroecology from 2012 onward, agricultural knowledge became increasingly fragmented. Farmers, digital actors, NGOs, and public and private institutions all began producing knowledge, each with its own logic. New information and communication technologies became a target for investment, particularly among tech companies viewing them as market opportunities (Compagnone, 2022). This multiplication of sources raised concerns about the reliability of knowledge produced through bottom-up innovation. In 2013, just before the Agricultural Orientation Law, the Minister of Agriculture tasked the head of the development actors' consortium with identifying agroecological practices to promote and relevant policy measures (Doré, 2013). This report stressed the need to *"capitalize references"* and to build *"a shared information system, qualification mechanisms for knowledge, and a joint technical review."*

Although agroecology implies a renewed relationship to knowledge and innovation (Meynard, 2017), knowledge produced by local initiatives was often considered unreliable. The Guillou Report stated: *"Farmers' references exist and are numerous, but they are partial and lack precision. They are not comparable, not multi-annual. They do not always include economic and environmental dimensions."* The report also pointed out that some publicly funded data was hard to access. It cited information overload caused by the proliferation of poorly interconnected digital systems (CGAAER, 2020). Each organization developed its own platform, which raised issues of accessibility, clarity, and knowledge sharing. As a result, both the transfer and practical use of knowledge were reportedly limited (Gachie-Vinson, GIS RA, 2013).

In this context, historical development structures—particularly Chambers of Agriculture and technical institutes—reinvested in mechanisms to centralize, standardize, and validate knowledge from dispersed innovation processes, in order to redistribute it to advisors. This strategic repositioning took form in 2016, when a decree established innovation and R&D services within the Chambers of Agriculture. In partnership with technical institutes, these services took charge of qualification and centralization efforts. In Occitanie, innovation services were explicitly designed as *"support to agricultural advisory work."* The unit was named *"IRD-Advice"* to underline its support role to *front-office* activities. The goal was to back up existing structures and act as a true *"back-office"* for advisors. A Chamber official involved in designing these services explained: *"Internally, we often say that our main target is not farmers, but advisors."*

Reinvesting the back-office to update front-office skills in a more competitive advisory field

The recognition of farmers as knowledge producers, the rise of digital technologies, and the arrival of new advisory actors reshaped the balance in agricultural development (Compagnone, 2022). Facing this reconfiguration, historical institutions—Chambers of Agriculture and technical institutes—sought to reaffirm their role in knowledge production and validation in an increasingly competitive landscape. *"Advisory work is very competitive. [...] There are innovations everywhere now. Everyone is a bit lost"*, said a Chamber official. The reorganization of agricultural development was not just about embracing grassroots innovations. It reflected a strategic repositioning, with new functions of coordination, qualification, and dissemination of knowledge.

Innovation and R&D services created from 2016 in regional Chambers were explicitly tasked with supporting field advisory services by facilitating knowledge management of on-farm innovations. This involved collecting, formatting, and disseminating technical content for advisors, while strengthening partnerships with innovation stakeholders such as technical institutes, CIVAMs, and farmer networks. The idea was to structure a back-office to equip the front-office with relevant knowledge material resources. These included thematic seminars (e.g., on climate change adaptation), booths at agricultural fairs, and platforms publishing factsheets based on expert-reviewed feedback (AGLAE).

However, this top-down logic raised concerns. One advisor voiced skepticism: *“Yes, the innovation seminars, the IRD days, it’s nice, of course. But in the end, it’s just big shows—what does it actually produce? In the end, we put all the institute logos, those of the Chambers, and we put the institutes on a pedestal, and they barely give us a crumb of what they do in R&D. They keep everything for their own events at 100 euros a ticket. It’s funny because we often talk about peer-to-peer exchange for farmers, but for advisors, there’s nothing.”* Others pointed to poorly recognized work overload: *“That’s not my job. My job is to be with my farmers. When I write a report for a platform, speak at a seminar, or work on a booth, I’m not in the field”* (agricultural advisor, April 2023).

4. Practical and Theoretical Implications

Our analysis shows how the institutionalization of agroecology is reshaping the French AKIS. This evolution reflects a response to the fragmentation of epistemic authority in agriculture (Compagnone, 2022). It raises the question of who is legitimate to produce and disseminate qualified knowledge. Chambers of agriculture, historical actors in the knowledge field, are reinvesting in *back-office* functions. They are creating new services and roles to ensure the quality of knowledge drawn from field experience and to update *front-office* skills (Labarthe & Laurent, 2011). The reinvestment in knowledge management activities to integrate farmers’ innovations within institutional R&D processes embodies this new configuration.

This reconfiguration is also transforming the professions in agricultural development. New roles are emerging (knowledge transfer manager), and the role of the agricultural advisor is evolving. The advisor no longer simply transmits research-based knowledge to a local group of farmers. They are now involved in broader dynamics of knowledge production, formalization, and circulation. However, a tension remains between the desire to structure and share knowledge—typical of a service standardization logic—and the realities of supporting practice changes in the field. In agroecology, this support relies more than ever on a personalized logic (Labarthe & Laurent, 2011). This raises questions about the actual effectiveness of upskilling schemes and the system’s ability to fully recognize advisors’ expertise in the production and circulation of agroecological knowledge.

5. References

- Compagnone, C., Lamine, C., & Dupré, L. (2018). The production and circulation of agricultural knowledge as interrogated by agroecology. *Revue d'anthropologie des connaissances*, 122(2), a-aa.
- Compagnone, C. (2022). Nouveau régime de savoirs et transformation des autorités épistémiques en agriculture. L’émergence de l’agroécologie dans un contexte de numérisation de l’agriculture. *Sciences, techniques et agricultures: gouverner pour transformer*, 231-236p.
- Doré, T. (2013). Note de lecture de " Vers des agricultures doublement performantes pour concilier compétitivité et respect de l'environnement", rapport de M. Guillou et al. au Ministre en charge de l'agriculture. *Agronomie, Environnement & Sociétés*, 3(2), 167-168.

- Duru, M., Therond, O., Martin, G., Martin-Clouaire, R., Magne, M. A., Justes, E., ... & Sarthou, J. P. (2015). How to implement biodiversity-based agriculture to enhance ecosystem services: a review. *Agronomy for sustainable development*, 35, 1259-1281.
- Girard, N. (2014). Quels sont les nouveaux enjeux de gestion des connaissances. L'exemple de la transition écologique des systèmes agricoles. *ESKA | Revue internationale de psychosociologie et de gestion des comportements organisationnels*
- Labarthe, P., & Laurent, C. (2011). Économie des services et politiques publiques de conseil agricole. *Cahiers Agricultures*, 20(5), 343-351.
- Lamine, C., Niederle, P. A., & Ollivier, G. (2019). Alliances et controverses dans la mise en politique de l'agroécologie au Brésil et en France. *Natures Sciences Sociétés*, 27(1), 6-19.
- Leeuwis, C., Leeuwis, C., & Ban, A. (2004). *Communication for rural innovation* (Vol. 231). Blackwell publishers.
- Le Foll, S. (2013). Une vraie ambition pour l'agroécologie. *Revue Projet*, 332(1), 20-23.
- Meyer, M., & Molyneux-Hodgson, S. (2011). «Communautés épistémiques»: une notion utile pour théoriser les collectifs en sciences?. *Terrains & travaux*, 18(1), 141-154.
- Meynard, J. M. (2017). L'agroécologie, un nouveau rapport aux savoirs et à l'innovation. *Oilseeds and fats crops and lipids*, 24(3), 9-p.
- Salembier, C., Segrestin, B., Weil, B., Jeuffroy, M. H., Cadoux, S., Cros, C., ... & Meynard, J. M. (2021). A theoretical framework for tracking farmers' innovations to support farming system design. *Agronomy for Sustainable Development*, 41(5), 61.
- Slimi, C., Prost, L., & Jeuffroy, M. H. (2024). Massification de l'agroécologie: que dit l'état de l'art et quelle stratégie construire? (Doctoral dissertation, INRAE; OFB, Office Français de la Biodiversité).
- Sutherland, L. A., & Labarthe, P. (2022). Introducing 'microAKIS': a farmer-centric approach to understanding the contribution of advice to agricultural innovation. *The Journal of Agricultural Education and Extension*, 28(5), 525-547.
- Utter, A., White, A., Méndez, V. E., & Morris, K. (2021). Co-creation of knowledge in agroecology. *Elem Sci Anth*, 9(1), 00026.
- Vedel, G. (2008). Développement agricole: la fin du modèle à la française? 1. *Pour*, (1), 199-207.

Research agendas in the interplay among researchers, extension agents and farmers: The case of the National Institute of Agricultural Technology (Argentina)

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Short abstract

This study explores how agricultural research topics are constructed in the interplay among researchers, extension agents, and farmers at the Argentine National Institute of Agricultural Technology (INTA). Drawing on 74 qualitative interviews, it examines the sources of research topics and the role of farmers' demands in shaping research agendas. While literature often emphasizes the importance of demand-driven research, findings show that other sources, such as researchers' interests, institutional priorities, and future production challenges, are also considered valuable. The study reveals important tensions: although many claim that

research should respond to farmers' needs, there is disagreement over whether this happens in practice, partly due to varying interpretations of what farmers actually need. These differences are shaped by the personal experiences of researchers and extension agents, and by the diversity and generality of farmers' demands. The paper also identifies biases in how demands are interpreted and highlights institutional mechanisms that mediate the inclusion of farmers' voices. Three promising strategies for better aligning research with farmers' needs are identified: consulting extension agents, engaging directly with farmers' contexts, and refining research topics through iterative dialogue.

1. Introduction

Despite shifts in how innovation is understood in recent decades, science and researchers are still widely seen as key actors in agricultural innovation processes (Ingram et al., 2018). Knowledge development (including scientific research) remains a core function of agricultural innovation systems (Hornum & Bolwig, 2021). However, expectations regarding the role of researchers and scientific knowledge have changed significantly. Traditionally, researchers were expected to generate knowledge and innovations to be transferred via extension agents to farmers for adoption (Landini & Conti, 2023). Yet, many authors have highlighted the limitations of this linear model in producing knowledge that truly meets farmers' needs, and in fostering innovation (Fieldsend, 2020).

Within this framework, scholars have argued that top-down, expert-led models often result in limited impact (Nettle et al., 2024), while demand-driven approaches improve service relevance and adoption rates (Maulu et al., 2021). However, the notion of "demand" is complex. It is frequently conflated with "need" (e.g. Schut et al., 2016) despite important distinctions: demands are explicitly expressed, while needs may be interpreted by others, carrying the risk of distortion. Moreover, demands are not static or homogeneous, they vary across farmer groups and evolve over time (Macours, 2019; Tarantini & Landini, 2023). Besides, rather than being pre-existing and easily expressed, farmer demands are often constructed interactively through processes of dialogue and mutual learning between farmers, researchers, and extensionists (Kilelu et al., 2014; Landini, 2016).

In this context, the collaborative construction of research topics among researchers, farmers, and other actors becomes particularly relevant. Although there is growing academic interest in addressing farmers' knowledge demands, the specific processes of research topic construction have received limited attention, usually addressed only through case studies in multi-actor innovation settings (Frank et al., 2025; Ingram et al., 2018; Pinxterhuis et al., 2019). This paper analyzes how research topics are co-constructed through the interaction of researchers, extensionists, and farmers at the Argentine National Institute of Agricultural Technology (INTA for its initials in Spanish).

2. Methodology

The research was qualitative. The INTA was selected because it is the leading Argentine institution for research, extension, and rural development. The INTA is an autarkic, public institution created in 1956. It has 6 research centers and 16 Regional Centers, which report to the national authorities, 53 Research Stations which fall under the regional centers, and more than 300 territorial extension units, which report to their respective Research Station. In total 74 interviews were conducted in five Research Stations. The sample was purposive. In terms of institutional role, 5 interviewees were institutional authorities, 33 were researchers and 36 were extension agents. In terms of gender, 27 were women and 47 men, in line with the institutional usual distribution. The interviews were recorded and transcribed,

upon prior acceptance of a verbal informed consent. The transcriptions were analyzed following the guidelines of grounded theory (Holton, 2008) using Atlas.ti software.

3. Findings

Determinants of research topics from the perspective of extensionists and researchers

In Table 1 we synthesize different sources of research topics according to the vision of extension agents (n=33), researchers (n=33) and others (institutional authorities and professionals with mixed experience) (n=8).

Table 1: Sources or origin of research topics

Sources or origins	Extensionists	Researchers	Others
Farmers' needs and demands	21	24	4
Researchers' own interests and priorities	22	17	3
Researchers' education and profile	12	16	4
Economic or agronomic relevance of topics	9	18	5
Continuity of current research lines	9	6	2

Results show that 66% of interviewees spontaneously mention that research topics are or should be based on farmers' needs and demands. However, interviews also show that a high percentage of respondents consider that topics researched by the INTA originate in other sources other than farmers' needs and demands, including researchers' own interests and priorities (57%), researchers' education and profile (46%), the scientific or agronomic importance of the topics (43%) or the continuity of current research lines (23%). Interestingly, researchers more frequently emphasize the scientific or agronomic relevance of the topics, while extension agents more often point out that topics are based on researchers' priorities, which evidences different perspectives.

Responding to farmers' demands: What should be versus what is

While there is a clear agreement on the importance that farmers' needs and demands should have in the INTA's research topics, not all interviewees agree that they are functioning as main sources to define the institutional research agenda. In fact, 67% of the interviewee extension agents argue that research topics do not respond or do not respond sufficiently to the farmers' needs and demands, in contrast to the 24% of researchers. In this regard, extension agents tend to be particularly critical of researchers for not considering the farmers' interests when conducting research:

"I listened in the meetings [...] it caught my attention [...] What are they [farmers] going to use that research for? If it's of no use to anyone, it's a very respected investigation, they obtained a lot of money [...] I think the researchers should focus their work on investigating things that really serve the farmers."

In contrast, when researchers highlight that the institution does not base research on farmers needs, they usually refer to other researchers, not to them, or mitigate the criticism, for instance, by means of highlighting the limitations and barriers that prevent from researching on those needs or the fact that the unmet demands only belong to specific groups or situations. A researcher expressed the problem in this way:

"I remember getting angry repeatedly during that planning exercise with my fellow forestry colleagues because it's a long-standing demand from the southern area [...] We are one of the few institutions in the country that pays attention to rural areas [...]. And

to have a research group that constantly turns its back on these demands [...] is very shocking.”

Demand representation bias and mismatches between actors and perspectives

In a context where there is clear agreement on the importance of selecting research topics based on farmers’ needs and demands, it is crucial to understand why a significant percentage of those interviewed, particularly extension agents, believe that research does not truly respond to farmers’ demands. This can be analyzed along two different lines.

Firstly, different interviewees highlighted that farmers’ demands are diverse, since they depend on the type of production, the size of the farm and the agroecological context, among other variables. However, the interviews show that extension agents and researchers build the idea of what farmers demand based on their own personal experiences. In this quotation, a researcher describes how she access to the farmer’s demands and needs: “Those farmers known to INTA or the extension agency come and tell you [what their needs are]. But what [is better to] [...] find out what's happening is when you go out into the field with the extension agents [...] and you find out what's going on”. Thus, it is apparent that what extension agents and researchers understand by ‘demand’ is shaped by the specific farmers they are connected to. Since extension agents work more frequently with family farmers and researchers with commercial farmers and even farming companies, it makes a lot of sense that extension agents complain to researchers that farmers’ demands are not taken into consideration, because they are most likely thinking about different types of farmers, and thus, different demands.

Secondly, different interviewees also argued that farmers’ demands tend to be generic. For instance, in this case: “representatives of each [farmer] sector [...] we listened to the demands, they agreed on that there is a lack of research on ‘water’”. Interestingly, in this case, ‘water’ was assumed to be a research topic, when it is very general theme which encompass countless specific research topics. Nonetheless, researchers, and even extension agents, seemed to neglect this fact and build specific research topics on their own, based on their general understanding of what the farmers they know may need in connection with water. In brief, even when the general topic was identified through participatory processes, in practice, research topics were identified (even created) by researchers believing that they had been identified by farmers: “the research demands [...] reach us as possible topics, and what we do [as researchers] is to look for research lines and develop trials that respond to those problems.”

Institutional arrangements

Though there are apparent biases in the process of developing research topics in the INTA in response to farmers’ demands, it is also important to acknowledge the existence of institutional arrangements and experiences that go in the direction of a participatory development of research agendas. The INTA’s Regional Projects with Territorial Approach (PRET), active between 2014 and 2018, controlled research funding and required that research was conducted in the context of prioritized rural development objectives participatorily built in workshops with local rural actors, including farmer organizations and representatives. Since 2019, the PRETs were replaced by Platforms of Territorial Innovation (PIT) which were meant to facilitate the interaction between INTA and other local actors, particularly farmer representatives and farmer organizations. However, since research funding was controlled at a national level, the interaction among local researchers, extension agents and farmers became dependent on the PITs’ coordinators. The INTA also has Local Advisory Councils, formed mostly by representatives of farmers’ organizations and public institutions, which are expected to contribute to the identification of research and extension

priorities. However, since participation is voluntary, these councils tend to be symbolic arrangements with participants personally linked to the INTA's personnel.

Finally, the INTA has also National Programs on topics that are considered institutional priorities, which tend to fund research that falls into their areas, regardless of whether research topics respond or not to farmers' local demands and needs.

Farmers' role in the construction of research topics and interactive construction of demands

The farmers may adopt (or be given) different roles in the construction of research topics. Evidence suggests that the most frequent role is as source of demand and problems, which can be tricky because of the interpretative process that takes place between the problem or demand and the fine tuning of the research problem without the participation of farmers. Nonetheless, interviews also show different practices used by researchers to develop research agendas that respect the essence of farmers' demands, which include:

- Asking extension agents about farmers' needs and problems, assuming extension agents have a more direct knowledge of farmers' situation and profile: "you ask them [extension agents] how they see the situation, how things are going and what the real need of the farmer is".
- Visiting rural areas to have a direct experience of farmers' problems and life context: "It that when you arrive [to the farms] you find out what's happening, it's when you go out into the field with the extension workers and you find out what's going on."
- Fine tuning the research topics in direct interaction with farmers: "we went to the office, developed a strategy, a proposal, and with that we returned again to the farmers and discussed [research] alternatives."

4. Discussion and conclusion

This research provides several key contributions to the understanding of how agricultural research topics are constructed. Although the literature recommends basing agricultural research on farmers' needs (Maulu et al., 2021), interviewees convincingly argue that other sources, such as institutional and policy priorities or emerging challenges that may affect future production, are also valuable. Authors should perhaps avoid overemphasizing farmers' demands and instead acknowledge the existence of multiple relevant sources for research topic selection.

The findings also highlight that farmers' demands are not homogeneous, but rather diverse, in line with other research (Kilelu et al., 2014; Tarantini & Landini, 2023). Therefore, claiming that research does not respond to farmers' needs becomes less meaningful, as the issue is not whether research addresses such needs, but rather whose needs are being prioritized and which types of farmers are being excluded. This study, therefore, suggests that the issue is more complex than merely assessing whether research aligns with farmers' needs.

Interestingly, the findings reveal that both extension agents and researchers often construct their understanding of farmers' needs based on personal experience. This is relevant because it hinders consensus on research priorities and often leads to conflict among stakeholders who interpret farmers' needs differently. In addition, the results suggest that institutional structures and authorities can play a key role in aligning research topics with farmers' demands.

Finally, the findings indicate that even when researchers are committed to addressing farmers' needs and demands, the typically general way in which these are expressed leads to implicit interpretation processes that may distance the final research topics from the original needs. In this regard, the study identifies three strategies that may help researchers better align research with farmers' needs: (1) discussing research topics with extension agents, (2)

gaining direct experience of farmers' problems and their life context, and (3) fine-tuning research topics through direct interaction with farmers.

5. References

- Fieldsend, A. (2020). Agricultural knowledge and innovation systems in European Union policy discourse: Quo vadis. *Studies in Agricultural Economics*, 122, 115-123. DOI: 10.7896/j.2055
- Frank, M., Amoroso, M., & Kaufmann, B. (2025). Social innovation in the making: Action research on relationship building and role understanding in the co-development of a Participatory Guarantee System in Argentina. *Action Research*. DOI: 10.1177/14767503251316368
- Holton, J. (2008). Grounded theory as a general research methodology. *Grounded Theory Review*, 7(2), 67-93. DOI: 10.1007/s11192-020-03387-8
- Hornum, S., & Bolwig, S. (2021). A functional analysis of the role of input suppliers in an agricultural innovation system: The case of small-scale irrigation in Kenya. *Agricultural Systems*, 193. DOI: 10.1016/j.agsy.2021.103219
- Ingram, J., Dwyer, J., Gaskell, P., Mills, J., & de Wolf, P. (2018). Reconceptualising translation in agricultural innovation: A co-translation approach to bring research knowledge and practice closer together. *Land Use Policy*, 70, 38-51. DOI: 10.1016/j.landusepol.2017.10.013
- Kilelu, C. W., Klerkx, L., & Leeuwis, C. (2014). How dynamics of learning are linked to innovation support services: insights from a smallholder commercialization project in Kenya. *The Journal of Agricultural Education and Extension*, 20(2), 213-232. DOI: 10.1080/1389224X.2013.823876
- Landini, F. (2016). Unfolding the knowledge and power dynamics of the 'farmers-rural extensionists' interface in North-Eastern Argentina. *The Journal of Agricultural Education and Extension*, 22(5), 399-413. DOI: 10.1080/1389224X.2016.1227050
- Landini, F., & Conti, S. (2023). Factors contributing to rural extension agents' support for a transfer of technology (ToT) approach: a multiple linear regression analysis. *The Journal of Agricultural Education and Extension*, 29(5), 605-625. DOI: 10.1080/1389224X.2022.2120027
- Macours, K. (2019). Farmers' demand and the traits and diffusion of agricultural innovations in developing countries. *Annual Review of Resource Economics*, 11(1), 483-499. DOI: 10.1146/annurev-resource-100518-094045
- Maulu, S., Hasimuna, O. J., Mutale, B., Mphande, J., & Siankwilimba, E. (2021). Enhancing the role of rural agricultural extension programs in poverty alleviation: A review. *Cogent Food & Agriculture*, 7(1), 1886663. DOI: 10.1080/23311932.2021.1886663
- Nettle, R., Major, J., Turner, L., & Harris, J. (2024). Selecting methods of agricultural extension to support diverse adoption pathways: a review and case studies. *Animal Production Science*, 64(1), AN22329. DOI: 10.1071/AN22329
- Pinxterhuis, I., Dirks, S., Bewsell, D., Edwards, P., Brazendale, R., & Turner, J. A. (2019). Co-innovation to improve profit and environmental performance of dairy farm systems in New Zealand. *Rural Extension and Innovation Systems Journal*, 14(2), 23-33.
- Schut, M., Klerkx, L., Sartas, M., Lamers, D., Mc Campbell, M., Ogbonna, I., Kaushik, P., Attakrah, K., & Leeuwis, C. (2016). Innovation platforms: experiences with their institutional embedding in agricultural research for development. *Experimental Agriculture*, 52(4), 537-561. DOI: 10.1017/S001447971500023X
- Tarantini, E. S., & Landini, F. P. (2023). El rol que desempeña el investigador en el marco de los procesos de innovación agropecuaria: tensión entre las prácticas reales e ideales en el noreste argentino. *Cuadernos de Desarrollo Rural*, 20. DOI: 10.11144/Javeriana.cdr20.eria

Co-Creation of Knowledge and Information Sharing in Rural Pakistan: Strengthening AKIS for Climate Change Adaptation

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Short Abstract

This study aimed to investigate how Agricultural Knowledge and Innovation Systems (AKIS) can enhance farmers' climate resilience in rural Pakistan by fostering knowledge co-creation and optimizing information-sharing networks. Employing a qualitative case study methodology, we conducted semi-structured group interviews with farmers and field observations to investigate the interactions among stakeholders involved in climate change adaptation. Research demonstrates that rural farmers predominantly depend on informal networks, including peer contacts and familial ties, for knowledge regarding climate adaptation. Institutional deficiencies in extension services, restricted access to formal training, socio-economic barriers, illiteracy, and skepticism towards formal knowledge impede the efficacy of AKIS. The study finds that fostering collaborative networks among extension workers, researchers, and farmers is essential for improving adaptive capacity. Enhancing participatory frameworks within AKIS can integrate indigenous and scientific knowledge, promoting food security, sustainable agriculture, and poverty alleviation. This research enhances the comprehension of how context-specific participatory methodologies might facilitate the transformation of Agricultural Knowledge and Information Systems (AKIS) to become more inclusive, resilient, and successful in tackling the problems posed by climate change in Pakistan.

1. Purpose

This research examines the capacity of Agricultural Knowledge and Innovation Systems (AKIS) to improve climate resilience in smallholder farmers in rural Pakistan. This study examines how the co-creation of knowledge and enhancement of information-sharing networks bolster the adaptive capacities of farmers against escalating climate variability. The research aims to enhance theoretical and empirical discourse on inclusive and participatory Agricultural Knowledge and Information Systems (AKIS) models in climate-vulnerable regions of the Global South.

2. Design

A qualitative case study method was utilized to obtain comprehensive insights into the knowledge dynamics of smallholder farmers. The data collection comprised semi-structured group interviews and field observations conducted in designated localities in rural Pakistan. Thematic analysis was employed to elucidate farmers' communication patterns, trust mechanisms, and knowledge validation procedures. The conceptual framework was guided by the interactive innovation model (Klerkx et al., 2012) and social learning theory within Agricultural Knowledge and Innovation Systems (AKIS) (Leeuwis & Aarts, 2011).

3. Findings

Farmers predominantly depend on informal networks, including peer exchanges, familial connections, and community forums, to obtain climate-related information. These informal networks offer reliable, culturally pertinent knowledge, however, frequently lack scientific

rigor. In contrast, formal extension services are underutilized due to restricted outreach, lack of trust, illiteracy, and socio-economic exclusion—obstacles corroborated by other research in South Asia (Shrestha et al., 2019; Spielman et al., 2021).

Farmers mostly rely on informal networks—such as peer exchanges, familial connections, and community forums—to obtain climate-related agricultural knowledge. These social networks are integrated into cultural and societal frameworks and frequently serve as reliable sources of guidance and localized information. Nonetheless, although they provide familiarity and relevance, these networks sometimes lack scientific rigor and may not consistently supply timely or accurate technical information (Ali & Erenstein, 2017). Conversely, institutional agricultural extension services are underutilized in numerous regions of South Asia owing to restricted outreach capability, trust deficits, poor literacy rates, and socio-economic marginalization. Research indicates that utilizing existing informal networks can effectively address the last-mile gap in climate and market information services, enhancing the efficacy of formal dissemination systems (Spielman & Ma, 2021).

The research revealed a distinct disconnect between formal Agricultural Knowledge and Information System (AKIS) participants, such as government extension agents and researchers, and rural farmers. Collaboration is weak, feedback channels are limited, and there is a lack of platforms for collective decision-making. This reinforces the findings of Birner et al. (2009), who assert that linear top-down extension models are insufficient for addressing the local complexity of climate adaptation.

The findings underscore the overlooked chances for integrating indigenous knowledge with modern research, hence constraining the adaptive capacity of farmers. Nyong et al. (2007) reached to similar conclusions for African contexts, while Chaudhary et al. (2025) emphasized and advocated for context-specific, co-produced climate knowledge in South Asian settings.

4. Practical Implications

The research underscores the significance of participatory extension and innovation platforms in reconciling formal and informal knowledge systems. These platforms could cultivate trust, facilitate reciprocal learning, and encourage the collaborative creation of contextually suitable climate-smart activities (Douthwaite et al., 2009; Kilelu et al., 2013). Enhancing the capabilities of local extension personnel, investing in community-centric information systems, and utilizing ICT tools like mobile phones and community radio could further democratize access to climate information. Policy interventions could promote inclusive Agricultural Knowledge and Information Systems (AKIS) governance that includes women, youth, and marginalized groups (Totin et al., 2018).

5. Theoretical Implications

The research confirms that effective Agricultural Knowledge and Innovation Systems (AKIS) should be seen as dynamic, interactive systems instead of linear knowledge pipelines. According to Leeuwis and Aarts (2011), knowledge generation in these systems arises through negotiation, reflection, and social learning among diverse participants. The integration of indigenous and scientific knowledge systems aligns with the concept of "boundary work" in agricultural innovation (Kristjanson et al., 2009).

This study advocates for a transition to more pluralistic and transdisciplinary knowledge systems to enhance agricultural resilience (Klerkx & Proctor, 2013; World Bank, 2010). Transforming the Agricultural Knowledge and Information System (AKIS) in Pakistan necessitates institutional reforms, the establishment of trust, and the incorporation of marginalized voices and diverse perspectives in innovation processes.

6. References

- Ali, A., & Erenstein, O. (2017). The role of social networks in agricultural adaptation to climate change: Implications for sustainable agriculture in Pakistan. *Climate*, 5(4), 85. <https://doi.org/10.3390/cli5040085>
- Birner, R., Davis, K., Pender, J., Nkonya, E., Anandajayasekeram, P., Ekboir, J., ... & Cohen, M. (2009). From best practice to best fit: A framework for analyzing pluralistic agricultural advisory services worldwide. *Journal of Agricultural Education and Extension*, 15(4), 341–355. <https://doi.org/10.1080/13892240903309595>
- Chaudhary, B. R., Acciaioli, G., Erskine, W., Piya, L., & Joshi, N. P. (2025). Adaptation to climate change by the indigenous farmers in the western Tarai of Nepal. *Climate Services*, 38, 100559. <https://doi.org/10.1016/j.cliser.2025.100559>
- Douthwaite, B., Kuby, T., van de Fliert, E., & Schulz, S. (2003). Impact pathway evaluation: An approach for achieving and attributing impact in complex systems. *Agricultural Systems*, 78(2), 243–265. [https://doi.org/10.1016/S0308-521X\(03\)00128-8](https://doi.org/10.1016/S0308-521X(03)00128-8)
- Kilelu, C. W., Klerkx, L., Leeuwis, C., & Hall, A. (2013). Beyond knowledge brokering: An exploratory study on innovation intermediaries in an evolving smallholder agricultural system in Kenya. *Knowledge Management for Development Journal*, 9(1), 73–94. <https://doi.org/10.1080/19474199.2011.593859>
- Klerkx, L., & Proctor, A. (2013). Beyond fragmentation and disconnect: Networks for knowledge exchange in the English land management advisory system. *Land Use Policy*, 30(1), 13–24. <https://doi.org/10.1016/j.landusepol.2012.02.003>
- Klerkx, L., van Mierlo, B., & Leeuwis, C. (2012). Evolution of systems approaches to agricultural innovation: Concepts, analysis and interventions. In Darnhofer, I., Gibbon, D., & Dedieu, B. (Eds.), *Farming Systems Research into the 21st century: The new dynamic* (pp. 457–483). Springer. https://doi.org/10.1007/978-94-007-4503-2_20
- Kristjanson, P., Reid, R. S., Dickson, N., Clark, W. C., Romney, D., Puskur, R., ... & Grace, D. (2009). Linking international agricultural research knowledge with action for sustainable development. *Proceedings of the National Academy of Sciences*, 106(13), 5047–5052. <https://doi.org/10.1073/pnas.0807414106>
- Leeuwis, C., & Aarts, N. (2011). Rethinking communication in innovation processes: Creating space for change in complex systems. *The Journal of Agricultural Education and Extension*, 17(1), 21–36. <https://doi.org/10.1080/1389224X.2011.536344>
- Nyong, A., Adesina, F., & Osman Elasha, B. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitigation and Adaptation Strategies for Global Change*, 12(5), 787–797. <https://doi.org/10.1007/s11027-007-9099-0>
- Spielman, D. J., & Ma, X. (2021). Putting social networks to practical use: Improving last-mile dissemination systems for climate and market information services in developing countries. *Climate Services*, 23, 100248. <https://doi.org/10.1016/j.cliser.2021.100248>
- Totin, E., Segnon, A. C., Schut, M., Affognon, H., Zougmore, R. B., Rosenstock, T., & Thornton, P. K. (2018). Institutional Perspectives of Climate-Smart Agriculture: A Systematic Literature Review. *Sustainability*, 10(6), 1990. <https://doi.org/10.3390/su10061990>
- World Bank. (2010). *Agricultural innovation systems: An investment sourcebook*. Washington, DC: World Bank.

Accompaniment of capacity building processes for the design of multi-stakeholder and multilevel agroecological initiatives: the case of the Ñuble region, Chile

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Short abstract

The development of family farming in Chile faces significant challenges, which must be addressed in order to move towards sustainable local agrifood systems. This transition is only possible through capacity building and the exchange of knowledge and experiences among the various actors involved in the management of the territory, with a particularly relevant role for local communities and rural extension teams. In this context, a descriptive case study is presented focusing on an agricultural farm in the Ñuble Region, which carries out collaborative work between the local community, extensionists from public agricultural institutions and FAO support, for the restoration of the productive landscape based on practices for the recovery of the soil and the water cycle. The establishment of a demonstration center conceived as a space for training and knowledge generation and the incorporation of lines of work focused on sustainability in the institutional framework will contribute to strengthening local resilience and the generation of appropriate conditions for the development of sustainable productive activities, positioning this territory as a local reference in terms of the generation of positive impacts and benefits for local communities at multiple levels. Keywords: rural extension, agroecological transition, scaling up, landscape restoration, Sustainable agri-food systems.

1. Purpose

The development of family farming in Chile faces structural challenges. In this context, support for transition processes, advice and capacity building by public and private actors are essential to promote the comprehensive development and resilience of these local production systems and their livelihoods in a diverse landscape. In the inland dryland ecosystems of the country, the historical expansion of monoculture tree plantations has led to the reduction of land cultivated by local agriculture, in addition to causing profound alterations in the hydrological cycle in several watersheds in the region (Torres et al., 2015). This situation has been aggravated by factors such as prolonged drought, the effects of climate change and the dynamics of water markets (del Pozo et al., 2024). In this scenario, the need and opportunity to move towards sustainable and resilient production models becomes evident. Capacity building, knowledge sharing and co-learning between organized communities, farmers and government institutions constitutes a central axis for advancing in this situation, allowing to improve the living conditions of local communities and their livelihoods through an integral territorial management that incorporates mechanisms aimed at the sustainability and resilience of agri-food systems and the restoration of the rural landscape (Knickel et al., 2018; Wilson, R., 2021). The objective of this work is to present a descriptive and analytical case study of an agricultural farm located in the Ñuble Region, Chile, which reflects the challenges mentioned above and documents a process of active collaboration between the empowered local community and agricultural extension teams from governmental organizations. Through this alliance, capacity and knowledge development actions, institutional support and implementation of strategies aimed at

restoring the productive landscape and the sustainability of the local agrifood system are promoted¹

¹ The work developed in San José de Ninhue is part of a pilot area of the Landscape Restoration Project executed by the Ministry of the Environment (MMA) and the National Forestry Corporation (CONAF), and implemented by the Food and Agriculture Organization of the United Nations (FAO), with funding from the Global Environment Facility (GEF) <https://www.fao.org/environmental-social-safeguards/project-detail/restoration-of-biodiversity-and-ecosystem-services-at-the-landscape-scale-on-productive-agroforestry-areas-and-their-natural-environment/en>

2. Design

The community described corresponds to inhabitants of the interior drylands of the Ñuble region, specifically in the Ninhue sector, who, affected by drought and soil degradation resulting from the establishment of monoculture tree plantations, with the consequent loss of biodiversity and water scarcity, have shown a growing interest in the transition to the design of sustainable production systems. The farm analyzed corresponds to a property managed by the Grupo Micelios, made up of local facilitators and territorial managers, who have established a process of dialogue and collaboration with extensionists from the Instituto de Desarrollo Agropecuario (INDAP), a government institution belonging to the Ministry of Agriculture, in charge of supporting and subsidizing small farmers, within the framework of a work supported for its implementation by FAO. One of the main focuses of the Micelio Group's work is the restoration of the landscape and the sustainability of the local agri-food system, based on the implementation of sustainable practices for the recovery of the soil and the hydrological cycle, the latter being a fundamental axis for the regeneration of ecosystems and sustainable production. Within this framework, the creation of a demonstration center is proposed, conceived as a meeting, learning and experimentation space that will contribute to strengthening the sense of community through the exchange of experiences, knowledge and shared visions aimed at a common objective: the recovery of the productive landscape. This center aspires to become a test laboratory and nucleus of operations to expand and strengthen capacities, promote the development of project managers in the different territories and the articulation with farmers, local communities, the neo rural population and INDAP technicians. This approach seeks to incorporate concepts of ecological restoration and good agricultural practices into institutional lines of action in order to move toward stronger territorial governance and agrifood management based on sustainability and resilience criteria.

3. Findings

The farm under study bases its farm design on the integrated and efficient management of water resources, considered the structuring axis of all productive activities. Its activities are guided by the permaculture system and regenerative agriculture (McLennan et al., 2021), which translates into the implementation of soil restoration practices (application of natural fertilizers, incorporation of organic matter, use of mulch, among others), as well as the implementation of biological corridors and integrated agroforestry systems. In particular, specific measures have been adopted for the restoration of the water cycle, such as the recharge of aquifers through infiltration ditches, swale design, rainwater harvesting from roofs and the installation of natural dams to retain and redistribute water. These interventions not only seek to restore the water cycle, but also to favor the ecological interconnection of the landscape. In addition, the farm carries out educational activities through training and dissemination workshops on hydrological design, syntrophic

management and eco-literacy, focused on strengthening food sovereignty and climate resilience of families and local communities. One of the main advances achieved in the articulation with public institutions has been the incorporation of the landscape restoration approach in INDAP's annual work plans in the region. This change has led to the inclusion of new strategic lines within its extension and communication programs. As part of the work developed with FAO support, INDAP's technical advisors will be trained in regenerative systems protocols, administrative procedures will be streamlined and the requirements for applying for subsidies will be updated. In addition, sustainable practices (e.g. water harvesting, agroforestry) will be included in these subsidies, as well as the definition of specific indicators for monitoring good regenerative agricultural practices (e.g. water infiltration and biodiversity indicators, among others). Finally, the training of professionals in regenerative design techniques will be promoted, with the aim of consolidating an institutional transition towards more sustainable and resilient production models.

4. Practical Implications

The joint work with INDAP has provided the institution with tools to incorporate a more holistic vision of the diversity of productive uses within the farms, understood as integral units. Until now, this diversity has been addressed in a fragmented and operational manner, with isolated interventions according to specific actions. The new perspective makes it possible to move towards public management that recognizes and addresses territorial units as interconnected productive systems, integrated within a functional landscape. This makes possible a more coherent and effective implementation of development and productive promotion instruments. Likewise, this collaboration generates tangible synergies in the territory, which contribute to the sustainability of the experiences and favor their autonomy and replicability. By working together with local actors, who contribute their knowledge and concrete experience, with the support of public institutions, collaborative work is promoted, enriched by the strengthening of the capacities of regional extensionists. This work is also enhanced by the integration of innovative technical tools in the intervention instruments and by the methodological support and international experience of FAO.

5. Theoretical Implications

The demonstration center under development is presented as a strategic opportunity for the creation of an educational hub that allows farmers, students and technicians to be trained in regenerative methodologies. Through continuous training programs, it seeks to foster conscious leadership and generate cooperation networks between rural communities, producers and experts, to share knowledge, multiply the positive impact and replicate the educational project in other territories. This process also aims to empower local communities as "water managers", i.e. active agents in the sustainable management of water and natural resources. At the same time, this initiative offers rural extension teams the possibility of adopting an integral vision in their work, promoting sustainable practices adapted to the productive and social diversity of each territory. It also contributes to the incorporation of approaches to the restoration of productive landscapes, sustainability and resilience of agricultural systems in public policies and financing instruments, positioning them as effective strategies for territorial development. This approach favors the recovery of essential ecosystem services, such as water regulation and soil fertility, which is essential to ensure the availability of natural resources and thus sustain a resilient local economy. The work developed in this context positions Ninhue, in the Ñuble Region, as a territorial reference for the transition to sustainable and resilient production models. This experience generates positive impacts and multidimensional benefits for local communities:

- Environmental, by restoring degraded ecosystems, recovering water regulation and mitigating the effects of droughts.
- Social and economic, by strengthening food security, developing local capacities, creating sustainable economic opportunities and fostering community cohesion.
- Educational, through the dissemination of knowledge and regenerative practices, the training of new leaders in sustainability and the promotion of a culture of respect and care for the environment.

Together, these actions contribute to transforming traditional practices into regenerative production systems, helping to break the historical cycle of degradation and pressure on inland rainfed landscapes in the Mediterranean ecoregion of Chile.

6. References

- Del Pozo, A., Catenacci-Aguilera, G., & Acosta-Gallo, B. (2024). Consequences of Land Use Changes on Native Forest and Agricultural Areas in Central-Southern Chile during the Last Fifty Years. In *Land* (Vol. 13, Issue 5). Multidisciplinary Digital Publishing Institute (MDPI). <https://doi.org/10.3390/land13050610>
- Knickel, K., Redman, M., Darnhofer, I., Ashkenazy, A., Calvão Chebach, T., Šūmane, S., Tisenkopfs, T., Zemeckis, R., Atkociuniene, V., Rivera, M., Strauss, A., Kristensen, L. S., Schiller, S., Koopmans, M. E., & Rogge, E. (2018). Between aspirations and reality: Making farming, food systems and rural areas more resilient, sustainable and equitable. *Journal of Rural Studies*, 59, 197-210. <https://doi.org/10.1016/j.jrurstud.2017.04.012>
- McLennon, E., Dari, B., Jha, G., Sihi, D., & Kankarla, V. (2021). Regenerative agriculture and integrative permaculture for sustainable and technology driven global food production and security. *Agronomy Journal*, 113(6), 4541-4559. <https://doi.org/10.1002/agj2.20814>
- Torres, R., Azócar, G., Rojas, J., Montecinos, A., & Paredes, P. (2015). Vulnerability and resistance to neoliberal environmental changes: An assessment of agriculture and forestry in the Biobio region of Chile (1974-2014). *Geoforum*, 60, 107-122. <https://doi.org/10.1016/j.geoforum.2014.12.013>

Leveraging Agricultural Knowledge and Information Systems for Nature-Based Solutions: A pathway to sustainable and resilient farming

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Short abstract

Purpose | This study examines the role of Agricultural Knowledge and Information Systems (AKIS) in developing and implementing nature-based solutions for sustainable, climate-resilient agriculture. It focuses on enhancing knowledge exchange among farmers, researchers, and policymakers to foster innovation and improve decision-making.

Methodology | A mixed-methods approach was used in three phases: (1) qualitative content analysis to identify AKIS indicators, (2) development of a measurement tool, and (3) validation

of indicators using expert surveys and CVR/CVI. Data analysis via SPSS included descriptive and inferential statistics to assess reliability and validity.

Findings | Sixty-six indicators were identified across nine AKIS dimensions: Research and Development, Education and Empowerment, Agricultural Extension Services, Farmers and Agricultural Organizations, the Private Sector, Policy-Making and Institutional Frameworks, Information and Communication Technology (ICT), Financial Services, and Markets and Value Chain Actors. Farmers and Agricultural Organizations showed the highest validity, emphasizing their key role in adopting nature-based solutions. The study also highlights the importance of ICT, private sector involvement, and market access.

Practical and Theoretical Implications | The research offers a validated framework for policymakers to strengthen AKIS, promoting sustainable practices through education, policy support, and financial aid. Theoretically, it contributes to sustainability transitions by integrating multidisciplinary knowledge systems into climate-resilient agricultural strategies.

Keywords | Sustainable Agriculture, Climate Resilience, Knowledge Exchange, Environmental Sustainability.

1. Purpose

The primary aim of this study is to explore how Agricultural Knowledge and Information Systems (AKIS) influence the development and implementation of nature-based solutions in agriculture. It highlights the importance of strengthening knowledge exchange between farmers, researchers, and policymakers to foster innovation and support more informed decision-making. Ultimately, the research seeks to promote sustainable and climate-resilient farming practices through more effective collaboration and knowledge sharing.

2. Methodology

This study adopts a mixed-methods approach, integrating both qualitative and quantitative techniques, to assess the role of Agricultural Knowledge and Information Systems (AKIS) in the development of nature-based solutions. The research is structured into three main phases: (1) conducting a qualitative content analysis using an inductive approach to examine existing literature and identify key AKIS indicators relevant to nature-based solutions; (2) designing a measurement instrument to evaluate these indicators; and (3) validating the identified indicators through expert surveys, utilizing the Content Validity Ratio (CVR) and Content Validity Index (CVI). Statistical analyses, including both descriptive and inferential methods, were performed using SPSS software to examine the reliability and validity of the proposed indicators. Expert input was collected via structured questionnaires, and the data were analyzed to refine the framework and enhance its relevance. This rigorous methodological design strengthens the validity and applicability of the resulting indicators, providing a robust foundation for promoting sustainable and climate-resilient agricultural practices.

3. Findings

In this study, using content analysis, 66 indicators were identified across nine key dimensions that highlight the role of Agricultural Knowledge and Information Systems (AKIS) in advancing nature-based solutions for sustainable and resilient farming. The validity of these indicators was confirmed through expert surveys and the calculation of the Content Validity Ratio (CVR) and Content Validity Index (CVI). The identified dimensions include: Research and Development, Education and Empowerment, Agricultural Extension Services, Farmers and Agricultural Organizations, the Private Sector, Policy-Making and Institutional Frameworks,

Information and Communication Technology (ICT), Financial Services, and Markets and Value Chain Actors. This approach ensured that both the necessity and relevance of the items were considered simultaneously. The dimension with the highest mean validity score was identified as the most critical, reflecting its strong alignment with expert evaluations in terms of both essentiality and clarity (Table 1).

Table 1: The average CVR and CVI for the Dimensions of the Questionnaire to Assess Agricultural Knowledge and Information Systems (AKIS) in Nature-Based Solutions

Dimensions	Content validity index (CVI)	Content Validity Ratio (CVR)	Mean	Rank
Research and Development	0.772	0.60	0.686	9
Education and Empowerment	0.804	0.63	0.717	7
Agricultural Extension Services	0.812	0.668	0.74	4
Farmers and Agricultural Organizations	0.828	0.705	0.766	1
Private Sector	0.826	0.705	0.765	2
Policy-Making and Institutional Frameworks	0.794	0.66	0.727	5
Information and Communication Technology (ICT)	0.806	0.69	0.748	3
Financial Services	0.804	0.648	0.726	6
Markets and Value Chain Actors	0.715	0.705	0.710	8

Also, Figure 1 illustrates expert consensus on the key dimensions of the Agricultural Knowledge and Information System (AKIS) for nature-based solutions, using the Content Validity Index (CVI) and Content Validity Ratio (CVR) as indicators. The horizontal axis (CVI) represents the level of agreement among experts on the importance of each dimension, while the vertical axis (CVR) reflects the perceived necessity of these dimensions. The findings indicate that the private sector, farmers and agricultural organizations, and Information and Communication Technology (ICT) exhibit the highest CVI and CVR values, highlighting their crucial role in strengthening AKIS. In contrast, Research and Development (R&D), Education and Empowerment, and Policy-Making and Institutional Frameworks have the lowest validity scores, suggesting challenges related to investment and implementation in these areas. Additionally, Markets and Value Chain Actors recorded the lowest CVI (0.715) and a moderate CVR (~0.70), underscoring concerns about weak market integration within AKIS. These findings emphasize the need for comprehensive policymaking, increased investment in R&D, and the development of supportive frameworks to enhance market integration and farmer education.

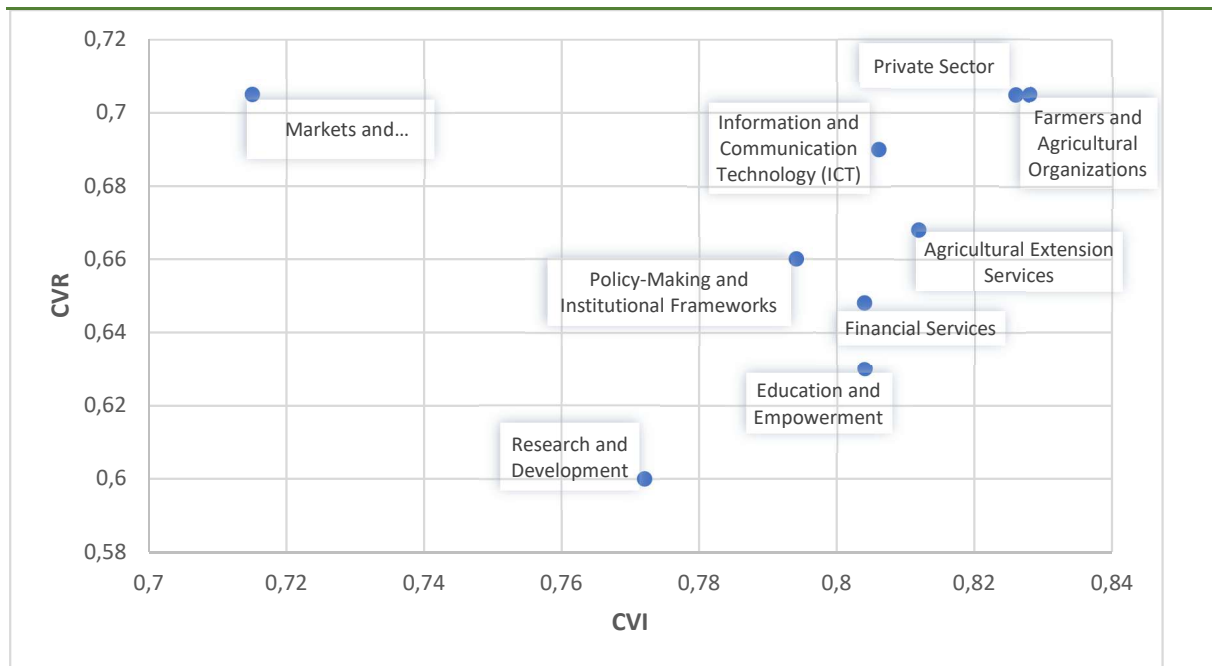


Figure 1: The average CVR and CVI for dimensions of the questionnaire to assess the impact of agricultural Knowledge and Information Systems (AKIS) in Nature-Based Solutions

4. Practical Implications

This study yields significant insights for policymakers, agricultural institutions, and key stakeholders within the agricultural sector. The identification of core indicators within the Agricultural Knowledge and Information System (AKIS) framework offers a structured basis for enhancing knowledge exchange and fostering collaboration among farmers, researchers, and policymakers. Such synergies are critical for the effective promotion and implementation of nature-based solutions (NbS) in agriculture. The findings underscore the necessity of supporting farmers and agricultural organizations through targeted financial mechanisms, capacity-building initiatives, and policy-driven incentives that encourage the adoption of sustainable agricultural practices. In particular, the integration of modern technologies, most notably Information and Communication Technologies (ICTs) and Artificial Intelligence (AI), should be strategically utilized to improve operational efficiency, broaden market access, and facilitate timely knowledge dissemination. Furthermore, active engagement of the private sector is vital for reinforcing agricultural value chains and market linkages, thereby contributing to the scalability and long-term sustainability of nature-based approaches. The practical recommendations derived from this study can inform the formulation of future policy frameworks and intervention strategies aimed at cultivating resilient, climate-adaptive agricultural systems.

5. Theoretical Implications

From a theoretical standpoint, this research advances the understanding of AKIS as a pivotal mechanism in the development and implementation of nature-based solutions within the agricultural domain. By delineating and validating key dimensions and indicators of AKIS, the study contributes to the growing body of literature on the role of integrated knowledge systems in promoting sustainable and adaptive agricultural practices. The research advocates for a comprehensive, systems-based approach that acknowledges the interdependence of research institutions, educational platforms, extension services, and private-sector actors in facilitating climate-resilient agriculture. Moreover, the application of robust content validity techniques, specifically the Content Validity Ratio (CVR) and Content Validity Index (CVI),

enhances the methodological rigor of the indicator validation process, offering a reliable and replicable framework for future empirical investigations. In doing so, this study lays a solid foundation for further research exploring the contextual adaptation and implementation of AKIS in diverse agricultural settings, with the overarching aim of advancing sustainability and resilience in food systems.

6. References

- den Heijer, C., & Coppens, T. (2023). Paying for green: A scoping review of alternative financing models for nature-based solutions. *Journal of Environmental Management*, 337, 117754.
- Kalantari, Z., Ferreira, C. S. S., Pan, H., & Pereira, P. (2023). Nature-based solutions to global environmental challenges. *Science of The Total Environment*, 880, 163227.
- Lawshe, C. H. (1975). "A quantitative approach to content validity." *Personnel Psychology*, 28(4), 563-575.
- Miralles-Wilhelm, F. (2021). Nature-based solutions in agriculture – Sustainable management and conservation of land, water, and biodiversity. FAO and The Nature Conservancy. <https://doi.org/10.4060/cb3140en>
- Sahu, K. K., Bardhan, R., Chouhan, N. S., Dixit, D., Tripathi, S., Pandey, A., & Ahmed, R. (2023). A Comprehensive review on role of agricultural extension services in the sustainable development of global agriculture. *International Journal of Environment and Climate Change*, 13(10), 3514-3525.
- Haghjoo, R., Choobchian, S., Morid, S., & Abbasi, E. (2022). Development and validation of management assessment tools considering water, food, and energy security nexus at the farm level. *Environmental and Sustainability Indicators*, 16, 100206.

The AKISInteractivity index: a system perspective assessment of interactions within the Agricultural Knowledge and Innovation Systems

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Short abstract

Purpose

The EU prioritizes dynamic Agricultural Knowledge and Innovation Systems (AKIS) with cooperative knowledge flows, valuing both explicit and tacit knowledge (Kountios et al., 2024; European Commission, 2023; Hermans, Klerkx, & Roep, 2012). A well-functioning AKIS requires effective interaction (Hermans, Klerkx, & Roep, 2015) and coordinated linkages, facilitating innovation diffusion (Kumar et al., 2001; World Bank, 2013) and knowledge dissemination, core components of the AKIS concept (European Commission, 2023; Rivera et al., 2005). However, actors often lack knowledge of each other, hindering interaction (Montero, Geerling, & Cristiano, 2019) and methodological approaches for the assessment of the intensity of interaction remain limited (Amerani et al., 2023; Kassem et al., 2022; EC, 2023).

Building on prior work (Montero-Aparicio & Cristiano, 2021; Cristiano et al., 2023), this paper addresses this gap, presenting a method to assess interactions among AKIS actors which

culminates in the definition of an 'AKISInteract index' that quantifies system-wide and bilateral interactivity among AKIS actors.

Design

Drawing on concepts from social cognition, systems thinking, and actor-network theory (Fiske & Taylor, 2017; Latour, 2005; Sterman, 2000) and the Entity-Relationship Model (ERM) (Elmasri & Navathe, 2015), the AKISInteract index assesses interactions among 17 predefined actor types within a system. This assessment relies on AKIS actors' perceptions of the frequency and formalization of reciprocal relations. A relational matrix (Montero et al., 2019) is used to solicit unbiased reports from well-positioned individuals within the AKIS regarding the extent of interaction between actor categories, with reference to a specific context. This study showcases the Italian AKIS case. Data collection, employing snowball sampling, involved interviewing 25 key AKIS actors between June and December 2024.

An AKIS interactivity index was computed using arithmetic mean to measure degree of interactions. An interactivity index equal or less than 1 but greater than 0 ($0 < A \leq 1$) indicate weak interaction; value equal or less than 2 but greater than 1 ($1 < A \leq 2$) indicate moderate interaction; and value equal or less than 3 but greater than 2 ($2 < A \leq 3$) indicate strong interaction.

Findings

The AKIS exhibits moderate interactivity (1.6). Farmers show the most interaction (1.6), but less with distributors (0.9). Private advisory services (1.5) outperform public ones (1.3); distributors have the least interaction (0.9). Private/public advisor interaction is moderate. Strongest ties link private advisors to farmers/cooperatives (2.5/2.3). Research ties strongly to academia and demo farms. Public administrations have moderate system interactivity (1.4), but strong ties with academia/research (1.9/1.8) and private advisors/farmers (1.7/1.6).

Practical and theoretical implications

This paper addresses a critical gap in literature by presenting a comprehensive methodological approach for quantitatively measuring the intensity of interaction between AKIS actors. This methodology and the AKISInteract index have the potential for: broad use across EU member states; provision of insight into Italian AKIS performance; offering practical, evidence-based foundation for CAP-supported interventions; informing policy decisions, AKIS strategy, and actor-specific support.

Keywords: AKIS, Interactivity Index, CAP, interaction, assessment.

References

- Amerani, E., Nastis, S. A., & Michailidis, A. (2023). Greece's AKIS: An evaluation of linkage mechanisms. *Rural Extension and Innovation Systems Journal*, 19 (2), 9-23.
- Cristiano, S., Proietti, P., Sturla, A., & Carta, V. Assessing performances of advisory services based on their quality: a user-centred evaluation model. In *BOOK OF ABSTRACTS* (p. 450).
- Elmasri, R., & Navathe, S. B. (2015). *Fundamentals of Database Systems* (7th ed.). Pearson.
- European Commission. (2023). *Evaluating the AKIS Strategic Approach in CAP Strategic Plans*. Directorate-General for Agriculture and Rural Development – Unit A.3 (2023): Guidelines.
- Fiske, S. T., & Taylor, S. E. (2017). *Social cognition: From brains to culture*. Sage.
- Hermans, F., Klerkx, L., & Roep, D. (2012). Structural conditions for dynamic innovation networks: a review of eight European Agricultural Knowledge and Innovation Systems.
- Hermans, F., Klerkx, L., & Roep, D. (2015). Structural conditions for collaboration and learning in innovation networks: using an innovation system performance lens to analyze

-
- agricultural knowledge systems. *The Journal of Agricultural Education and Extension*, 21 (1), 35-54.
- Kassem, H. S., Ismail, H., & Ghoneim, Y. A. (2022). Assessment of Institutional Linkages and Information Flow within the Agricultural Knowledge and Innovation: Case of Dakahlia Governorate, Egypt. *Sustainability*, 14 (11), 6415.
- Kountios, G., Kanakaris, S., Moulogianni, C., & Bournaris, T. (2024). Strengthening AKIS for Sustainable Agricultural Features: Insights and Innovations from the European Union: A Literature Review. *Sustainability*, 16 (16), 7068.
- Kumar, S., Kumar, R., & Sah, U. (2001). Linkages among research, extension and farmers—A review. *Agricultural Reviews*, 22 (3and4), 215-221.
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford University Press.
- Montero, A. A., Geerling, F., & Cristiano, S. (2019). *MS AKIS implementing tools to bridge the gap between research and practice*. https://scareurope.org/images/SCARDocuments/Reports_outcomes_studies/AKIS4_Study_vf_01072019.pdf
- Rivera, W. M., Qamar, M. K., & Mwandemere, H. K. (2005). Enhancing coordination among AKIS/RD actors: An analytical and comparative review of country studies on agricultural knowledge and information systems for rural development (AKIS/RD). *Food and Agriculture Organization of the United Nations*.
- Sterman, J. D. (2000). *Business Dynamics: Systems thinking and modeling for a complex world*. MacGraw-Hill Company.
- World Bank. (2013). *Agricultural Innovation Systems: An Investment Sourcebook*. World Bank, Washington, DC.

TOPIC 2 – Collective learning, innovation processes and capacity building: new tools and methodologies

Convenors: Alexandros Koutsouris; Hycenth Tim Ndah; Patrizia Proietti

Session 1B

ADVISORS' EDUCATION-TRAINING

Rethinking advisory capacities and roles: Fostering learning and change for Climate Smart Farming

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Keywords: advisors, climate smart advice, capacity development, trust, creative tension, second order learning

1. Purpose

Agricultural advisors play a crucial role in the development and dissemination of Climate Smart innovations and practices. This paper explores the capacities agricultural advisors need to support farmers in implementing sustainable and climate-smart agriculture. We compare the capacities emphasized in project ambitions and academic and policy discourses and the priorities that advisors themselves identify as most relevant in practice. By reflecting on differences and identifying tensions, we aim to contribute to a more grounded and actionable understanding of how to support advisors in developing the knowledge, skills, and attitudes required to inspire, engage with, and support farmers in navigating multiple sustainability transition pathways.

2. Methodology

Our analysis builds on the first year of Monitoring, Evaluation, and Learning (ME&L) within the Horizon Europe project ClimateSmartAdvisors, a pan-European multi-actor network covering 27 countries. The project aim is to strengthen the advisors' capacity in providing CS advice and boosting the advisors' role in the transition towards CS farming. Communities of Practice (CoPs) are organised as key learning spaces for social learning, exchange and peer-supported capacity development. This study follows a reflexive, practice-based inquiry approach, in which the authors, involved as ME&L team in the CSA network, systematically observed, documented, and reflected on emerging patterns, tensions and dynamics within the network. Besides the initial literature review, we draw on analytical dialogue within the CSA network, a baseline capacity assessment, the CoP action plans, a CoP self evaluation and advisors' self-defined learning questions for the Dynamic learning Agenda. The approach allowed us to link empirical experiences with theoretical perspectives on learning and systemic change.

3. Findings

The CSA goal already contains two sides of the role of the climate smart advisor role, providing targeted CS advice and have a strong role in the transition towards CS farming. For the CoPs guidelines have been developed, but in line with the nature of a CoP the advisors have much flexibility to follow their interests in determining the topical focus and ways of learning together. The result is an rich patchwork of operationalisations of the CSA ambition in practice, with varying emphasis on different capacities and aspects of the CS advisor's role. The analysis and comparison of the capacities for Climate Smart Advice as identified in project ambitions and academic and policy literature with those prioritised by advisors in the CSA project's Communities of Practice (CoPs) is summarised in table 1. The capacities are grouped under three domains: knowledge, skills, and attitudes. In the last column similarities and differences between academic expectations and practical realities are summarised.

	Policy ambition	Advisors CoP priorities	Key similarities and differences
Knowledge	Climate change and systems thinking, effects sustainable development principles, policy and regulations	Local climate impacts, crop adaptation, technical options. What are benefits for farmers?	Advisors focus on localised, practice-relevant knowledge; literature often more emphasises systemic concepts
Attitudes	Reflexivity, openness to learning and change, dedicated to promote transition, culturally sensitive	Trust-building, neutrality, openness to dialogue	Advisors are cautious about being seen as advocates; trust precedes transformation
Skills	Communicate climate issues, analyse climate challenges and solutions, GHG assessments, ability to overcome initial hesitancy	Use assessment tools, technical advising, how to interest farmers?	Advisors value hand on advisory skills; where literature includes climate awareness raising

Table 1: Climate Smart Advice capacities as identified in project ambitions and by participating advisors

The comparison shows an interesting difference in focus between the more systemic ambitions of the project and the more practical, trust-based orientation of advisors in practice. While there is convergence around adaptive communication, advisory skills and openness to dialogue, key differences emerge in knowledge and attitude domains specifically relevant to climate change. In the CoP plans we observe an understandable initial tendency towards concrete and technical topics and new tools and less attention for second order learning and exploring and rethinking both advisors' and farmers' assumptions, practices, and approaches. We recognise this as an inherent tension in the role of advisors in multi-actor projects with a transformative ambition. The tension is the need to balance two seemingly contradictory demands: on one hand, the necessity to build trust and relate to actors where they currently stand, and on the other, the imperative to introduce creative tension that challenges existing assumptions and stimulates transformative change. In the CSA project this tension is mirrored at two interconnected levels:

- 1) At the CSA network level, the process of capacity development must navigate the gap between policy and academic expectations of advisory roles—which emphasize transformative, systemic change—and the everyday realities and priorities of advisors, who often focus on more immediate, technical issues. The network thus faces the complex task of supporting advisors in bridging these worlds: respecting their current capacities and contexts while encouraging expansion toward new roles and mindsets.
- 2) At the individual advisor level, a very similar dynamic plays out in the relationship with farmers. Advisors must first earn trust and connect with farmers’ existing perspectives and motivations, which often prioritize economic and social goals over climate considerations. Simultaneously, advisors are challenged to foster creative tension that encourages farmers to rethink practices and explore more sustainable, climate-smart pathways.

This analogy highlights that the challenge of balancing trust-building and transformative disruption is fundamental and recursive—both the network and the advisors it supports must engage in navigating these tensions to enable meaningful learning and change. As a result, advisors’ initial focus on technical knowledge and practical tools reflects a necessary grounding in trust and relevance, rather than resistance to change. Recognizing and working with this dynamic is crucial for fostering advisory capacities that can progressively engage with deeper systemic shifts in climate-smart agriculture.

To make this tension more tangible and support reflection, we propose a conceptual matrix that captures the dual navigation challenge faced by both the CSA network and individual climate smart advisors (Figure 1). The matrix uses two axes: the horizontal axis ranges from alignment with farmers’ immediate interests to alignment with policy/scientific objectives for systemic sustainability; the vertical axis ranges from the advisor as a neutral service provider to the advisor as a transformative change agent.

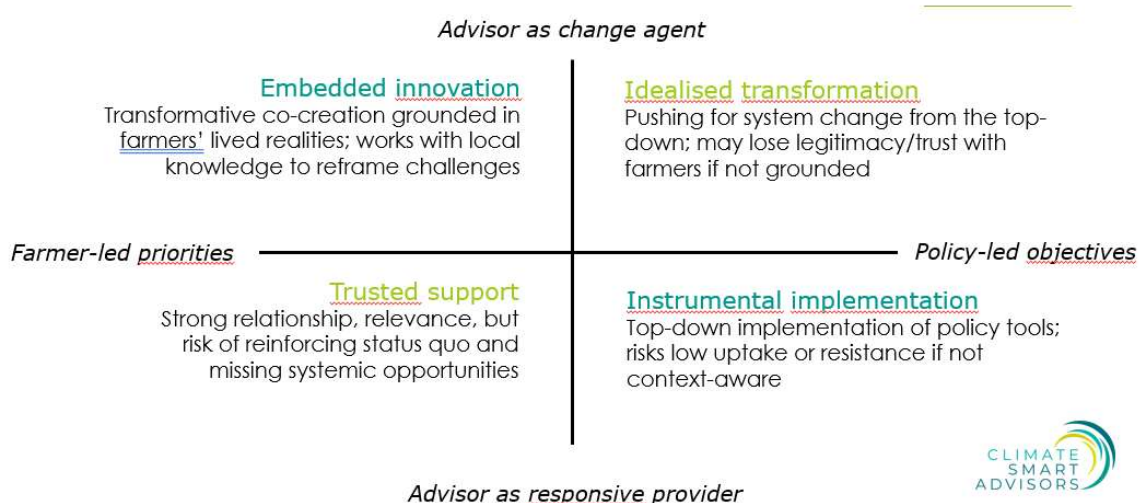


Figure 1: Matrix for navigating tensions in advisory roles in transformation

This yields four fields: from *trusted support* (grounded but potentially conservative), to *embedded innovation* (context-aware transformation), *instrumental implementation* (top-down delivery), and *idealised transformation* (ambitious but disconnected). Our findings suggest that many advisors—and the CoPs and thus the CSA network itself—naturally gravitate towards the lower-left quadrant (trusted support), because trust and relevance are essential starting points. Yet policy and academic frameworks often speak more from the top-

right quadrant, envisioning transformation that risks lacking traction if disconnected from farmers' realities.

The exciting work of strengthening the advisors' capacity in providing CS advice and boosting the advisors' role in the transition towards CS farming lies in surfing the tension, supporting movement towards the upper-left field (*embedded innovation*), where trust, co-creation, and systemic change meet. The matrix can thus serve as a reflection tool for navigating roles, relationships, and learning trajectories in complex transformation processes.

4. Practical implications

These findings provide practical insights for designing and facilitating advisory capacity development. Trust, groundedness, and local relevance should not be seen as distractions from transformation, but as starting points and essential foundations. Effective support strategies should honour where advisors and farmers are—focused on practical engagement—and incrementally introduce reflective practices, systemic insights, and facilitation skills. The matrix provides a tool to support strategic reflection by advisors, trainers, and project coordinators. It can help identify where advisors currently operate, clarify tensions in their expected versus actual roles, and guide capacity development that respects current relationships while expanding the space for transformation. In multi-actor settings like CSA, it helps shift the discussion from fixed role expectations toward adaptive learning pathways, without losing legitimacy or connection with farmers. Development strategies should create support for role evolution; people (either advisors or farmers) need time, encouragement, and peer learning to explore new ways of working. Developing hybrid capacity building which combine technical training with reflexive tools can support this. The findings are a deliberate reminder to embrace the tension between ambition and practice as complex reality and as a signpost for adaptive, incremental transformation — grounding ambition in lived practice.

5. Theoretical implications

The findings contribute to academic discussions on capacity development and learning in sustainability transitions by articulating the recursive tension between trust-building and transformation. They challenge linear or normative models of advisory innovation and instead highlight a relational, situated, and adaptive process. On the other hand they inspire participatory multi actor approaches to not lose the change ambition out of sight. The analogy between system-level (network) and micro-level (advisor-farmer) navigation reveals how multi-level learning architectures must accommodate and even embrace these tensions. Furthermore, the matrix offers a conceptual tool to reflect on and analyse advisory positioning and trajectory, which may be of interest to scholars studying multi-actor learning processes, the politics of participation, and institutional transformation.

Learning About Crossing the Lines: The WELL-E Approach to Capacity Development

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Short abstract

WELL-E, Research and Innovation Chair on Animal Welfare and Artificial Intelligence, is a Digital Living Laboratory, focused on the needs of animals and end-users with deep industry partnerships, as well as multi-disciplinary scientific committees, in which end-users and the research team interact intensively in the co-creation of projects and delivery of high-impact results. WELL-E strategically pursues capacity development (CapDev) as an all-encompassing approach to building capacity, enabling capacities to change ways of knowing and doing, thereby responding and contributing to systems change. WELL-E's pursuit of CapDev to enable individual students to build direct links with diverse scientists, organizations, and networks across systems of higher education, research partnerships and industry is an important model for future Living Labs. WELL-E's contribution to transforming agri-food systems and extension services through enhancing capacity crosses many boundaries, not only within science disciplines but twinning science-based industries like dairy and information technology that have not always had sufficient learning opportunities together.

1. Purpose

Developing capacity can comprise a culmination of i) human skills development and knowledge mobilization, ii) changes in organizations and networks, and iii) changes in governance/institutions. These are linked system processes of change that react with complex environments (Morgan, 2005). Capacity development is a core pillar of WELL-E, a Digital Living Laboratory, focused on the needs of animals and end-users with deep industry partnerships, as well as multi-disciplinary scientific committees, in which faculty and graduate students interact intensively in the co-creation of projects and delivery of high-impact results. WELL-E core research produces knowledge on the impact of "smart" (digitally enhance/supported) modifications to livestock housing systems, management practices, and handling in relation to the welfare and longevity of dairy cows, but also the wellness of people who work in and consume within Canadian dairy; a leading sector of the national agri-food innovation system. WELL-E strategically pursues capacity development (CapDev) as an all-encompassing approach to building capacity, enabling capacities to change ways of knowing and doing, thereby responding and contributing to systems change.

Capacity building is not the same as capacity development, but it is an acceptable term to many who work in the area of agricultural education, research and extension. It is preferred over « training » because the starting point is not the deficit of knowledge, but its strengthening. Capacity builds over a period of time and intentionally works past teacher-learner norms of knowledge transfer. Building capacity links knowledge to action using experiential, self-leadership and reflective or collective practices for critical inquiry and

learning. Evolving in the latter part of the 20th century, and popular among systems thinkers of governance and leadership, CapDev is the ability of people, institutions and societies to set and achieve objectives, perform functions and solve problems (Theisohn & Lopes, 2003; Land et al, 2009). Harle et al (2023:7) frame capacity with five guiding principles:

1. Capacity always already exists, and we learn from and build on that with partners.
2. Technical expertise, while important, is never sufficient.
3. Use approaches that recognize and seek to work across multiple levels of change.
4. Genuine partnerships that centre a process of mutual learning are critical.
5. To be effective we must be learner-led, using technology to enhance our work, but not being led by it.

Capacity development is the vehicle on which the dynamics of knowledge sharing and co-production anticipated by Living Labs like WELL-E are riding. WELL-E poses an unique opportunity for CapDev studies because digitalized animal-human environments have unprecedented learning needs and mutual learning conditions that include attentiveness to responsible innovation (Habibipour, 2024). WELL-E has had to strategize and operationalize capacity development that empowers individual, group and organizations' abilities to mobilize and use resources in order to achieve objectives on a sustainable basis. As members of WELL-E we are aware that capacity development in the age of AI use knowledge systems is challenging because individuals, groups and organizations become more aware of their own as well as others' learning needs and demands for resilient, real-world problem-solving and practices. Several lines that separate improving animal welfare, longevity and artificial intelligence-based technologies are crossed in the WELL-E initiative. These are boundaries of science-based disciplines (computer science/cyber-security/animal behaviour/animal welfare/social science). As well, separations of organizational culture within these science groups and within industries (dairy, information technology, cyber-security).

Our entry to individual, group, organizational and institutional change processes further recognize gaps in science structuration (e.g. ideation between students and faculty, intellectual asset management, competency-sharing, etc.). We see learning and self-leadership as the basis for a signal reconfiguration as individuals working together in new ways to help with real-world, on-farm decision making while developing a learning community that has impact pathways well beyond the academy, and further beyond the real world but set boundaries of research processes within Living Lab environments. The primary objective of this paper is to explore how our capacity development activities have been able to create profiles, assess needs and identify barriers to learning in WELL-E.

2. Approach

We designed a three-prong Learning Needs Assessment (LNA) last year that focused on «capacity that exists» in terms of our current cohort of WELL-E graduate students. This year the process will involve other participant groups in WELL-E such as faculty/researchers, partners and users (e.g. producers), but at later phases of the WELL-E initiative.

For the WELL-E graduate students, we use a structured process for the LNA to (a) identify barriers and opportunities for science restructuring, (b) assess individual learner needs using a nominal group technique, (c) building learner profiles and following them up. Concurrently the WELL-E co-Chairs and CapDev partners meet at intervals to discuss how best to facilitate student abilities to grow and use hard and soft skills, knowledge and attitudes. The process involves conducting a two-part, in-person workshop with 17 student participants (four participated online) representing 90% of the WELL-E graduate students. Ten graduate students are enrolled in computer science and seven in animal science. A participatory

nominal group technique method was used to complete the gap analysis and prioritize learning needs.

3. Findings

Graduate students brainstormed over 120 areas of capacity that they expect to use and develop to achieve and sustain the objectives of WELL-E. Learning needs were brainstormed and individually ranked in the participatory nominal group technique. Subject areas such as statistics and data management were identified as the top learning needs by 70% of participants. At least one soft skill for social interaction such as professional networking, mentoring and communication was identified by 80% of participants but the variation of these learning needs was configured by science discipline and graduate student level (MSc vs. PhD). It is the intersection of the technical and social skills that predominate the LNA findings. For example, some areas of dairy welfare and longevity research use tools such as Social Network Analysis for behavioural analysis but remaking this tool with machine learning and AI has required working across familiar student groups to interact as mixed teams that share learning needs for math and statistics but at varying needs of technical expertise. Skills attainment requires enhanced communication and networking practices to gain as well as share knowledge.

The results of 17 learner profiles point to self-leadership development and the desire for experiential learning that would strengthen not only existing competencies but remove perceived barriers. The most cited barrier was writing skills for contributing to scientific literature. Defining user requirements in the farm environment featured among computer and animal science sub-groups. Profiles followed up the LNA with participants and their construction produced narrative data that we compared to the prioritized needs and profiles. Participants expressed growing commitment to and realization of their contributions to cross-disciplinary innovation.

Discussions among the partners further noted novel areas of capacity development emerging from crossing disciplinary boundaries. For example, pairing of students across labs to facilitate projects involving physical infrastructure improvements in the Living Lab environment, developing communications and using animal science research assistants to test and develop early AI prototypes. There is also the development of new curriculum and coaching focussed on communications skills for researchers. Research and innovation field days brought together the teams and had them co-presenting in different dyads/triads. The deeper pool of potential co-authors of WELL-E presentations and papers led to communicating more clearly and defining co-publication rules. A welcome package for new students was co-created. Most recently, WELL-E's own governance structure was also opened up to reconfiguration. In sum, the boundaries of WELL-E are more numerous, and complex to cross than initially anticipated.

4. Practical Implications

Considering the immense demands for resilient and responsible innovation systems, universities are crucial for producing highly qualified personnel (HQP) with specialized skills capable of using and developing technologies and expanding the frontiers of knowledge while engaging locally (Altintas & Kutlu, 2021). Universities connect, cluster and build national capacity in terms of generating jobs or entrepreneurialism, adapting to and managing the risks of technological change and addressing other societal needs (Nilsson, 2006). Given global crises in recent years, if not months, not the least of which are human and livestock pandemics, even greater crossing of the lines are needed for resource generation, access to knowledge and sharing of scarcer resources to achieve and update objectives within agri-food systems. Capacity development is entering a new era not only in relation to AI but for

enhancing the abilities of individuals, groups and organizations to navigate near constant system disruption and motivate change.

WELL-E's pursuit of CapDev to enable individual students to build direct links with diverse scientists, organizations, and networks across systems of higher education, research partnerships and industry is an important model for future Living Labs. WELL-E's contribution to transforming agri-food systems and extension services through enhancing capacity crosses many boundaries, not only within science disciplines but twinning science-based industries like dairy and information technology that have not always had sufficient learning opportunities together. Commercialization opportunities for CapDev services to these industries may be considered.

5. Theoretical implications

The results of this study confirms the principle that capacity always already exists within individuals such as graduate students and that we can traverse, learn from and build collective capacity across organizations and institutions. Capacity development is not reduced to acquisition of technical expertise even in digital living labs. While important, we concur with Habibipour (2024) that measures for responsible innovation are surfacing with action that recognizes and seeks to work across multiple levels of change. Mutual learning among and between humans with AI/machines in digitalized living labs requires further study. Technology can enhance but not lead, or self-lead the humans. This is the unreplaceable human dimension of socio-technical systems in dairy (agricultural) innovation.

As a CapDev team we found that assessment of learning needs proves resilient as an entry point for doing learning and communication where knowledge co-production achieves shared objectives. In WELL-E this is the development of practices to improve animal welfare and longevity using AI-based tools to help with on-farm decision making. If new students are recruited, they join this capacity development process which is essentially turning the initiative into an environment of study which is distinct from our Living Labs, subjecting it to the same academic scrutiny as work in welfare and AI, ensuring that issues are highlighted and addressed as they appear. This inspires new capacity development literature.

6. References

- Altinas, O. & Kutlu, O. (2021). An Inquiry on the Third Mission of Universities: The Measurement of Universities' Contribution to the Social, Cultural and Economic Development of a City. *International Journal of Progressive Education* 17:4.
- Habibipour, A. (2024). Responsible living labs: what can go wrong? *Journal of Information, Communication & Ethics in Society (Online)*, 22(2), 205–218. <https://doi.org/10.1108/JICES-11-2023-0137>
- Harle, J., Nzegwu, F. & Wild, J. (2023). Part 1: Setting the Scene, In Wild, J., & Nzegwu, F. *Digital Technology in Capacity Development: Enabling Learning and Supporting Change*. African Minds. <https://doi.org/10.47622/9781928502708>
- Land, T. & Hauck, V. & Baser, H. (2009). Capacity Development: Between Planned Interventions and Emergent Processes. ECPDM.
- Nilsson, J. E. (Ed.) (2006). *The role of universities in regional innovation systems: A Nordic perspective*. Copenhagen: Copenhagen Business School Press.
- Theisohn, T. & Lopes, C. (2003). *Ownership Leadership and Transformation: Can We Do Better for Capacity Development*. Routledge.

Designing interactive summer school training: Insights from i2connect trainers

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Short abstract

This article adopts a trainer perspective to shed light in the design and implementation of the I2CONNECT summer schools, and the roles undertaken by trainers to balance group dynamics. The findings show that creating interactive learning situations requires continued effort from trainers. Taking a flexible and adaptive approach allows the translation of educational objectives into targeted learning activities. Mindsets and attitudes that trainers adopt are important for their navigation from the traditional trainer role who controls the educational process to the role of training facilitator who creates opportunities for trainees to take ownership of the process. Self reflection and openness to peer constructive criticism are equally important, facilitating trainers' mutual support.

1. Purpose

An academic summer school is an educational program that takes place during university vacations. It is characterized by flexibility, as it can serve multiple purposes, utilizing various approaches and activities to address different needs of multiple target groups. These elements made the summer school approach an ideal choice for delivering interactive training to postgraduate students in the framework of the I2CONNECT Horizon project. The overall focus of I2CONNECT (2019-2024) was to empower advisors and their organizations to engage and support farmers and foresters in interactive innovation processes, heeding the need for new advisory tools and competences that are necessary for facilitating collaboration, social learning and problem solving in multi actor networks adopting a systems approach to innovation. Identifying this need, the project initiated and implemented three summer schools for future advisors attending universities across Europe the period 2022-2023, with the aim to: a. expose them to experiential, collaborative learning environments that reflect the complex realities of innovation support in practice and create opportunities for networking with professionals in innovation support; b. familiarize them with interactive methods and tools that the project developed and applied; and c. help them develop the skills needed to engage in and support interactive innovation processes. This article adopts a trainer perspective to shed light on the design and implementation of the I2CONNECT summer schools, as well as the roles undertaken by trainers and group dynamics influencing the effectiveness of the summer schools.

2. Design

The article employs a case study approach, which is suitable for in-depth exploration of situated processes (Creswell and Poth, 2018). The collection of data is based on trainers' team reflections during meetings before and after each training course. These reflection meetings aimed to utilize the evaluation feedback provided by trainees and the trainers' own

observations during the training and to introduce changes that would improve the educational experience of the subsequent summer schools' participants. Trainees were selected among those who applied in response to open calls, launched in early 2022, 2023 and 2024. Out of the 130 applicants, 80 MSc and PhD students (including few lecturers) from universities all over Europe were chosen and registered to attend and, finally, 75 of them attended the three summer schools (26, 25 and 24 students respectively). The applicants were selected based on their knowledge and skills related to the summer school topics according to their CV, also indicating the context in which these skills were acquired (e.g. dedicated courses, thesis or project work etc.). Each school was facilitated by a different team composed of four or five trainers/facilitators. The teams consisted of a mix of very experienced and comparatively less experienced trainers in both the traditional (mainly academic) education and interactive training. However, overall, the team that facilitated the first summer school accumulated much more experience in facilitating interactive training. Most of the trainers were already familiar with each other before holding the summer schools through long-term acquaintances, being academic colleagues and/or partners in previous European projects or linked by mentoring and/or employer-employ relationships. The structure and the didactical strategies of the summer schools were designed by a team of six experienced in Extension Education and Higher Education academics, including the team of trainers of the first summer school, based on the mandate and the fundamental theoretical concepts of the project (see Knierim et al., 2020)

3. Findings

3.1 Strategies, methods and implementation of the summer school courses

The summer schools followed a blended approach, following a three-stage structure with each summer school combining a two-hour kick-off online meeting, a four (and later five) full-day course with physical presence and a two-hour follow-up online meeting (Table 1). The design team agreed that this structure was necessary for multiple reasons. In the first place, the kick-off meetings gave trainees the opportunity to get acquainted with each other and the trainers the opportunity to prepare trainees for the corresponding face-to-face courses, providing them with a common core of knowledge regarding interactive innovation. In addition, trainers had the opportunity to assign the study of an interactive project as well as of the extension/advisory/innovation support services of their country to trainees. The assignments were crucial for the implementation of many course activities as the trainees' cases provided the context and the content for exploring and better understanding critical tools and concepts (e.g. AKIS, the importance of actors' complementarity and quality of relationships in networks etc.). Then, the follow up meetings allowed trainees to come together again and jointly reflect on the learnings they had put in practice after the course while, in parallel, strengthening further their networks. These meetings provided feedback to trainers about the longer-term effects of the training on the trainees.

Table 1: Stages, time and place of the summer school courses

	1st Summer School	2nd Summer School	3rd Summer School
Organizer	Agricultural University of Athens (Greece)	University of Hohenheim (Germany)	Teagasc (Ireland)
Kick-off session	Online, 28 June 2022	Online, 30 Aug. 2023	Online, 19 June 2024
In person course	Mediterranean Agronomic Institute of Chania, 23-29 July 2022	UHOH, 11-15 Sept. 2023	Kildalton College, 22-26 July 2024
Follow-up session	2 November 2022	30 November 2023	26 September 2024

The summer schools were designed as facilitated interactive and collaborative training sessions/courses. At first, the design team developed a 4-days training program, based on the assumptions that most trainees had been raised in a teacher-centric educational environment, and, in practice, had limited experience on advisory/innovation support work. The program was based on a sequence of experiential, learner-centred activities (Table 2), including energizers and informal social activities (e.g. shared dinners, evening outings) to encourage interactions and team building. It also included the implementation of dynamic networking tools based on the work of Wielinga and Sjoerd (2020). Each training activity was part of the overall pedagogical strategy and served a specific learning objective. For example, the experiential role play activities “cross the river” and “guide the blind” aimed the first one at triggering trainees’ thinking about the importance of being an active learner and their responsibility for their own learning, and, the other one at raising awareness on clients’ perspectives and the role and responsibilities of rural advisors. On the other hand, the exercise “egg drop”, an example of interactive, collaborative learning, introduced trainees in interactive innovation processes. The program was designed to maintain a balance between theory and practice, utilizing trainees’ own knowledge. For this reason, the introduction of each concept was accompanied by interactive activities that were designed to encourage trainees to apply and deepen their understanding of the concept. The aim was to inform trainees about fundamental concepts and tools and sensitise them on interactive innovation and the role of advisors/facilitators, while helping them develop a collaborative mindset and skills. To these ends, tools such as the “spiral of innovation” and the “co-creation triangle” were introduced to help trainees analyze, in small groups, their own innovation cases. In parallel, the facilitation exercise aimed at deepening trainees’ understanding of facilitation and the crucial distinction between content (i.e. what is discussed) and process (i.e. how it is discussed). All activities included a reflection step, allowing trainees to reconsider what had happened. Trainees were also encouraged to record their experiences to daily reflection journals, which promoted critical reflection and transformative learning. In addition, reflective practices were integrated into the face-to-face course (energy timeline) and the online- follow-up meeting as evaluation processes.

Table 2: Overview of the training program developed for the summer school in-person course: structure and topics

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
MORNING SESSIONS		<ul style="list-style-type: none"> Recap & daily programme Exercise (Guide the blind) Types of advisory approaches Understanding innovations The AKIS concept & exercise 	<ul style="list-style-type: none"> Energizer, recap & daily programme The egg drop The spiral of innovations – hot and cold processes Analysis of participants' cases Triangle of co-creation and roles & exercise (participants' cases) The role of the advisor in the innovation process 	<ul style="list-style-type: none"> Energizer, recap & daily programme Harvesting from farm visit & conclusion Exercise – Identification of facilitation-related tasks/ situations 	<ul style="list-style-type: none"> Energizer, recap & daily programme Networking exercise My own role as an advisor (walk and talk) Evaluation (energy timeline) Next steps
AFTERNOON SESSIONS	<ul style="list-style-type: none"> Icebreakers Learning interests (learning diary) Introduction – Training overview & rules & AOB Visualization hints Exercise (Cross the river) Daily reflection (diary) 	<ul style="list-style-type: none"> Practical case (bottom-up and interactive innovation case) Tasks & competencies of advisors (brainstorming) Communication exercises (Distortion of message & Controlled dialogue) The 4 sides of a message Daily reflection (diary, pearls, puzzles) 	<ul style="list-style-type: none"> Introduction to the field tri Farm visit (introduction & interviews) 	<ul style="list-style-type: none"> Introduction to facilitation exercise Facilitation exercise (role playing) Facilitation - feedback Daily reflection (diary, pearls, puzzles) 	

Furthermore, an additional evaluation mechanism was introduced, based on questionnaires with close and open questions, filled in by trainees at the end of the in-person training. All the activities of the face-to-face course were recorded through a photographic documentation, including a brief comment and photographs of trainees performing each of them. The same principles of interactive, collaborative, transformational learning were applied to the online sessions, included energizers, short inputs from the trainers and work in small groups by trainees. The interactive presentation platform Mentimeter and the online whiteboard platforms MIRO and MURAL were used to record the results from the group work and trainees' reflections. The program was implemented as designed in the first summer school, while adaptations were introduced in the following ones. These resulted from trainees' (generally enthusiastic) feedback² and trainers' reflections. Specifically, the first summer school trainers pointed out the need for better explanation of the summer school objectives and key concepts (e.g. AKIS) and tools. They also suggested that more attention should be paid to group dynamics and, also, that trainees' quick and objective understanding of concepts and tools should not be taken for granted, despite their high educational level. Based on this, the introduced adaptations concerned the duration of the summer school, to provide more space/time to students to get better involved in the activities and deepen their understanding. Thus, it was decided the extension of the face-to-face course to five full days, also in response to trainees' request to ease the hectic pace of the first course. Although trainees also requested the inclusion of a wide range of additional topics (e.g. conflict management etc.), the trainers decided that it was necessary for the trainees to deepen their understanding and skills on the topics already included in the program. In parallel, an effort was made to avoid the introduction of difficult topics (e.g. four sides of a message) in the afternoon hours, when trainees' fatigue was increased. In addition, to expose the trainees to more real-life examples, two farm visits were organized in the last two summer schools (vs. one in the first school). Also, more examples (e.g. in the control dialogue exercise) were provided to better explain the tools and concepts used. For the same reason, two Teagasc advisors were invited to the third course to discuss the advisory work and the challenges in delivering innovation support services.

3.2 Roles of trainers and group dynamics

Based on the collaborative, learner-centered approach adopted in the i2connect summer schools, the role of the trainers was more to facilitate the learning process, moderate group dynamics and create favorable conditions for meaningful dialogue between participants and

much less to provide instructions and direct knowledge on the topics addressed. Thus, the trainers were guiding the educational process by briefly introducing each new topic and further explain it through examples and answers to the trainees' questions. Each topic was accompanied by a group activity, in which the groups had to select one of their case studies and analyze it based on the new knowledge. During the group activity the trainers were close by and available to support the working groups, elaborating aspects of the topic that were not understood well enough or not included in the introduction of the topic, but without responding to requests to provide the "right answers" or to express their personal understanding of the case. Adopting a facilitator role, the trainers created space for trainees to engage critically in their own learning by listening carefully to both their peers and trainers and experience the effort and the uncertainty that the development of collaborative knowledge entails. At the same time, the trainers abandoned much of the authority of the knowledge carrier that accompanies traditional lecturers. Though most trainees embraced and accepted this role, some among them in the course of various activities, requested "the right answers" and more "concrete knowledge" instead of exploring aspects and interpretations of reality. This caused some feelings of inefficiency in some trainers; the trainers with long experience in traditional education felt the impulse to return to the security of their traditional role, while the less experienced trainers felt that their competence as trainers was questioned. This also triggered a discussion in the trainers' team about the ways they could intervene to support more effectively the dialogue within the groups. This, in turn, led to the decision that trainers should carefully monitor the group dynamics and support the dialogue but not interfere in the groups' decisions, given that the dialogical process is a part of the hidden curriculum and shapes trainees' learning experience. Group dynamics involved the interactions developed between trainees, between trainees and trainers and between the trainers. All participants benefited from building relationships of respect and trust, that made all participants feel welcome, safe and comfortable. This was achieved through the overall 3-step design of each summer school and the inclusion of a sufficient number of team building activities (e.g. energizers) and informal activities that gave both trainees and trainers opportunities to discuss and get to know each other. Setting clear group rules was a fundamental element of the training program; these rules were more consistently applied after the first summer school, especially as regards the use of mobile phones. Groups dynamics included interactions that shaped the way the trainees assimilated new knowledge. For example, the activity "crossing the river" seemed to be internalized differently, with the trainees participating in the first and third courses ultimately emphasizing the value of being an active learner, while those in the second course, influenced by one of the trainees, also emphasized the value of inclusiveness and letting no one being left behind. Furthermore, the interactions between trainers benefited from the long acquaintance and the trust that they had already developed from previous collaborations. Trust and self-reflection helped them to harness peers' constructive criticism without questioning their motivation. Overall, in each summer school all trainers worked closely to plan the facilitation process, however usually each of them was responsible for developing some content and carrying out specific activities, taking in turn the lead of the facilitation process. On several occasions the most experienced trainers co-facilitated activities in pairs with great results. Also, the less experienced trainers developed and modified content together and co-facilitated activities with the one leading and the other supporting the facilitation process. This indicates that not only the trainees but also the trainers engaged in collaborative learning, improve their coordination and communication competence and their experience in interactive training facilitation.

4. Practical Implications

The study adds empirical evidence into the development of interactive educational programs for future advisors and the evolving role of university lecturers as interactive training facilitators. This evidence can contribute to the design and improvement of future educational programs and the integration of interactive training into traditional Higher Agronomic Education.

5. Theoretical Implications

The study emphasizes the importance of including collaborative interactive learning and systematic reflection in the design, the implementation and evaluation of educational programs.

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6. References

- Knierim, A., Gerster-Bentaya, M., Mekonnen Birke, F., Bae, S. & Kelly, T. (2020). Innovation advisors for interactive innovation process: Conceptual grounds and common understandings. I2CONNECT, Deliverable 1.1 Available online at: https://i2connect-h2020.eu/wp-content/uploads/2021/09/i2connect_Final_Deliverable-1.1_correctedversion.pdf Wielinga, E. & Sjoerd, R. (2020). Energizing networks. Tools for co-creation. Wageningen, NL: Wageningen Academic Publishers.
- Zarokosta, E., & Koutsouris, A. (2024). Building Advisors and Researchers' Capacity to Support Agricultural Knowledge and Innovation Systems in Europe: The Case of the I2CONNECT Summer School. *Proceedings*, 94(1), 33. <https://doi.org/10.3390/proceedings2024094033>

The use of official tools in university education for the practice of rural extension: An educational experience with the National Registry of Family Farming (ReNAF)

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Short abstract

The pedagogical experience implemented within the course "Sociology and Rural Extension", part of the fourth year of the Agricultural Engineering degree at the National University of Chilecito, aimed to integrate rural extension practices within real-world contexts. To this end, the National Registry of Family Farming (ReNAF)—an official tool developed by the National Institute of Family, Peasant and Indigenous Agriculture (INAFCI)—was employed as the central methodological framework. Students introduced this instrument within rural

communities, completing ReNAF forms in order to register producers for public programmes designed to strengthen family farming.

This activity enabled a departure from traditional educational approaches through the use of practical and participatory methodologies. Furthermore, it was supported institutionally by INAFCI and the National Institute of Agricultural Technology (INTA), thereby enhancing its legitimacy. The registration process was carried out in the department of San Blas de los Sauces, La Rioja Province, Argentina, where students developed territorial engagement skills and forged stronger ties with local producers and organisations.

The experience concluded with the production of a technical report on the state of Family Farming in the department, and the establishment of the Family Farming Observatory. It is concluded that this type of practice reinforces the theory/practice nexus, holds potential for replication across other disciplines, and addresses the theoretical limitations in the academic training of future extension professionals.

1. Purpose

The present initiative aimed to undertake rural extension practices within real-world contexts, with the objective of addressing the limitations identified in Latin American university education concerning rural extension work. These include the insufficient coverage of extension-related content, an overemphasis on theory, and the predominance of linear approaches (Landini, F., 2020). Such limitations manifest as shortcomings perceived by extension practitioners based on their personal professional experiences. The utilisation of the National Registry of Family Farming (ReNAF) forms as a central methodological tool in this experience served not only to enhance technical assistance for families within the sector but also to enrich the national database with new information from the Department of San Blas de los Sauces.

2. Design

The structure of the experience centred on the active participation of students in presenting and disseminating information about the National Registry of Family Farming (ReNAF) to rural communities. Students also conducted surveys and registered families interested in being recognised as family farmers by the National Government. It is important to note that registration in ReNAF not only enables families to access specific public policies, but also contributes to a more comprehensive characterisation of the sector through the collection of data on Family Farming Units (NAF), one of the registry's core functions.

This initiative emerged from the extension work of the lecturer and author of this study, within the scope of her professional role at the National Institute of Family, Peasant and Indigenous Agriculture (INAFCI). The experience was made possible through funding from a university extension project submitted by the course and the National University of Chilecito (UNDeC) to the Secretariat for University Policies (SPU), an agency under the Argentine Ministry of Education responsible for the planning and coordination of university policy.

The project was carried out by students currently enrolled in the course, as well as by more advanced students who maintained an ongoing connection with it. The initial engagement with ReNAF took place in the classroom, through a theoretical-practical approach supported by audiovisual materials. Using a paper version of the registration form (see Annex 1: "ReNAF Registration Form and Official Leaflet") and a shared reading activity, students examined the variables defining the sector, the registration requirements, legal and socio-productive aspects, gender considerations, and the general structure of the survey.

Once familiar with the ten thematic axes of the survey and the operational aspects of the data collection process, students were encouraged to reflect critically on the strategic importance of this tool for the family farming sector. Discussions covered both the significance of

obtaining up-to-date information on the sector for the first time and the potential benefits for registered families and for the broader characterisation of Argentine family farming.

It is important to clarify that registering families does not automatically ensure their inclusion in ReNAF. Once the data are entered into the official online system, the National Government evaluates the applicants' profiles and decides on the acceptance or rejection of their registration based on variables such as household income, number of livestock, and others.

Fieldwork was conducted in the Department of San Blas de los Sauces, in the province of La Rioja, Argentina (see Annex 2: "Geographical Location of the Project"), where the extension lecturer was professionally active. In procedural terms, the lecturer and author was responsible for organising in-person meetings with local producers' organisations. During the first meeting, students presented the features and scope of ReNAF using accessible language and supporting materials. They also answered questions, learned about the daily work of farmers, and independently established ongoing communication channels via WhatsApp.

As part of the ReNAF presentation in the livestock posts of the Valle del Pipanaco (Aimogasta, La Rioja), students interacted with the Director of the INTA Aimogasta Rural Extension Agency (AER INTA), who acted as a "key technician" to facilitate access to the local community (see Annex 3: "ReNAF Presentation in Valle del Pipanaco").

In subsequent meetings, producers from the "Association of Small-Scale Walnut Growers of San Blas de los Sauces" and the "Association of Small-Scale Agricultural and Livestock Producers" of the same department were registered, always with the support of teaching staff (see Annex 4: "Registration in San Blas de los Sauces").

The data collected via the forms comprised both qualitative and quantitative socio-productive and economic information, based on closed-ended questions from the ReNAF survey. A total of 30 printed forms were used, although not all were completed by the students.

Resources available for fieldwork included a portable whiteboard with tripod, markers, journalist-style voice recorder, projector, laptop, extension lead, mobile phone camera, notebooks, and calculators.

Data entry and processing were conducted using an Excel spreadsheet, in which each row represented a survey response and each column corresponded to a variable from the instrument.

3. Findings

Through the project, a total of thirty (30) registrations were completed, although not all were carried out directly by students due to constraints on institutional travel and limited contact hours. It was not possible to determine how many of these registrations ultimately resulted in official enrolments, owing to the discontinuation of INAFCI's national operations following administrative changes implemented by the new government as of 1 April 2024.

Participating students had the opportunity to engage in core rural extension activities, developing competencies for conducting official surveys in real-world contexts. This experience enabled them to establish direct connections with the territory and its social actors—such as producers and family farming organisations—fostering a meaningful exchange of knowledge and relationships that have endured over time. In addition, students interacted with extension professionals from public institutions dedicated to rural development, such as INAFCI and the National Institute of Agricultural Technology (INTA), which afforded them insight into the importance of coordinated inter-institutional work in local territories.

Students reported feeling motivated and satisfied with their involvement in activities beyond the classroom setting.

The team also took part in the city's Book Fair, where they presented an institutional project banner at the stand of the National University of Chilecito.

Using the information collected, the lecturer prepared a report characterising Family Farming in the department of San Blas de los Sauces, which will be shared with producers and local government authorities. This report led to the creation of the Family Farming Observatory, which is currently coordinated by the course.

As a result of this experience, interest has emerged in extending the characterisation of Family Farming to other departments within the province of La Rioja. To that end, the signing of a cooperation agreement has been proposed with the People's University (Universidad Popular), an institution affiliated with the social movement *Barrios de Pie*.

It is anticipated that these initiatives will give rise to new lines of work and research, the outcomes of which may serve as valuable, ongoing reference sources.

4. Practical Implications

The results of the experience confirm that rural extension practices carried out in real-world contexts constitute a valid and highly valued pedagogical strategy among students. These practices, when integrated with the use of official tools inherent to the extension work undertaken by lecturers and professionals, allow for an increase in practical training hours relative to theoretical instruction. Furthermore, they promote the integration of theory and practice, reshape students' perceptions of rural extension work, strengthen effective communication skills, encourage group cohesion, facilitate an understanding of inter-institutional collaboration, and foster values such as empathy and solidarity.

Real-world extension experiences, alongside critical extension approaches, place emphasis on "ensuring that university graduates possess the knowledge, capacities, skills, and both technical and human competencies required to actively, justly, critically, and transformatively contribute to the resolution of socio-cultural issues" (Monge Hernández, C., 2022).

The use of official tools adds value to the pedagogical strategy by generating benefits—some of which are indirect—for rural communities, producers' organisations, governmental agencies, and public and educational institutions.

5. Theoretical Implications

Based on the experience, it can be inferred that future professionals who engaged in extension activities within real-world contexts are likely to exhibit a lower degree of deficiencies in their extension practice. This is attributable to their initial acquisition of knowledge concerning territorial engagement approaches, participatory and group work, and the value of knowledge exchange.

The promotion of extracurricular activities that connect students with diverse social actors, a re-evaluation of the balance between theoretical and practical hours within curricula—in favour of the latter—and the strengthening of ties between lecturers, extension practitioners, and the tools inherent to extension and development, all constitute essential pedagogical strategies. These measures contribute to the mainstreaming of extension within university education and to the training of professionals with territorial awareness and a strong sense of social commitment.

6. References

- Landini, F. (2020). Límites y potencialidades de la formación universitaria en América Latina para la práctica de la Extensión Rural. *Educação e sociedade*. Educ. Soc. 41, 2020. <https://doi.org/10.1590/ES.218569>
- Ministerio de Agricultura, Ganadería y Pesca, Dirección de Tecnologías de la Información y las Comunicaciones. ReNAF. <https://renaf.magyp.gob.ar>
- Monge Hernández, C. (2022). Aportes de la extensión universitaria a la formación estudiantil: Estudio de caso de la Universidad Nacional de Rosario (UNR), Argentina. *Saberes y*

prácticas. *Revista de Filosofía y Educación* / ISSN 2525-2089 Vol. 7 N° 1 (2022) / Sección Dossier / pp. 1-22 / DOI: <https://doi.org/10.48162/rev.36.051>

Yardley, S.; Teunissen, P.; Dornan, T. (2012). Experiential learning: Transforming theory into practice. *Medical Teacher, Abingdon*, v. 34, n. 2, p. 161-164, 2012.» <https://doi.org/10.3109/0142159X.2012.643264>

Asynchronous collaborative student engagement to foster development of communication and innovation skills at fourth level

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Short abstract

Employers increasingly value advanced communication, analytical, and problem-solving skills—areas often underemphasized in traditional university curricula. To address this gap, we introduce a 10-credit master's module in Animal Science focused on developing critical thinking, collaboration, and transferable communication and innovation (C&I) skills. Delivered virtually and asynchronously, the module engages students with multidisciplinary experts, real-world problem-solving, and reflective practice. Students begin by exploring the importance of C&I skills, then define a personally relevant problem to address through a business canvas. Coaches, consultants, academics, and industry experts—including journalists and a health psychologist—guide students in building their C&I toolbox, enhancing stakeholder communication, and understanding behavioural change. A real-world business canvas example from a recent start-up further contextualizes learning. Students then present their own canvas and submit a reflective piece to assess metacognitive growth. This module complements traditional teaching by equipping students with the practical skills needed to innovate and lead in the rapidly evolving animal science sector.

1. Purpose

Communication and innovation skills are focal competencies for future Animal Science graduates, according to an employer survey conducted during the development of a new MSc in Animal Science at University College Dublin. Supported by similar findings from the literature (Norris-Parish et al., 2024; Zinn, Faustman, & Riesen, 1993), we therefore crafted a tailored novel module for the following purposes:

- To improve student awareness of the need to develop and tailor their communication skills to achieve personal and business objectives as well as to optimise leadership employment opportunities.
- To understand the connectivity between communication and innovation in terms of articulating a clear, concise problem and a potential solution using active learning techniques.

- To allow students to independently and collaboratively experience phases of an innovation process through sharing the pertinent, real-world experience and stories of other professionals and thereby gain inspiration and encouragement for joining the workforce with critical thinking skills to succeed in their career.
- To develop confidence in the use of appropriate tools and technologies including innovation frameworks to support student-driven innovation and follow that through to presenting the concept for peers and professionals with a view towards implementation.
- To develop their reflective practice as a life tool to understand personal growth and opportunities for improvement.

2. Design

The design of the module was based on the pedagogical literature and expertise of the professional participants who were actively involved in the co-design. A key focus had to be the successful delivery on learning outcomes in an exclusively online format. The key novel features of the approach included the following features:

- *Transformative* – Students were encouraged to view communication and innovation skills as relevant not just to their careers but to their life in general. The module leaders also advocated for a change of perspective from viewing these as ‘soft’ skills to one where C&I skills acquisition require maintenance, practice and as a core component of lifelong learning. The ability to tailor communication approaches to the desired audience was shown as critical (Bates, Brenner, Schmid, Steiner, & Vogel, 2022).
- *Asynchronous* – To circumvent real barriers with access to education⁴, and to facilitate participants in employment, the content was designed for asynchronous delivery. Asynchronous delivery necessitated the recording of the modules. Student feedback consistently rated the ability to control access to the lecture material at a time of their choosing as important.
- *Collaborative* – It was critical to harness the collaborative expertise of industry professionals, with diverse approaches and experiences to illustrate the connectivity between communication and effective change (behavioural change theory) and as a key tool in innovation. Collaboration between students was also fostered through collaborative tools and peer working assignments in between expert talks to facilitate the practice of the knowledge acquired.
- *Reflective* – “We don’t learn from our experiences, we learn from reflecting on our experiences” – John Dewey, American Philosopher. Students were asked to dwell on their C&I journey as a means for them to appreciate their progress and support the development of metacognitive skills (Schraw & Dennison, 1994), (Battisti, Passmore, & Sipos, 2008).
- *Practical* – Using a Business Model Canvas, Design Thinking elements (and a variety of digital tools e.g. Canva, Mural, etc.), students developed a suite of practical tools in the design a new product or service, which they then present to the class and mentors to illustrate their newly enhanced communication and innovation skills (Bitar & Davidovich, 2024).

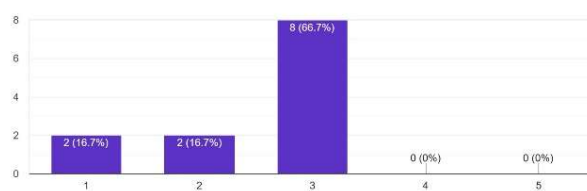
3. Findings

Following the 12-week module in 2023 and 2024, all students were issued an opportunity to participate in a survey assessing key aspects of the C&I module including satisfaction, workload, measures of improvement in C&I skills prior and post-module, assessment of group work and presentation skills of career relevance and suggestions to improve the module. Responses from n=12 students were obtained and selected results are shown in Figure 1.

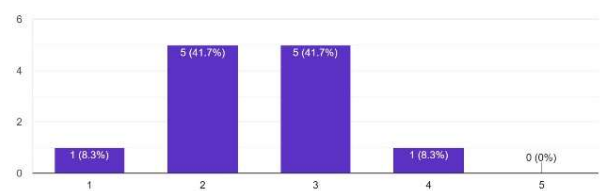
⁴ https://www.esri.ie/system/files/publications/BKMNEXT138_1.pdf

A clear shift in skills improvement was noted as well as the acquisition of career-relevant skills and a change in attitude toward entrepreneurship. Key statements from students include *“It was better than what I expected”* and *“I found the module extremely helpful in terms of career direction and self-improvement”*. Another student said *“It definitely gave me more confidence speaking in public, even online. It gave me more skills in preparing a presentation also”* and *“Presentation pitch was good to see so many innovative ideas amongst the class and also to engage with one another”*.

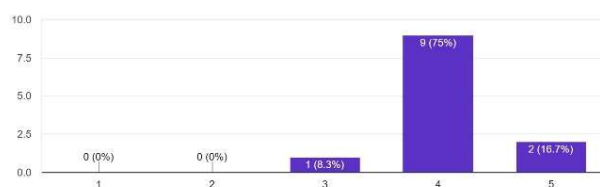
Question 3A: How would you have rated your communication skills PRIOR to taking the module
12 responses



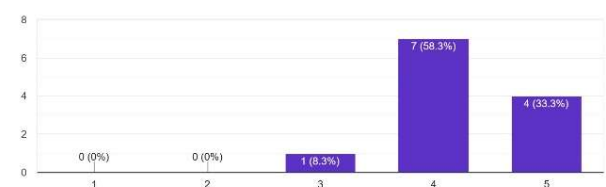
Question 4A: How would you have rated your knowledge of innovation PRIOR to taking the module
12 responses



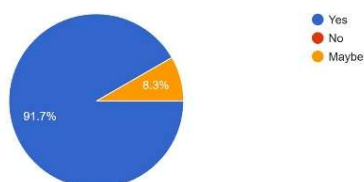
Question 3B: How would you have rated your communication skills AFTER to taking the module
12 responses



Question 4B: How would you have rated your knowledge of innovation AFTER to taking the module
12 responses



Question 12: Do you think this module gave you skills of relevance to your career?
12 responses



Question 20: After the business model canvas, do you now think differently about your potential to be an entrepreneur?
4 responses

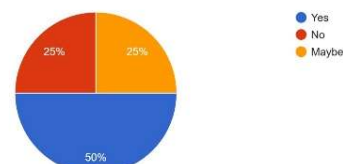


Figure 1: Summary of selected feedback collected from participants after 12-week module

4. Practical Implications

The agricultural sector is facing issues of immense importance which will impact on sustainability and security of the food chain and ultimately on global security. Transformation at all levels is required to achieve our collective aims – that includes transformation in preparation of students for productive engagement across all levels of society. In the post-Covid era, students themselves recognise the need for improved theory and on-going practice in communication skills which endows them with the confidence to engage in an increasingly complex world. In addition, the deluge of technologies now available means that continual professional development and lifelong learning will be a key feature of competency in this domain. The reputation of graduates from university will increasingly be impacted by the C&I skills of graduates and well taught students will outcompete others to occupy leadership positions and will therefore be high impact individuals. Additionally, a key message from employers was that communication skills can make the difference between securing a job and not and therefore it is essential that universities provide cutting edge skills delivered by leading experts in this domain.

5. Theoretical Implications

The curricula in Animal Science requires constant examination and updating to prepare students for an increasingly challenging and complex world (Kauffman, 1992; Meade, 2023). Curriculum design needs to reflect the revolution that has occurred in recent years since the pandemic, and with subsequent changes in the university learning environment, specifically with a sustained online teaching experience (Zhao & Watterston, 2021). With technological advances embedded in smart agriculture, including the increasing use of artificial intelligence (AI), no longer can transferable C&I skills take a back seat to curriculum-specific subjects. Student-staff co-creation of curriculum is the future (Bovill & Woolmer, 2019) and curriculum “connectivity” is required to equip future animal scientists to occupy leadership positions in industry and deliver on the urgent ambition for more sustainable food systems (Sørensen, Germundsson, Hansen, Rojas, & Kristensen, 2021). Curriculum reform as outlined here as well as flexible, online CPD courses are advocated to urgently address the need for in C&I in the animal science sector. In addition, the practice of reflection was introduced and applied as students used Rolfe, *et al* (Rolfe, Freshwater, & Jasper, 2001) to consider their experiences in learning throughout the course. The use of this model helped students benchmark their progress as it encourages critical thinking and self-structured self-awareness. According to Moon (Moon, 2009), a reflective practice when used by students leads to deeper learning and understanding, improved problem-solving capacity, improved emotional intelligence and better preparation for lifelong learning. Thus, this module can lead to transformative learning of multi-domain relevance resulting in lifelong impact.

6. References

- Bates, R., Brenner, B., Schmid, E., Steiner, G., & Vogel, S. (2022). Towards meta-competences in higher education for tackling complex real-world problems – a cross disciplinary review. *International Journal of Sustainability in Higher Education*, 23(8), 290-308. doi:<https://doi.org/10.1108/IJSHE-06-2021-0243>
- Battisti, B. T., Passmore, C., & Sipos, Y. (2008). Action Learning for Sustainable Agriculture: Transformation through Guided Reflection. *NACTA Journal*, 52(2), 23-31. Retrieved from <http://www.jstor.org/stable/43766961>
- Bitar, N., & Davidovich, N. (2024). Transforming Pedagogy: The Digital Revolution in Higher Education. *Education Sciences*, 14(8), 811. Retrieved from <https://www.mdpi.com/2227-7102/14/8/811>
- Bovill, C., & Woolmer, C. (2019). How conceptualisations of curriculum in higher education influence student-staff co-creation in and of the curriculum. *Higher Education*, 78(3), 407-422. doi:10.1007/s10734-018-0349-8
- Kauffman, R. G. (1992). Modernizing the animal science curriculum: is change needed? *Journal of Animal Science*, 70(8), 2593-2596. doi:10.2527/1992.7082593x
- Meade, K. G. (2023). The increasing relevance of immunobiology within a connected animal science curriculum. *Transl Anim Sci*, 7(1), txad007. doi:10.1093/tas/txad007
- Moon, J. A. (2009). *A handbook of reflective and experiential learning: theory and practice*. London: RoutledgeFalmer.
- Norris-Parish, S. L., Leggette, H. R., Pesl Murphrey, T., Parrella, J. A., Richburg, A., & Herring, A. D. (2024). Beefing up communication skills of upper-level animal science students. *Transl Anim Sci*, 8, txae007. doi:10.1093/tas/txae007
- Rolfe, G., Freshwater, D., & Jasper, M. (2001). *Critical Reflection for Nursing and the Helping Professions: A User's Guide*: Palgrave MacMillan.

-
- Schraw, G., & Dennison, R. S. (1994). Assessing Metacognitive Awareness. *Contemporary Educational Psychology*, 19(4), 460-475. doi:<https://doi.org/10.1006/ceps.1994.1033>
- Sørensen, L., Germundsson, L., Hansen, S., Rojas, C., & Kristensen, N. (2021). What Skills Do Agricultural Professionals Need in the Transition towards a Sustainable Agriculture? A Qualitative Literature Review. *Sustainability*, 13, 13556. doi:10.3390/su132413556
- Zhao, Y., & Watterston, J. (2021). The changes we need: Education post COVID-19. *J Educ Chang*, 22(1), 3-12. doi:10.1007/s10833-021-09417-3
- Zinn, S. A., Faustman, C., & Riesen, J. W. (1993). Developing Oral Communication Skills in Animal Science Classes. *NACTA Journal*, 37(4), 14-17. Retrieved from <http://www.jstor.org/stable/43765170>

Session 2B
NETWORKS – MAA

Role of social network for the diffusion and adoption of Climate Smart Agricultural technologies in Bangladesh**Md Rezaul Karim¹, Andreas Thiel², Mohammad Anamul Haque³**¹ Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh² University of Kassel, Germany³ Cosmic Agro Ltd, Uttara, Dhaka, Bangladesh

Short Abstract

This study aims to unravel the intricate network measures underlying the diffusion and adoption of Climate-Smart Agriculture (CSA) technologies. By conducting personal interviews with both Common Interest Group (CIG) and non-CIG farmers, the researcher gathers rich data on the key actors involved in the diffusion process in the northern Bangladesh. The data analysis for the network visualization was done by Gephi software. Pearson's correlation coefficient was estimated to explore the centrality measures that can significantly affect the adoption of CSA technologies by SPSS software. The findings reveal compelling insights into the structure and functioning of diffusion networks for CSA technologies. Central actors within these networks emerge as influential figures, playing pivotal roles in disseminating knowledge and catalysing adoption among their peers. The results highlight the role of social networks in shaping farmer's adoption decisions, as connections to influential peers and access to relevant information significantly influence the CSA adoption. Overall, the findings show the intricate interplay between social networks and CSA technological adoption, emphasizing the need for targeted interventions that leverage existing social structures to promote CSA uptake effectively.

Key words: Adoption, Pheromone Trap, Vegetables Cultivation and Bangladesh

1. Purpose

The demand for the transformation of agricultural innovation is urgent and worldwide. Innovation diffusion system plays a crucial role in agricultural development by providing update-to-date knowledge and technologies. Innovation diffusion among farmers is not only the adoption of a new technology made by farmers, but a process of communication and coordination between different actors or information sources (Wu & Zhang, 2013). It is agreed that linear diffusion is poorly equipped to deal with the risks and constraints faced by farmers (Pretty & Chambers, 1994). More recently innovation diffusion is theorized as complex outcome of open-ended interactions by building network (Valente, 1995). This study focuses on the role of social networking for the diffusion of individual Climate Smart Agricultural (CSA) technologies. The purposes of study are to determine the key actors and to determine network characteristics in the diffusion of CSA technologies.

2. Methodology

The research was conducted in the Dinajpur district of Northern Bangladesh. This study follows the socio-centric mode of network within a defined boundary at micro level in the village. Data collection was done through personal interviews of each of the sampled and listed farmers based on the question: “what do know (e.g., name of technologies, how to use it and what are purposes of use?) about this specific CSA technology. The intensity/strength of relationship for between two actors was weighed by three-point (1 to 3) Likert scales such as Regularly (contact 2-3 times per week); Often (contact 2-3 times per month) and Sometimes (contact 2-3 times per season). The data analysis such as density, degree, betweenness, closeness and eigenvectors centralities were calculated by Gephi software.

3. Findings

The results give an opportunity to compare the role of network among three CSA technologies, namely, drought tolerance crops (DTC), pheromone trap (PT), and vermicompost (VC). The findings related to degree centrality and weighted degree indicate that the choice of information actors and the intensity of communication are varied (Table 1). The findings related to betweenness, and eigenvector centrality indicate that influential actors or brokers also differ according to the types of CSA technologies. In terms of similarity, demonstration acts as an important broker for the diffusion of all three CSA technologies. In terms of dissimilarity, field day is an important broker for the diffusion of DTC only.

Table 1: Role of centralities for the adoption climate-smart technologies

Network measures	Pearson's correlation coefficients (r) with the adoption of-		
	Drought Tolerant Variety	Pheromone Trap	Vermicompost
Degree Centrality	0.326 ^{**}	0.263 [*]	0.205
Weighted Degree	0.314 ^{**}	0.245	0.233 [*]
Closeness Centrality	0.218	0.262 [*]	0.283 ^{**}
Betweenness Centrality	0.355 ^{**}	0.227	0.162
Eigenvector Centrality	0.327 ^{**}	0.304 [*]	0.278 [*]

^{**}Correlation is significant at the 0.01 level (2-tailed). ^{*}. Correlation is significant at the 0.05 level (2-tailed).

4. Practical & Theoretical Implications

This study provides an empirical contribution to literature by applying social network approach to investigating the role network characteristics in the diffusion of CSA technologies. The results suggest that affiliation and participation in field day, meeting, and demonstration as well as frequent communication with group leaders and lead farmers are crucially important for the diffusion of individual CSA technologies. Furthermore, research on social network analysis could be conducted in different contexts in comparison manner for the diffusion of different CSA technologies.

5. References

- Pretty J.N., & Chambers R. (1994). Towards a learning paradigm: new professionalism and institutions for sustainable agriculture. In : Scoones I, Thompson J, editors. *Beyond Farmer First*. London: Intermediate Technology Publications. 182–202.
- Valente, T. (1995). *Network models of the diffusion of innovations*. Cresskill New Jersey Hampton Press.
- Wu, B., & Zhang, L. (2013). Farmer innovation diffusion via network building: a case of winter greenhouse diffusion in China. *Agriculture and Human Values*, 30, 641–651.

The functioning and potential of European Online Advisory Networks: the case of short food supply chain advisors.

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Short abstract

The European Union has supported the establishment of several Online Advisory Networks (OANs) aimed at strengthening the role and skills of agricultural advisors across the EU. As significant resources are invested in building these networks, this paper explores the functioning, potential, and future sustainability of OANs in facilitating a well-connected and effective EU-wide advisory system.

The case study focuses on the EU Horizon twin projects, COREnet and EU4Advice, which are jointly developing an OAN for advisors working in short food supply chains (SFSCs). The findings highlight the value of a multi-actor approach in encouraging the registration and engagement of 480 SFSC advisors across 27 EU Member States. Approximately 60% of the registered individuals refer to themselves as informal advisors and the majority works for professional organisations (73%). Small primary producers is the predominant target group for advice. Given the general lack of SFSC-specific advisory knowledge, a European OAN represents a valuable asset for fostering knowledge sharing and information flow among advisors. However, active network facilitation is essential to remain relevant to advisors and to prevent the spread of misinformation. This study is relevant for supporting SFSC advisors and informing the EU's ongoing efforts to ensure the future sustainability and effective management of OANs.

1. Purpose

Online Advisory Networks (OANs) are a valuable asset for knowledge transfer and information flow among advisors, helping to support innovative ideas, drive innovation, and translate needs into new activities. These networks leverage digital technologies to connect advisors with farmers, experts and peers. Unlike traditional physical networks, OANs operate through online platforms that enable real-time communication and information sharing across regions and countries. These platforms support the exchange of best practices, guidance on market access, and sustainability measures, thereby enhancing the overall efficiency of the food system (Gruchmann et al., 2019).

Agricultural advisors play a crucial role in the sector, acting as intermediaries between farmers and a wide range of knowledge sources to improve productivity and sustainability (Charatsari et al., 2022). Their role and skill set have evolved in response to shifts in agricultural practices and technologies, particularly in the context of short food supply chains (SFSCs) (Huang et al., 2014). Digitalization significantly enhances the capacity of agricultural advisors, as digital tools, data management systems, and online communication can improve both productivity and sustainability (Fielke et al., 2020; Charatsari et al., 2023). Advisors who effectively use digital platforms can deliver timely and relevant information to farmers, supporting improved decision-making (Lybaert et al., 2022).

In recent years, the European Union (EU) has actively supported the development of online professional networks across various sectors such as environmental technology and health care. EU Horizon-funded OANs in agriculture are multi-actor projects that connect advisors across all EU Member States in a European-wide network. These networks aim to (EU CAP Network, 2025):

- Help advisors stay up to date with cutting-edge knowledge and innovations;
- Facilitate opportunities for knowledge exchange and experience-sharing on how to best address challenges or capitalize on opportunities on farms, in forests, and in rural communities.

These networks are designed to foster collaboration among advisors and stakeholders throughout the EU, ensuring that best practices are disseminated and innovative solutions co-created to support farmers (EU CAP Network, 2025). OANs can equip agricultural advisors with the necessary skills to support farmers effectively and help create an inclusive online environment. However, they must also be mindful of and work to prevent the spread of misinformation, disinformation, and malinformation (Chowdhury et al., 2023).

This communication aims to shed light on these emerging OANs by investigating their functioning, potential, and future sustainability in contributing to a well-connected and effective EU-wide advisory system. It does so through the case study of COREnet and EU4Advice, two EU Horizon projects jointly developing an OAN for advisors in short food supply chains.

2. Design

The case study analyses the EU Horizon twin projects COREnet and EU4Advice, which are jointly developing an Online Advisory Network (OAN) for advisors in short food supply chains (SFSCs). SFSCs are characterized by a reduced physical and social distance between producers and consumers, often involving fewer intermediaries. This structure fosters more direct relationships between farmers and consumers, enhancing transparency and trust in the food system (Jia et al., 2024). SFSCs can also promote local economies and support sustainable agricultural and food production (Menéndez i Molist et al., 2025), while preserving local agricultural traditions and food practices (Bayir et al., 2022). There is growing interest in SFSCs within European policy frameworks, aimed at strengthening local food systems and improving food security (Van Der Ploeg et al., 2020). However, a major barrier to scaling SFSCs is the knowledge gap among farmers across all stages—from production to consumption—which highlights the need for effective advisory and support services. A further challenge is the limited recognition of SFSCs by larger advisory organisations, which can hinder the effectiveness of SFSC-specific advising (Charatsari et al., 2024). These challenges underline the rationale for creating a pan-European SFSC advisory network.

The OAN developed by COREnet and EU4Advice aims to promote peer-to-peer learning, which is particularly important in SFSC advising due to the direct producer–consumer interactions involved. The methodology for building the SFSC OAN is based on the Multi-Actor

Approach (MAA), which seeks to involve a wide range of stakeholders. The key steps of this ongoing effort include:

- i. Identifying SFSC advisors and advisory organisations across the public, private, and civil society sectors in all 27 EU Member States;
- ii. Inviting them to register for the SFSC OAN via an online form;
- iii. Creating an online contact database of advisors;
- iv. Informing and inviting advisors to participate in project initiatives;
- v. Providing information and materials to help develop their skills and competencies in SFSC advising.

The advisory database, available on the COREnet website, includes advisors' names, countries/locations, scale of operation (e.g., regional, national, international), organisations, websites, and details on their skills, competencies, tools, practices, and services related to SFSC advising. Advisors were also asked to categorize themselves as either:

- Formal advisors: Professionals formally engaged in advisory roles across the private, public, and third sectors;
- Informal advisors: Individuals offering advice in an ancillary or informal capacity, often secondary to their main occupation.

Registrants were also asked to indicate the focus areas of their work related to SFSCs, such as business planning, partnerships and knowledge exchange, legal and regulatory compliance, production and processing, packaging, distribution and logistics, marketing, technology, digital data. They were also asked about their primary target groups—i.e., the stakeholders they work with most frequently, for example small primary producers and processors, organic farmers, food hubs, catering providers, tourism operators, retailers, final consumers, educators, etc.

The mapping and scouting initiative was launched by the COREnet and EU4Advice partners in 2023 and remains ongoing, with the aim of achieving a strong and broad representation of advisors from every EU Member State by the projects' completion in 2027. In addition, both projects have engaged SFSC experts and advisors through physical and hybrid meetings, such as the COREnet European Roadshows (held to date in Belgium, Italy, Portugal, and Hungary) and the EU4Advice Living Lab activities (in Hungary, Ireland, Spain, and the Netherlands).

A wide range of informational materials has been collected and produced by the COREnet project to support knowledge sharing within the OAN. For example, the "Golden Cases" provide examples of SFSC advisory models and best practices. These, along with periodic updates, news, and training materials, form the foundation for ongoing and planned information dissemination and capacity building for SFSC advisors connected to the OAN.

3. Findings

So far, the effort has resulted in 480 SFSC advisors registering in the OAN. The distribution of registered advisors across EU countries is shown in Figure 1. Almost all EU Member States are represented, with the exception of the Czech Republic and Denmark. This is likely due to limited outreach efforts in these countries to date.

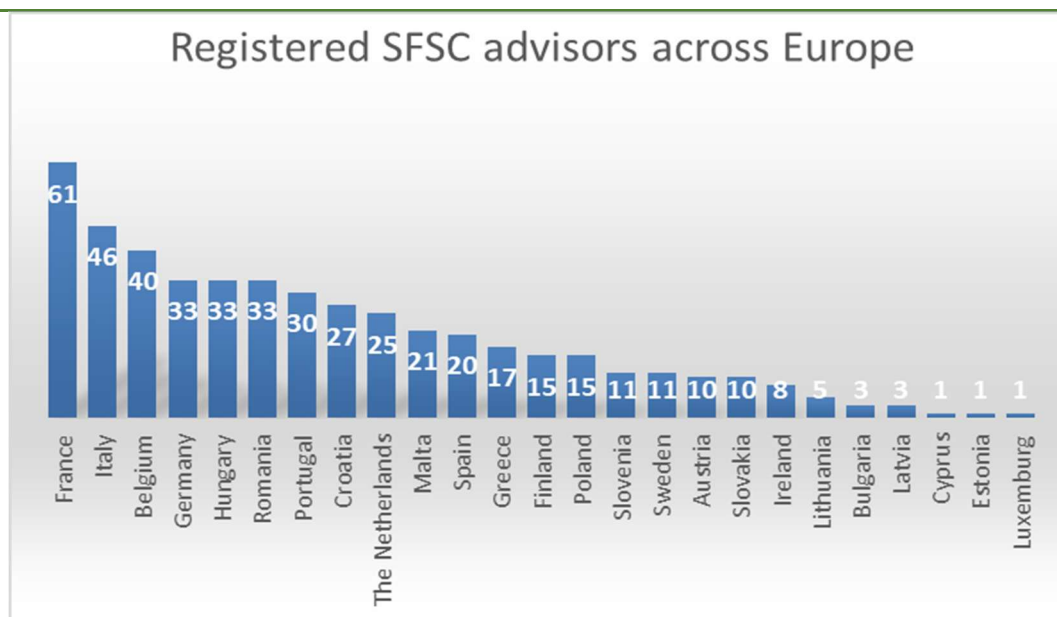


Figure 1: Registered advisors in the SFSC OAN from EU countries

An analysis of the advisor profiles reveals that a majority—approximately 60%—of registered individuals identify as “informal” advisors. This implies that, while they regularly provide advice and support to other actors within SFSCs, their official job titles do not designate them as advisors. Most of these individuals work for various professional organizations (e.g., national farmers' organizations). Discussions among project partners across different EU countries have highlighted that the nature and positioning of SFSC advisory activities within agricultural knowledge and innovation systems (AKIS) varies significantly between Member States. Interestingly, the results show that both “formal” and “informal” advisors report very similar target groups and focus areas for their advisory activities. Although there is a difference in numbers among registered formal and informal advisors, their focus of advice is almost similar, having partnerships and knowledge exchange, business planning, regulatory compliance, production and processing, branding and marketing as the most covered fields (each area was selected by almost 14% of respondents). The target group for advice most selected by registered advisors was small primary producers (15%), followed by organic farmers, small scale food processors and consumers (almost 10% per each category).

The findings also indicate that a vibrant and active online network does not automatically emerge simply because a large number of users have registered. Active facilitation is required from those managing the OAN to stimulate information flow, knowledge sharing, and member engagement. For example, simply inviting users to events—such as the hybrid COREnet European Roadshows—resulted in only limited participation. The number of registered advisors (Figure 1) was not significantly higher in countries that hosted either a COREnet European Roadshow or EU4Advice Living Lab activities.

Furthermore, shortcomings have been pointed out in the technical solution for the database, which makes it difficult for registered individuals to update their own information and keep it current. The many different languages spoken across the EU27 may also pose a barrier that needs to be addressed through direct translation or other technical solutions to overcome language obstacles between people who speak different languages.

4. Practical Implications

Despite the potential of OANs, several challenges remain. For instance, group moderation and policy interventions are necessary to prevent the spread of misinformation through OANs and other online sources (Kankanamge et al., 2025). Additional barriers include digital literacy gaps, infrastructure deficits, and cybersecurity risks, all of which can hinder the widespread adoption and long-term sustainability of these systems (Bui et al., 2024; Morepje et al., 2024). Addressing these challenges requires focused capacity building to ensure the quality and trustworthiness of shared information. Furthermore, if the EU intends to integrate several OANs into a common platform, policy support and investments in hosting, management, and facilitation capacities will be essential.

5. Theoretical Implications

Knowledge flow and collaboration are essential for advancing agricultural sustainability, and OANs can play a vital role—if managed effectively. Given the growing policy interest in SFSCs across Europe and the existing gaps in SFSC-related knowledge sharing, the SFSC OAN represents a significant opportunity. This study is among the first to evaluate an EU-funded OAN, and as such, the findings are preliminary due to the ongoing nature of the implementation process. Continued research and development will be critical to overcoming the challenges faced by SFSC advisors and to informing the design and management of future EU-funded OANs.

Acknowledgement

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6. References

- Bayir, B., Charles, A., Sekhari, A., & Ouzrout, Y. (2022). Issues and Challenges in Short Food Supply Chains: A Systematic Literature Review. *Sustainability*, 14(5), 3029. <https://doi.org/10.3390/su14053029>.
- Bui, H. T., Yan, S., Islam, Z., Islam, R., Bewong, M., Singh, D., Aboutorab, H., Gauravaram, P., Sultan, N. H., Parvez, M. Z., Gao, Y., Mahboubi, A., Chauhan, A., Camtepe, S. A., & Ali Babar, M. (2024). Agriculture 4.0 and beyond: Evaluating cyber threat intelligence sources and techniques in smart farming ecosystems. *Computers & Security*, 140, 103754. <https://doi.org/10.1016/j.cose.2024.103754>
- Charatsari C., Lioutas, E.D., Papadaki-Klavdianou, A., Michailidis, A. & Partalidou, M. (2022) Farm advisors amid the transition to Agriculture 4.0: Professional identity, conceptions of the future and future-specific competencies. *Sociologia Ruralis*, 62, 335–362. <https://doi.org/10.1111/soru.12364>
- Charatsari, C., Lioutas, E. D., Bournaris, T., Lazaridou, D., Paltaki, A., Michailidis, A., & Loizou, E. (2023). Competencies Needed for Guiding the Digital Transition of Agriculture: Are Future Advisors Well-Equipped? *Sustainability*, 15(22), 15815. <https://doi.org/10.3390/su152215815>
- Charatsari, C., Michailidis, A., Francescone, M., De Rosa, M., Aidonis, D., Bartoli, L., La Rocca, G., Camanzi, L., & Lioutas, E. D. (2024). Do Agricultural Knowledge and Innovation Systems Have the Dynamic Capabilities to Guide the Digital Transition of Short Food Supply Chains? *Information*, 15(1), 22. <https://doi.org/10.3390/info15010022>.
- Chowdhury, A., Kabir, K. H., Abdulai, A.-R., & Alam, M. F. (2023). Systematic Review of Misinformation in Social and Online Media for the Development of an Analytical Framework for Agri-Food Sector. *Sustainability*, 15(6), 4753. <https://doi.org/10.3390/su15064753>

-
- EU CAP Network, (2025). https://eu-cap-network.ec.europa.eu/advisory-networks-connecting-advisors-across-eu_en accessed online 13-04-2025.
- Fielke, S., Taylor, B., Jakku, E. (2020). Digitalisation of agricultural knowledge and advice networks: A state-of-the-art review, *Agricultural Systems*, Volume 180, 2020, 102763, ISSN 0308-521X, <https://doi.org/10.1016/j.agsy.2019.102763>.
- Gruchmann, T., Seuring, S. and Petljak, K. (2019), "Assessing the role of dynamic capabilities in local food distribution: a theory-elaboration study", *Supply Chain Management*, Vol. 24 No. 6, pp. 767-783. <https://doi.org/10.1108/SCM-02-2019-0073>
- Jia, F., Shahzadi, G., Bourlakis, M., John, A. (2024). Promoting resilient and sustainable food systems: A systematic literature review on short food supply chains (2024). *Journal of Cleaner Production*, Volume 435, 2024, 140364, ISSN 0959-6526, <https://doi.org/10.1016/j.jclepro.2023.140364>.
- Kankanamge, K., Chowdhury, A., Kabir, K., Khan, N. (2025). Evils of knowledge sharing and learning: The case of agri-food misinformation in virtual communities of practices in Sri Lanka. *Data and Information Management*. 100090. [10.1016/j.dim.2024.100090](https://doi.org/10.1016/j.dim.2024.100090).
- Lybaert, C., Debruyne, L., Kyndt, E., & Marchand, F. (2022). Competencies for Agricultural Advisors in Innovation Support. *Sustainability*, 14(1), 182. <https://doi.org/10.3390/su14010182>
- Menéndez i Molist, A., Kallas, Z., Guadarrama Fuentes, O.V. (2025). How the proximity sales certification shapes consumer perception of sustainability in short food supply chains. *Discov Sustain* 6, 259 (2025). <https://doi.org/10.1007/s43621-025-01107-x>.
- Morepje, M. T., Msweli, N. S., Agholor, A. I., & Sithole, M. Z. (2024). The Influence of E-Commerce Platforms on Sustainable Agriculture Practices among Smallholder Farmers in Sub-Saharan Africa. *Sustainability*, 16(15), 6496. <https://doi.org/10.3390/su16156496>
- Van Der Ploeg, J.D., Renting, H., Brunori, G., Knickel, K., Mannion, J., Marsden, T., De Roest, K., Sevilla-Guzmán, E. and Ventura, F. (2000). Rural Development: From Practices and Policies towards Theory. *Sociologia Ruralis*, 40: 391-408. <https://doi.org/10.1111/1467-9523.00156>

Facilitating exchange and co-creation of knowledge relating to sustainable calf management in the UK: the multi-actor Calf Action Network

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Short abstract

Calf management is vital to the performance and future viability of dairy farms. However, calves and youngstock are often not prioritized on dairy farms and inconsistencies in advisory services further contribute to calves being overlooked in the wider agricultural knowledge and innovation system (AKIS). There are a variety of actors with interests in calf management, but opportunities for social learning have been limited. The Calf Action Network (CAN) is a multi-actor network that aims to establish a calf knowledge and innovation system which champions shared experiential learning and enables and inspires improvements to calf management and advice. Here, I reflect on the opportunities and challenges presented by establishing this network based on the needs and passion of individuals involved in calf health

and welfare and using the Free Actors in Networks (FAN) approach. The range of people in the network make it a powerful resource with the potential to consider a range of perspectives when identifying priority areas and facilitate applied research, on-farm trials and industry engagement for real-world application and impact. However, this value has so far not been reflected in monetary terms.

1. Purpose

Calf management is vital to the performance and future viability of dairy farms. Calf health and performance has been linked to lifetime fertility, milk production and overall lifespan (Bach, 2011), thereby affecting the ongoing and future financial performance and environmental credentials of farms. Calves not destined as replacements to the milking herd can enter the beef supply chain, contributing to efficient food production (Hessle et al., 2017). Healthy, well-growing youngstock are key to harnessing these potential benefits in the future herd and UK industry have aimed to promote this through e.g. the Calf to Calving initiative (AHDB, 2016). However, calves and youngstock are often not prioritized on dairy farms for various reasons, and veterinary practices take different approaches to calf service provision (Aplin et al., 2023), often following a reactionary treatment model for calves, despite preventive medicine and herd health planning being applied to the adult herd (Palczynski et al., 2022). Inconsistencies in advisory services further contribute to calves being overlooked, not just on farms, but in the wider agricultural knowledge and innovation system (AKIS). Competing commercial interests contribute to perceived mixed messaging around recommended practices for calf rearing, and calves and youngstock rarely feature during dairy industry events or farm walks (Palczynski et al., 2022). The GB Calf Strategy (AHDB, 2020) drove markets for dairy-bred calves, but the quality of calf management still varies across farms, with a range of veterinary, advisory, and technical offerings.

There are a variety of actors with interests in calf management, e.g. farmers and calf rearers, veterinarians, feed and equipment providers, technology developers, researchers and wider industry. These actors have diverse and complementary perspectives, knowledge and skillsets, but opportunities for social learning have been limited. Informed by needs identified through my PhD research (Palczynski, 2021), I founded the Calf Action Network (CAN) in 2022 - a multi-actor network that brings people together through mutual interests and ambitions and aims to provide vital space within which to experiment and learn (Wielinga & Robijn, 2020). The CAN's ambitions are to establish a calf knowledge and innovation system which champions shared experiential learning and enables and inspires improvements to calf management and advice. Here, I reflect on the opportunities and challenges presented by establishing this network based on the needs and passion of individuals involved in calf health and welfare.

2. Design

Whilst working for an independent agricultural knowledge exchange organisation, I wrote a critical blog (Innovation for Agriculture, 2022) about one of the first calf-focused industry events held in the UK. Informed by my PhD which investigated factors affecting calf rearing in England and grounded in data from those in-depth interviews (Palczynski, 2021), I invited readers to join my ambition to improve the quality of calf-focused knowledge exchange. This prompted a range of industry actors (including veterinarians, researchers, industry representatives, farmers and calf rearers) to reach out to speak to me one-to-one, followed by the first online meeting of what was to become the CAN in December 2022.

Facilitated and coordinated by myself, the network was established based on shared interests and used the Free Actors in Networks (FAN) approach (Wielinga & Robijn, 2020), with no funding in place. There is a core steering group for the network, with more peripheral members with specific interests attending events. A small amount of funding was won in April 2024 to fund administration of the Network, with additional funding being secured for specific activities. Network objectives and activities (webinars, interactive workshops, events) are co-created based on members' interests and topics of interest that are evident from discussions. Network membership continues to increase, now with over 100 members.

3. Findings

Firstly, the support of my employer to establish and maintain the CAN, despite its lack of funding, was essential – the FAN approach relies upon the passion and time availability of Free Actors. Secondly, the focal areas of CAN were co-created in a bottom-up approach, recognizing that the success of the network is intertwined with the engagement of the network. As facilitator, I seek to energise the network through opportunities to mobilize the knowledge and expertise within the network. The CAN's objectives are flexible and responsive to changing needs, but broadly agree to focus on:

- i) Promoting farmer-led, applied and/or farm trial calf research projects which address practical needs and questions
- ii) Establishing lifelong learning opportunities and qualifications to recognize calf skills and expertise
- iii) Providing opportunities for social learning about calf management

Successful funding has been won for standalone activities, including two interactive workshops which provided research insights whilst also providing knowledge exchange and social learning opportunities to attendees. These events have been well attended with positive feedback about the level of interactivity and opportunity to speak with different types of actors. One of these events was the first stage of a modified Delphi consensus process to agree priority focus areas for research and industry, and another explored the potential role for technology in calf welfare. These activities not only contribute to the research literature, but also help to inform future CAN activities, as well as industry initiatives - the CAN is contributing to the next iteration of the GB Calf Strategy which will launch later this year.

However, identification of appropriate funding mechanisms to sustain the CAN has been challenging. Lack of formal staff and financial sustainability of the network limits its ability to harness its full potential value and threatens its continuation. On the other hand, the CAN is a 'bureaucratically light', informal network (Fieldsend et al., 2021) which is responsive to the wants and needs of its members, strengthening its participatory nature. Regardless, the risk remains that without regular events and activities to energise the network, the lack of warm processes could lead to the decline and death of CAN as a living network (Wielinga & Robijn, 2020).

4. Practical Implications

Although no formal impact assessment has been conducted on the CAN, continued participation of members and positive feedback from events indicate that this living network has value. The range of people in the network make it a powerful resource with the potential to consider a range of perspectives when identifying priority areas and facilitate applied research, on-farm trials and industry engagement for real-world application and impact. However, this value has so far not been reflected in monetary terms.

5. Theoretical Implications

In line with policy recommendations made by Fieldsend et al., (2021), the CAN could contribute to greater user participation and inclusion of value chain co-innovation in the AKIS. However, ensuring and measuring the impact of a network is challenging, particularly with regards to the organisation of resources in the absence of specifically allocated funds (Feo et al., 2022).

6. References

- AHDB. (2016). *Calf to Calving reduces heifer rearing costs*. <https://ahdb.org.uk/news/calf-to-calving-reduces-heifer-rearing-costs>
- AHDB. (2020). *GB Dairy Calf Strategy 2020-2023*.
- Aplin, K., Morgans, L., Palczynski, L., Main, D., Debbaut, C., Hepworth, L., & Reed, J. (2023). Calf health veterinary services: Making them work for calves, farmers and veterinarians. *Veterinary Record*, 193(8), no. <https://doi.org/10.1002/vetr.3051>
- Bach, A. (2011). Associations between several aspects of heifer development and dairy cow survivability to second lactation. *Journal of Dairy Science*, 94(2), 1052–1057. <https://doi.org/10.3168/jds.2010-3633>
- Feo, E., Spanoghe, P., Berckmoes, E., Pascal, E., Mosquera-Losada, R., Opdebeeck, A., & Burssens, S. (2022). The multi-actor approach in thematic networks for agriculture and forestry innovation. *Agricultural and Food Economics*, 10(1), 1–24. <https://doi.org/10.1186/S40100-021-00209-0/TABLES/6>
- Fieldsend, A. F., Cronin, E., Varga, E., Biró, S., & Rogge, E. (2021). ‘Sharing the space’ in the agricultural knowledge and innovation system: multi-actor innovation partnerships with farmers and foresters in Europe. *Journal of Agricultural Education and Extension*, 27(4), 423–442. <https://doi.org/10.1080/1389224X.2021.1873156>
- Hessle, A., Kumm, K. I., Bertilsson, J., Stenberg, B., & Sonesson, U. (2017). Combining environmentally and economically sustainable dairy and beef production in Sweden. *Agricultural Systems*, 156, 105–114. <https://doi.org/10.1016/J.AGSY.2017.06.004>
- Innovation for Agriculture. (2022). *Unlocking the potential of calves and youngstock: Have we misplaced the key?* <https://www.i4agri.org/news-article/Unlocking%20the%20potential%20of%20calves>
- Palczynski, L. J. (2021). *The effect of farmer and advisor perspectives about calf rearing practices on dairy farms in England: ‘There might be other priorities’* [Harper Adams University]. <https://hau.repository.guildhe.ac.uk/id/eprint/17772/1/Laura%20Palczynski%20upload.pdf>
- Palczynski, L. J., Bleach, E. C. L., Brennan, M. L., & Robinson, P. A. (2022). Youngstock Management as “The Key for Everything”? Perceived Value of Calves and the Role of Calf Performance Monitoring and Advice on Dairy Farms. *Frontiers in Animal Science*, 3. <https://doi.org/10.3389/FANIM.2022.835317>
- Wielinga, Eelke., & Robijn, Sjoerd. (2020). *Energising networks: tools for co-creation*. Wageningen Academic Publishers.

A Dynamic Action Plan for the monitoring of a National Network in a European demonstration project of climate-smart farming practices (Climate Farm Demo).

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Short abstract

The ClimateFarmDemo project (2022–2029) has established a pan-European network of 1,500 Pilot Demonstration Farms (PDFs) across 27 EU countries to promote climate-smart farming through a multi-actor approach. By connecting PDFs, Climate Farm Advisors (CFAs), and other Agricultural Knowledge and Innovation System (AKIS) actors, the project fosters knowledge exchange via demonstration events, advisory meetings, and peer-to-peer learning. This study explores the challenges and solutions in building engaging national demonstration networks, focusing on the challenges faced by actors in the national networks and what solutions have been proposed. Using Dynamic Action Plans (DAPs) and online focus groups, the study identifies five categories of challenges, including farmer reluctance, time and skill constraints, relevance of activities, limited collaboration, and structural policy gaps. An enabling environment is often missing. Solutions therefore focus on enhancing communication, tailoring content, co-organizing events, and strengthening advisor capacity. Focus groups helped refine nine solutions into transferable formats for broader application. Findings highlight the need for establishing an enabling environment to support changes. The study contributes practical insights for improving the design and implementation of national demonstration networks within EU-wide agricultural innovation initiatives.

1. Purpose

The aim of this paper is to gain insights in the challenges and potential solutions for creating engaging national networks on climate-smart farming in the Horizon Europe ClimateFarmDemo project. Through a comprehensive evaluation of these networks, the paper identifies the obstacles encountered by various stakeholders, such as Pilot Demo Farmers (PDF), Climate Farm Advisors (CFAs), and other Agricultural Knowledge and Innovation System (AKIS) actors. Additionally, the paper delves into potential solutions to these challenges, provided by the national networks. These solutions are further developed for the testimony and adapted to national contexts. The goal is to enhance the effectiveness of these national networks.

2. Design

The ClimateFarmDemo project (2022-2029) has established an EU-wide network of 1,500 PDFs across 27 EU countries. The project adopts a multi-actor approach by connecting PDFs, CFAs, and other AKIS actors at both national and European levels to enhance knowledge exchange and cross-fertilization on climate smart farming practices. Multiple types of networking activities are organised within the project, including one-on-one advisory meetings, peer-to-peer exchanges (e.g. demonstration events), and activities connecting national actors. The main activity is the organization of on-farm demonstration events. These demonstration events have been shown to significantly influence farmers in adopting successful practices (Adamsone-Fiskovica & Grivins, 2022; Brown & Roper, 2017; Cooreman et al., 2021; Sutherland & Marchand, 2021).

This research does not aim to conduct an evaluation of demonstration events or review adoption factors of climate-smart practices (Gemtoui et al., 2024). Instead, it explores challenges and potential solutions for building engaging national demonstration networks. The study addresses two research questions. (1) What are the main challenges faced in setting up an engaging national demonstration network? (2) What solutions have been proposed by national networks, and what factors influence their successful implementation across different contexts

To address the first question, the study uses the Dynamic Action Plans (DAP) developed annually by the national coordinators. These plans evaluate network functioning, identify challenges, propose solutions, highlight key areas for improvement and outline actions for the following year.

For the second question, nine solutions from the DAPs were further explored in online focus groups with project actors. The focus groups began with a testimony from a national coordinator who had implemented the solution (or partially). Participants then used a MURAL board to discuss five guiding questions: (1) How could this be applied in your national network, (2) Which concrete actions can be taken to make this solution achievable ; (3) Who should be involved ; (4) To which project activities and/or resources can it be linked ; and (5) What would be the best timing. Facilitators synthesized the input to reformulate each solution into a transferable format, enabling implementation across different national contexts to address shared challenges.

3. Findings

A general observation is that the main focus of the networks is on organizing demonstration events, with less attention is paid to other types of network activities. This is mainly due to the project design, which primarily funds demonstration events.

Challenges related to sustaining engagement among Pilot Demonstration Farms (PDFs), Climate Farm Advisors (CFAs), and other AKIS actors were categorized into five groups. These challenges were further explored in focus groups, where participants discussed potential solutions based on experiences documented in the Dynamic Action Plans (DAPs).

One key challenge is the **reluctance of some PDFs to host or participate to demonstrations events**. This hesitation often stems from limited motivation, low awareness of climate change impacts, or scepticism about the benefits of climate-smart practices, which may not yield immediate results. Farmers may also perceive high costs associated with changing practices. Additionally, prior to demonstration events, one-to-one meetings are organised between PDFs and CFAs to perform audits and develop adaptation and mitigation plans. These are time consuming for both and require a good relationship between both parties. To address this challenge, testimonies proposed to show the impact of climate-smart practices on farm profitability and explain what the consequences of non-participation might be on production and society. Strategies such as regular (short) contacts, trust-building, and emphasizing both the economic and societal impacts of climate change were proposed. Testimonials from stakeholders (peer farmers, industry, consumers,. ...), informative flyers highlighting economic benefits, and privacy-respecting data sharing were also suggested to increase participation. Additional measures include targeted communication, incentives, and involvement of public authorities. Identifying effective entry points to engage farmers is critical. Focus on profitability or current issues and bring the climate topic on the second place.

Both PDFs and CFAs face constraints related to **time and skills**, which impact both the planning and delivery of demonstration events. Time-wise, farmers often have limited availability due to seasonal workloads, and increasingly unpredictable weather conditions are narrowing the windows for organisation events. Winter months also pose logistical challenges in several countries, making it harder to engage participants. To address these issues, solutions include co-organizing events with fairs or other organizations to reduce planning time and reach broader audience, reducing the number of demo events while increasing participant numbers, using virtual farm visits when physical presence is not feasible, and staggering different types of activities throughout the year – reserving October to March for administrative and one-on-one advisory work, and the rest of the year for demonstrations. On the skills side, farmers may be unfamiliar with interactive formats, while advisors may lack confidence or technical expertise in specific climate-smart practices. To overcome this, targeted training is recommended to strengthen the CFA's technical knowledge, advisory methods, and interpersonal skills, which are essential for facilitating effective knowledge exchange and building trust within the network.

Closely linked to time constraints and motivational issues is the **relevance of the networking activities**. Farmers are less likely to attend if the content does not align with their immediate needs or if the benefits are not clear. For the 1-on-1 advisory meetings, selecting the useful outputs for the discussion with the farmers and eventually compare the results with other countries or production systems might possibly increase the engagement of both PDF and CFA. For demonstrations, showing short-term outcomes of long-term practices remains a challenge. Proposed solutions include organizing PDF-specific events, strengthening coordination with national and regional partners, and linking demonstration events to other ongoing initiatives. Tailoring content to specific audiences and showcasing concrete innovations can enhance relevance. However, competition with other national and international events remains a barrier, and peer-to-peer exchange varies in effectiveness across countries. In general, strengthening communication channels and information sharing within the network is a key aspect to enhance the relevancy and transparency of the events. There is a need for a strategic planning of activities that can be directly linked to the farmers' (climate) challenges and interests, such as collaboration with other initiatives to avoid competition for the same target groups.

Another challenge is the **lack of collaboration and support** among advisors and with other networks, projects and AKIS actors. Possible setback in strengthen collaboration and support include limited awareness or visibility of the network, fragmentation of efforts, reluctance to share tools and practices, lack of structured communication channels to share experiences and unclear expectations in terms of collaboration. Looking for synergies between projects, networks and international networks can identify **collaboration** opportunities, while integrating promotional efforts into partner communications ensures targeted outreach. Persistent engagement efforts are essential. Collaborations with other AKIS actors and local experts can attract more participants and address skeptical inquiries. Beyond collaboration with other parties and projects, there is a lack of collaboration and support among advisors and they may not be well-acquainted with the network. Capacity building and network of advisors within the project is therefore crucial. This should enhance exchange and communication amongst advisors to e.g. share experiences about tools and audits.

Finally, the challenge of **lack of policies and structural support** requires a multifaceted approach. While direct engagement through one-on-one meetings remains important, indirect methods—such as social media campaigns, policy briefs, public events,

and including policy makers in relevant networks—play a crucial role in raising awareness and applying pressure on farmers, institutions, and related projects. These approaches help build visibility and momentum around climate-smart practices. Strategic collaboration with regional and national initiatives, including authorities working on rewarding mechanisms, can further enhance policy impact. Increasing the involvement of private companies in supporting farmers to reduce their carbon footprint and meet climate targets is also essential. For policy engagement to be effective, it is important to identify and target stakeholders based on their interest in climate issues, their availability and their decision-making power, or influence. Joint efforts with other actors, institutions, and projects can broaden outreach and increase the likelihood of capturing policy attention and support.

4. Practical Implications

The DAPs have proven to be a valuable tool for project management, helping to identify challenges, track progress, and support meaningful outcomes within national networks. While there is still room for improvement, DAPs already assist project managers and national coordinators in pinpointing needs and facilitating exchanges that foster stronger national-level collaboration. Insights from this analysis can also inform other networking projects in designing activities that go beyond isolated events and instead focus on building an **enabling environment**. Such an environment is essential for increasing the impact of demonstration activities and should prioritize **capacity building, ongoing networking efforts**, and a **supportive structure** that empowers advisors and stakeholders to engage meaningfully.

Within the Climate Farm Demo project, DAPs will also be used to assess impact. Given that national networks are dynamic and continuously evolving, ongoing monitoring - tailored to each country's context – can offer valuable insights. To support this, DAPs will be updated based on past feedback, with more focused questions to collect relevant information. At this stage of the project, national or regional differences are difficult to extract from the DAPs. A major discrepancy relates to the absence of, or undeveloped, advisory system in some of the East European countries (e.g. Hungary, Slovenia) due to which some challenges are more pronounced, such as the lack of support among advisors.

A recurring theme across focus groups is the importance of collaboration - with other networks, stakeholders, and projects – as essential in achieving project goals, such as organizing the targeted number of demonstration events and ensuring stakeholder involvement. Strengthening these partnerships further will help amplify the project's overall impact. At the same time, creating an enabling environment also means clearly communicating the social and economic benefits of participating in the project and national networks (Prager & Creaney, 2017). This requires well-defined outcomes, co-created goals, and joint planning of events to address motivation and time constraints. Project partners should actively use available resources, strengthen internal connections, and improve the functioning of networks by sharing information with advisors, involving local authorities, expanding outreach, using multiple communication channels, and building on existing platforms.

5. Theoretical Implications

The challenges identified in this paper can be directly linked to several of the Nine P's framework for successful demonstration events (Adamsone-Fiskovica et al., 2021). Farmer reluctance, stemming from limited motivation and scepticism about benefits from participating in such a network, primarily relates to the Purpose (ensuring clear, jointly agreed objectives) and Positioning (effectively reaching and attracting the target audience) of the

network. The relevance of activities, particularly when content doesn't align with farmer's direct needs or benefits are unclear, directly corresponds to the Problem (identifying and framing a topic tailored to farmer needs) and Programme (designing balanced activities) elements. Time and skill constraints, affecting both farmers and climate farm advisors (CFAs), fall under Personnel (ensuring a motivated and trusted team) and Progress (aligning communication with diverse learning styles). Last, limited collaboration and support among advisors and other stakeholders, and structural policy gaps, impact the foundational Purpose and the Personnel capacity within the AKIS. Moreover, active stakeholder involvement, as emphasized by Wijnands et al. (2014) and by Lambrecht et al. (2018), emerged as a critical characteristic for successful innovations within the network. From our focus groups, this is a recurring strategy in addressing challenges such as limited time and specific skill gaps, while also enhancing the relevance of events and fostering synergies with other projects, AKIS actors, and networks. This can be related to the post-event engagement described by (Adamsone-Fiskovica et al., 2021). Similar to this success factor for demonstration activities, continuous engagement of the actors is crucial for creating a successful network.

According to Cofré-Bravo et al. (2019) and Richardson et al. (2022), different configurations of networks can achieve similar innovation outcomes, highlighting the adaptability and context-specific nature of (demonstration) networks. These contextual differences present a valuable area for further exploration in the coming years, with the DAPs as a useful monitoring tool.

By connecting empirical observations with theoretical models of networked innovation, this study contributes to a deeper understanding of how national demonstration networks function in practice. It highlights the importance of contextualization, dynamic monitoring, and actor engagement in designing resilient and adaptable climate-smart farming networks across Europe.

6. References

- Adamsone-Fiskovica, A., & Grivins, M. (2022). Knowledge production and communication in on-farm demonstrations: putting farmer participatory research and extension into practice. *Journal of Agricultural Education and Extension*, 28(4), 479–502. <https://doi.org/10.1080/1389224X.2021.1953551>
- Adamsone-Fiskovica, A., Grivins, M., Burton, R. J. F., Elzen, B., Flanigan, S., Frick, R., & Hardy, C. (2021). Disentangling critical success factors and principles of on-farm agricultural demonstration events. *Journal of Agricultural Education and Extension*, 27(5), 639–656. <https://doi.org/10.1080/1389224X.2020.1844768>
- Brown, P., & Roper, S. (2017). Innovation and networks in New Zealand farming. *Australian Journal of Agricultural and Resource Economics*, 61(3), 422–442. <https://doi.org/10.1111/1467-8489.12211>
- Cofré-Bravo, G., Klerkx, L., & Engler, A. (2019). Combinations of bonding, bridging, and linking social capital for farm innovation: How farmers configure different support networks. *Journal of Rural Studies*, 69, 53–64. <https://doi.org/10.1016/j.jrurstud.2019.04.004>
- Cooreman, H., Debruyne, L., Vandenabeele, J., & Marchand, F. (2021). Power to the facilitated agricultural dialogue: an analysis of on-farm demonstrations as transformative learning spaces. *Journal of Agricultural Education and Extension*, 27(5), 699–719. <https://doi.org/10.1080/1389224X.2021.1969958>
- Gemtou, M., Kakkavou, K., Anastasiou, E., Fountas, S., Pedersen, S. M., Isakhanyan, G., Erekaló, K. T., & Pazos-Vidal, S. (2024). Farmers' Transition to Climate-Smart Agriculture: A Systematic Review of the Decision-Making Factors Affecting Adoption. In *Sustainability (Switzerland)* (Vol. 16, Issue 7). Multidisciplinary Digital Publishing Institute (MDPI). <https://doi.org/10.3390/su16072828>

- Lambrecht, E., Crivits, M., Lauwers, L., & Gellynck, X. (2018). Identifying key network characteristics for agricultural innovation: A multisectoral case study approach. *Outlook on Agriculture*, 47(1), 19–26. <https://doi.org/10.1177/0030727018760604>
- Richardson, M., Coe, R., Descheemaeker, K., Haussmann, B., Wellard, K., Moore, M., Maland Cady, J., Gubbels, P., Tchuwa, F., Paz Y, R., & Nelson, R. (2022). Farmer research networks in principle and practice. *International Journal of Agricultural Sustainability*, 20(3), 247–264. <https://doi.org/10.1080/14735903.2021.1930954>
- Sutherland, L. A., & Marchand, F. (2021). On-farm demonstration: enabling peer-to-peer learning. In *Journal of Agricultural Education and Extension* (Vol. 27, Issue 5, pp. 573–590). Routledge. <https://doi.org/10.1080/1389224X.2021.1959716>
- Wijnands, F. G., Brinks, H., Schoorlemmer, H., & de Bie, J. (2014). Integrated Pest Management Adoption in the Netherlands: Experiences with Pilot Farm Networks and Stakeholder Participation. In Peshin Rajinder & Pmentel David (Eds.), *Integrated Pest Management, Experiences with Implementation, Global Overview* (Vol. 4). Springer.

Collaborative processes as strategies for social innovation in a mountain context

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Short abstract

This article reflects on social innovation processes in mountain territories, based on the experience of the Bem Comum project, which promoted co-creation with a network of multidisciplinary, multisectoral and rural-urban actors. The research considers social innovation as a collaborative and transformative response to complex challenges such as depopulation and rural abandonment. The study describes the design and implementation of co-creation actions on three fronts: developing new ecotourism products, recreational-scientific activities for young people and boosting female entrepreneurship in cooperation with the Spanish ‘Ganaderas en Red’ project. The results demonstrate the potential of collaborative networks to generate effective solutions, mobilising diverse resources and promoting shared learning within a logic of proximity and complementarity. The positive impacts have been felt in the empowerment of local communities, in the strengthening of the Commons as a space for social experimentation and in the creation of useful tools for reconnecting populations with the territory. The experience contributes to the theoretical and practical debate on participatory governance and sustainable development, showing that the combination of social innovation, co-creation and local involvement can significantly strengthen rural mountain territories.

1. Purpose

Reflecting on the experience of innovative co-creation processes, integrating a network of multidisciplinary, multisectoral and rural-urban actors, aimed at counteracting depopulation

and abandonment in mountain territories. The aim of this article is to analyse how collaborative processes can be effective strategies for social innovation in mountain territories marked by structural challenges such as depopulation, population ageing and rural abandonment. Based on the practical experience of the Bem Comum project¹, the aim is to understand how co-creation between actors from different backgrounds - rural and urban, public and private, formal and informal - can generate transformative responses adapted to local specificities. The research also aims to contribute to the theoretical deepening of the relationship between social innovation and participatory governance, testing applied methodologies that directly involve local communities in the definition of sustainable solutions and in the valorisation of their territorial, cultural and social resources, in a logic of promoting endogenous local development.

2. Design

This study is based on contemporary approaches to social innovation, co-creation and participatory governance, with a specific focus on rural and mountain territories. Social innovation is understood, in the light of Neumeier (2012), as a process in which networks of actors change their modes of action, generating tangible improvements for those involved or even for the community in general. This perspective is complemented by Bock (2016), who emphasises the importance of collaboration and social learning as ways of responding to complex challenges in peripheral territories. Co-creation is understood as an interactive process whereby actors with different points of view, and even different knowledge systems, work together, implementing collective action and sharing risks, resources and responsibilities (Utter et al., 2021). These perspectives can be reconciled with the notions of geographical proximity and organised proximity, the latter made possible by new technologies and complementary to the former, as forms of relational proximity between people and actors integrated into cooperation processes with potential for regional and rural development (Torre, 2019). In addition, the concept of proximity networks (Torre, 2019) is essential for understanding the construction of collaborative dynamics, allowing rural and urban actors to liaise, promoting the circulation of knowledge and the creation of mutual trust. In the field of governance, this study adopts a perspective based on the distribution of responsibilities among multiple actors, promoting more inclusive and territorially appropriate decisions. The Quintuple Helix approach (Carayannis & Campbell, 2009) explicitly incorporates the role of the environment and civil society in innovation systems, and is particularly relevant for territories facing socio-ecological pressures. This logic is consistent with the proposals of Pike et al. (2017) who emphasise the importance of multi-level approaches that are sensitive to local realities. Finally, the valorisation of mountain territories is supported by references that recognise their strategic potential. Multifunctional agriculture (MacDonald et al., 2000), sustainable tourism and community management of wasteland are structuring elements of development and cohesion. The Satoyama Initiative (UNU-IAS & IGES, 2015) is mobilised here as an example of linking traditional and scientific knowledge with a view to revitalising sustainable socio-ecological systems. This conceptual framework guided the creation, in the context of the Bem Comum project, of a network of regional, rural and urban partners, with complementary but different skills and areas of activity, understood as a process of social innovation to revitalise rural mountain territories. Within this collaborative framework, co-creation actions were implemented in territories in the north of Portugal aimed at a) co-creation of tourist experiences with the aim of creating new ecotourism products; b) co-creation of recreational-scientific activities for young people to showcase the possibilities of life and enterprise in mountain territories; c) boosting female entrepreneurship through international cooperation with the 'Ganaderas en Red' project. The

collaborative processes, impact of the initiatives and potential for replication in other territories were tested

3. Findings

The experience of the Bem Comum project has shown that collaborative processes, based on co-creation networks between multidisciplinary and multisectoral actors, foster the emergence of innovative solutions to complex problems in mountainous territories. The results show that the joint mobilisation of local and external knowledge, combined with the diversity of skills and resources, favours mutual learning and the strengthening of social capital. There has been a positive impact on empowering local communities, boosting initiatives with economic and social value (such as new tourism products and activities for young people), as well as strengthening the Commons as a space for experimentation and social innovation. These processes have helped to increase the attractiveness of the area and stimulate more participatory and horizontal forms of governance.

4. Practical Implications

The focus on social innovation, through the coordinated actions of a network of players and participatory work with local communities, has made it possible to achieve improvements in the quality of collective action in terms of boosting and empowering innovation in rural territories, including greater recognition and empowerment of communities and territories weakened by decades of socio-demographic decline, making them more attractive and more proactive in building sustainable development. This work of networking and co-creation has resulted in products that will remain in the territory and which aim to support its promotion from an endogenous development perspective: a) four new ecotourism products, involving tourist animation companies, farmers, small local businesses and craftspeople; b) four booklets of recreational-scientific activities for young people to publicise the possibilities of life and enterprise in mountain territories; c) the creation of a national network of women livestock farmers, as a way of promoting female entrepreneurship. The results suggest that social innovation strategies anchored in participatory methodologies can be replicated in other rural territories with similar characteristics. The implementation of collaborative networks makes it possible to overcome structural limitations and develop responses tailored to local realities, promoting sustainable territorial development. In addition, the active involvement of communities in co-creating solutions strengthens their autonomy and sense of belonging, promoting greater social and institutional resilience. This approach also offers useful clues for public policies that are more sensitive to the diversity of contexts and to valuing local knowledge, and should be taken into account when building more inclusive and lasting development models.

5. Theoretical Implications

The theoretical implications of this study are related to broadening the understanding of social innovation processes in rural mountain contexts, particularly: a) Validation of collaborative networks as a driver of social innovation. The study confirms that networks of actors with shared goals and values, even when geographically dispersed or sectorally distinct, can generate effective solutions to complex problems such as depopulation. Theoretically, this reinforces the importance of horizontal cooperation and organised proximity (Torre, 2019) as structuring elements of social innovation. b) Consolidation of co-creation as a methodological approach. The use of co-creation with multiple actors and local communities contributes to consolidating this approach as a relevant tool for participatory territorial planning and for boosting endogenous development processes. c) Integration between social innovation and participatory governance. The study contributes to debates on

alternative models of governance, showing that social innovation can be seen not just as a result, but as a systemic process involving dialogue, experimentation and shared responsibility. d) Articulation between scientific knowledge and local knowledge. This theoretically reinforces the idea that hybrid knowledge (scientific + local) is fundamental for territorially appropriate solutions, challenging top-down logics and promoting plural epistemologies.

6. References

- Bock, B. B. (2016). Rural Marginalisation and the Role of Social Innovation; A Turn Towards Nexogenous Development and Rural Reconnection. *Sociologia Ruralis*, 56(4), 552–573. <https://doi.org/10.1111/soru.12119>
- Neumeier, S. (2012). Why do Social Innovations in Rural Development Matter and Should They be Considered More Seriously in Rural Development Research? - Proposal for a Stronger Focus on Social Innovations in Rural Development Research. *Sociologia Ruralis*, 52(1), 48–69. <https://doi.org/10.1111/j.1467-9523.2011.00553.x>
- Torre, A. (2019). Les différentes approches de la proximité. *Soins Cadres*. 28. 18-20. [10.1016/j.scad.2019.03.004](https://doi.org/10.1016/j.scad.2019.03.004)
- Utter, A., White, A., Méndez, V. E., & Morris, K. (2021). Co-creation of knowledge in agroecology. In *Elementa* (Vol. 9, Issue 1). University of California Press. <https://doi.org/10.1525/elementa.2021.00026>

Session 3B AKIS ACTORS

Innovating in policy space: Innovation Policy Labs making policies more impactful

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Short abstract

Recognizing the need for more dynamic and participatory governance models, this paper aims to present the methodology, insights, and lessons learned from the implementation of FAO's Innovation Policy Labs (IPLs) across multiple developing countries. It seeks to demonstrate how IPLs serve as effective platforms for fostering multistakeholder collaboration, and co-creation across the science-policy-practice interface to implement transformative policies.

By highlighting the integration of innovative methodologies aligned with the TAP-capacities and the UN 2.0 capabilities, i.e. innovation, foresight, behavioural science (BeSci), data and digital tools within a participatory governance framework, the paper illustrates how IPLs can address critical gaps in knowledge, multistakeholder consensus-building, and feedback mechanisms for evidence-based and impactful policymaking. Ultimately, the paper explores how these innovative approaches can strengthen the capacity of stakeholders to drive systemic change and accelerate agrifood system transformation through more inclusive, adaptive, and evidence-informed policies, thereby contributing to resilient and sustainable rural development worldwide.

The main findings prove that, by leveraging collective intelligence, IPL help remove barriers to innovation at the policy ideation stage, clearing the way for transformative outcomes.

1. Purpose

In the face of complex and interconnected global challenges—such as climate change, food security, biodiversity loss, and rural-urban disparities—traditional approaches to policy formulation in agrifood systems are often insufficient to generate transformative solutions. Promoting innovation in policy development is therefore crucial to fostering adaptive, inclusive, and evidence-based responses that can better address these multifaceted issues. Recognizing the need for more dynamic and participatory governance models, this paper aims to present the methodology, insights, and lessons learned from the implementation of FAO's Innovation Policy Labs (IPLs) across multiple developing countries. It seeks to demonstrate how IPLs serve as effective platforms for fostering multistakeholder collaboration, and co-creation across the science-policy-practice interface to implement transformative policies.

By highlighting the integration of innovative methodologies aligned with the TAP-capacities and the UN 2.0 capabilities, i.e. innovation, foresight, behavioural science (BeSci), data and digital tools within a participatory governance framework, the paper illustrates how IPLs can address critical gaps in knowledge, multistakeholder consensus-building, and feedback mechanisms for evidence-based and impactful policymaking. Ultimately, the paper explores how these innovative approaches can strengthen the capacity of stakeholders to drive systemic change and accelerate agrifood system transformation through more inclusive,

adaptive, and evidence-informed policies, thereby contributing to resilient and sustainable rural development worldwide.

2. Methodology

The methodology is grounded in FAO's pluriannual experience in multistakeholder and participatory approaches for co-innovation.

The objectives of the IPLs are to:

- Co-create and stress-test innovative and actionable policy options;
- Capacitate and empower stakeholders to meaningfully engage in the co-creation and decision-making process.

In order to achieve these objectives, the process of the IPL is equally important as policy solutions it generates, as it leads to stakeholders' empowerment.

The Innovation Policy Labs (IPLs) utilize a participatory methodology based on workshops, consultations and pilots and include a broad range of stakeholders from diverse sectors directly and indirectly involved and impacted by the given challenge. They should include policy makers, research, academia, producers, value chain actors, private sector, civil society, nongovernmental organizations etc., making sure that vulnerable groups, especially women and youth, are empowered to engage.

IPL methodology is grounded in principles of inclusiveness, engagement of diverse stakeholders to ensure that all perspectives are considered, national ownership, evidence-based decision-making, sustainability, creation of holistic solutions viable in the long term, and leveraging the UN 2.0 capacities: innovation, data, digital, foresight, and behavioural science.

The IPL process involves a structured yet flexible approach with **three main phases**, preceded by a preparatory phase that includes discussions with decision-makers to identify the focus, establishment of an IPL national team, an inception workshop to build awareness and engagement, and followed by the pilot phase.

Phase 1: Sensemaking focuses on understanding the key issues and barriers. This phase includes national and local level workshops, utilizing tools such as problem tree, futures wheels, and spaghetti maps to identify root causes and implications. A key element is the "Iceberg Exercise," which deconstructs the current model by identifying visible events, underlying patterns and trends, structural factors, and the mental models that drive the system and cause the current model's malfunctioning.

These results are then further explored through a participatory scoping study to generate a solid evidence, based on both scientific data and informal knowledge and experience, and inform the solutions co-created through the IPLs.

Phase 2: Co-development of innovative solutions/policy options. It involves a mini-foresight visioning exercise to create a joint vision of the "preferred future" related to the theme addressed through the IPL, followed by the co-creation of concrete, win-win solutions. The phase incorporates behavioural insights and human-centered-design (HCD) to ensure the solutions are user-centred and address potential behavioural barriers. Tools include brainstorming, the "Ocean of Opportunities" diagram to map and refine options, stress-testing methodologies, and surveys to gather ideas from a broader group of stakeholders.

Phase 3: Action plan development. It focuses on translating the solutions into actionable plans. This phase involves co-developing of a concrete action plan that includes risk mitigation strategies and clearly defined roles and responsibilities for each stakeholder, identifying collaborative platforms, potential public-private partnerships and innovative funding opportunities. Tools include backcasting, where pathways are created by starting with the desired future and working backward to the present. A key element is the integration of a

Monitoring, Evaluation, and Learning (MEL) plan to assess implementation effectiveness and outcomes.

Pilot phase: This phase aims to test the generated solutions, adjust them and prepare for scaling up, and to further explore funding opportunities.

Throughout these phases, the IPL methodology emphasizes MEL for adaptive learning, adjusting the process based on a "Tuner Model" checklist that monitors the level of co-creation, stakeholder influence and capacities to be strengthened through the process, and other factors. Integrating MEL early, with real-time feedback loops, helps improve implementation and increase impact. Furthermore, various communication and advocacy means serve to validate the IPL results and ensure their sustainable implementation.

This comprehensive methodology aims to develop capacity, foster innovation, and translate IPL results into actionable knowledge for transformative and sustainable impact.

3. Findings

The Innovation Policy Labs (IPLs) have been implemented in several countries, each focusing on context-specific priorities. In Liberia, they contributed to the revision of the extension and research policy, while in Tunisia, it facilitated the co-construction of a governance model for extension and advisory services. In Uzbekistan, efforts have been directed at strengthening the Agricultural Knowledge and Information System (AKIS) in the Fergana Valley, with a particular focus on women and digitalization.

Currently, IPLs are being implemented in a new set of countries, addressing diverse policy challenges. In Colombia, the work centres on the formulation of a local seeds protection policy and the co-construction of a governance model to implement the International Treaty on Plant Genetic Resources for Food and Agriculture. In Ethiopia, the initiative supports the development of a start-ups policy. Madagascar is focusing on the implementation of its national rice strategy, while in Uzbekistan, attention has shifted to fostering the development of the local bee sector.

While it is too early to evaluate the impact of the solutions generated by the IPLs, the findings so far lead to important conclusions regarding the added value of the participatory approaches to policy making and how the IPL maximize it. However, any participatory process may face challenges: if not properly applied, it may be costly, time-consuming, misused by authorities and other powerful actors, diminishing the effect, slowing the transformative process and creating "participation fatigue" that discourage stakeholders from engaging.

IPL methodology has been developed based on the pluriannual experience in similar approaches which allowed for integrating innovative solutions to maximize the benefits and address the challenges mentioned above and potential new ones:

- Ownership by national stakeholders, transparent communication, strong advocacy, institutionalization strategy, and experienced facilitation are critical success factors.
- The methodology is flexible and adaptive to different contexts and needs, yet it follows the core principles (see the Methodology section) and a structured process with innovative tools to ensure the achievement of the results.
- Strong evidence, based both on formal and informal sources, ensures that co-created solutions are locally-relevant and accepted by stakeholders implementing them and impacted by them.
- MEL, with a strong emphasis on learning, allows for timely adjustment of the process to generate impactful and relevant solutions, while at the same time empowering stakeholders to steer the process and maximize positive changes in their functional capacities.

- The UN 2.0 “quintet of change” capabilities – data, innovation, digitalization, behavioural science, and foresight – when properly integrated into policy-making, boost change on the ground.
- Partnerships that bring datasets, know-how, diverse experiences and potentially also funding, are engines of rural innovation.

In conclusion, it has been showed that the IPL brings a strong value:

- IPL innovates by unlocking co-creation to bring together multiple disciplines and stakeholders within the agrifood policy domain.
- Through collective intelligence, IPL co-develops policies or innovative solutions for addressing complex challenges cost-effectively and efficiently, driving systemic change.
- IPL help remove barriers to innovation at the policy ideation stage, clearing the way for transformative outcomes.
- IPL strengthen stakeholders' functional capacities for co-innovation and effective participation in decision-making processes.

Participatory approaches like the IPL one, are particularly effective when the goal is to build consensus around a social mission and enhance legitimacy and capacities. Yet, there are instances— when a very specific issue requires highly specialized expertise, or in emergency situations—where non-participatory approaches may also be appropriate.

4. Practical Implications

IPL has some important practical features, such as stakeholders' ownership and context-specific design for more politically and socially acceptable and sustained solutions, flexibility and adaptivity of the methodology which is, however, supported by a well-structured process and an experienced facilitation, solid evidence base, incorporation of the UN 2.0 capabilities, and MEL, treated not as a back-end reporting requirement but as a dynamic tool for process steering and empowerment.

In this sense, a broad adoption and institutionalization of the IPL has far going practical implication for the governance and decision-making.

The conventional policy-making process consists usually in one or few (external) experts advising policy makers and formulating a policy based on little evidence. Even if some stakeholders are consulted, it tends to be done to obtain information from them rather than actively engage them in decision-making. Sometimes, such consultations serve to “tick the box” on the participation requirement.

IPL, to the contrary, consists in a process made of iterative consultations where stakeholders discuss, exchange, learn, negotiate and make decisions collectively to co-create innovative and transformative solutions.

Such process requires time as IPL are not done over a day, and resources for consultative events etc. But first and foremost, IPL requires a deep mindset shift and enhanced capacities for stakeholders to engage meaningfully and on an equal footing. Those who usually are in power need to open up to hear and consider other voices and let go of their interest, experts need to value experiential knowledge of people without formal education, the vulnerable need to speak up. Functional capacities are essential, such as capacity to navigate complexity and to network, facilitation, deep listening, negotiation, consensus building etc. Currently, these capacities are usually poor or lacking at all. While the well-conducted IPL is itself a capacity development, as the participation in the process boost these capacities and

empower stakeholders, more emphasis is needed in education at different levels to focus not only on technical skills, but also on functional capacities.

In comparison to a top-down decision-making, the very same characteristics of the IPL that may seem complex to implement, lead to much more innovative and transformative solutions, relevant to the context and that are socially acceptable, addressing multifaceted nature of the issue and diverse needs, and hence guaranteeing their more impactful and sustainable implementation.

In this sense, IPL triggers important practical implications both for the way policies are made, and their outcomes.

5. Theoretical Implications

While participatory approaches to policy making are not new, they are gaining track. The IPL brings a new quality through its holistic and innovative methodology triggering a paradigm shift in relation to governance and decision making. Theoretical boundaries of multi-actor governance are boosted through shifting towards experimental governance, collaborative and inclusive policy-making, evidence-based policy, user-centered design, adaptive learning, and innovation upscaling, acting as hubs for innovation leading to broader systemic changes. Alexandrova-Stefanova et al.2024 identified IPL as one of the most powerful innovation for agrifood system transformation (based on votes of approx. 300 experts and stakeholders), and FAO is scaling it out in diverse country contexts, paving the way for an accelerated agrifood systems transformation.

In fact, the IPL methodology offers several important theoretical contributions to the fields of policy studies, innovation systems, and participatory governance. First, by framing policy development as a co-creative, multi-actor process, the IPL approach challenges linear models of policymaking. It aligns with network-based theories that emphasize the socially embedded nature of knowledge production and decision-making.

Second, the operationalization of the Agricultural Innovation Systems (AIS) framework through governance innovation extends the scope of innovation beyond technological advancement, positioning policy processes themselves as sites of systemic change.

Third, by acknowledging the risks of elite capture, inefficiency, and participation fatigue, the IPL approach supports a more nuanced, power-aware understanding of participatory governance.

Fourth, the integration of informal knowledge sources, behavioural insights, and foresight tools broadens theoretical frameworks in policymaking and values pluralism and anticipatory governance. Finally, the emphasis on real-time learning through embedded MEL advances theoretical understandings of institutional change as a dynamic and negotiated process. The IPL experience thus contributes to developmental evaluation by positioning MEL as an intrinsic part of adaptive governance and innovation.

6. References

Alexandrova-Stefanova, N., Nosarzewski, K., Mroczek Z.K., Audouin, S., Djamen, P., Kolos, N. & Wan, J. 2024. Shaping sustainable agrifood futures: pre-emerging and emerging technologies and innovations for impact - An extended global foresight report with regional and stakeholders' insights. Rome, FAO and Paris, CIRAD. <https://doi.org/10.4060/cd2743en> - <https://agritrop.cirad.fr/610673> Revised November 2024

Engaging AKIS actors in shared learning with researchers: The Re-Livestock Project

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Short abstract

Re-Livestock is a five-year EU-funded research project which brings together farmers, researchers, and other Agricultural Knowledge and Innovation Systems (AKIS) actors to identify and promote science-based innovations that support both GHG reduction and resilient livestock systems. Central to this effort are annual stakeholder workshops conducted across 13 case studies in eight European countries. Each case study established a forum of AKIS actors which was led by a case study facilitator. Facilitators, mostly livestock researchers with limited experience in group facilitation, were trained and supported to lead the workshops. Initial findings from Year 1 of the project show high levels of engagement, with 151 stakeholders participating, 46% of these being farmers. Facilitators used a variety of interactive methods to effectively engage with workshop participants including plenary discussion and breakout groups. Facilitators noted both positives (active participation and open discussion) and challenges (participant recruitment and managing group discussion) with their groups. Insights and reflections from the workshops are shared with the project partners and used to inform subsequent annual workshop design. Overall, this work demonstrates a practical and promising model for engaging AKIS actors and integrating stakeholder perspectives into research processes.

1. Purpose

Reducing greenhouse gas (GHG) emissions from livestock systems requires farmers to identify and adopt climate mitigation practices and technologies. Research highlights the influence of the AKIS (Agricultural Knowledge and Innovation System) on farmers' decisions (Moeyersons & Mathijs, 2024) and the importance of knowledge-sharing between researchers and AKIS actors for agricultural innovation (Cruz et al., 2022). Re-Livestock, a five-year EU-funded research project, aims to promote innovative practices to reduce GHGs from livestock farming. The project brings together farmers, AKIS actors, and researchers from across Europe to develop innovative science-backed approaches tailored to diverse livestock systems and regions.

Collaboration is seen as central to identifying and validating these practical innovations, and in the Re-Livestock Project this is facilitated via stakeholder forums. The objective of the stakeholder forums is to engage a diverse range of stakeholders to better understand the changes required within the livestock sector and to enable co-innovation in climate change mitigation and adaptation practices. In doing so, the forums consider the diverse experiences and perspectives of the main actors within the associated AKIS. The forums also work to identify practical solutions that promote sustainable transformation and resilience, ensuring these solutions are acceptable to stakeholders and grounded in reality. For each case study, four rounds of annual stakeholder forum workshops are proposed to take place over the course of the Re-Livestock Project. These forum workshops not only seek stakeholder input

on different topics, but they also provide a platform for sharing project results and facilitate unique interactions between researchers and a range of actors in the livestock sector. This paper will outline how these stakeholder forum workshops were established and implemented, as well as detailing some initial findings from the first round of workshops.

2. Design

At the outset, Re-Livestock Project partners identified 13 case studies to assess livestock system resilience. Case studies were focused on certain innovative practices in dairy, beef, and pig farming systems in eight EU countries, offering a diverse sample of European livestock contexts (Table 1). For each case study, a forum of AKIS actors was established based on farmers identifying their key information sources related to the case study practice, ensuring a farmer-centric approach. Some of these actors were already involved in the case study, whilst others were not. These AKIS actors are invited to an interactive annual workshop that is facilitated for each case study, which initially (Year 1) explored drivers and barriers to resilient farming, and subsequently (Year 2) will identify what future resilient farms might comprise. Each case study workshop is led by a facilitator who is a subject expert to that case. Many of these workshop facilitators are livestock system researchers with limited prior experience of group facilitation. Through Re-Livestock, these facilitators received training and mentoring in facilitation skills with training aimed at equipping them with the understandings, tools, and skills needed to effectively manage their own local stakeholder forum workshops. Insights arising from the workshops are subsequently shared with the broader Re-Livestock research team demonstrating the value of an iterative learning approach.

3. Findings

In Year 1 (September 2023 - April 2024), 13 stakeholder forum workshops (one virtual and rest in-person) were undertaken, each lasting 2.5 – 3 hours. Across all workshops, 151 stakeholders participated, almost half (46%) of whom were farmers (Table 1). Other participants included veterinarians, feed merchants, animal nutritionists, and agricultural advisors.

Table 1: Attendance at the first round of case study stakeholder forum workshops

	Case Name	Country	Total Stakeholders	No. farmers
1	100% grass-fed cows	Switzerland	13	10
2	Re-breeding livestock for resilience	Netherlands	12	6
3	Animal welfare and mitigation	Italy	12	5
4	By-products as a feeding strategy on dairy farms	Spain	10	5
5	Compost bedded pack	Spain	9	3
6	100% pasture-fed livestock	UK	9	7
7	Beef cattle in low input systems	Spain	13	9
8	Dual-purpose dairy cattle	Switzerland	10	7
9	Cross breeding in dairy cattle herds	Sweden	9	7
10	Slurry management in pig farmers to reduce GHG	Spain	11	5
11	Implementation of trees in pastoral systems	Denmark	10	0
12	Substituting soy with local legumes	Poland	18	4
13	PLF and heat stress management	Spain	15	1

3.1 Engaging AKIS Actors (first round)

A common agenda was developed by project partners to address the workshop objective which was to explore the concept of resilience; what does resilience mean, and what are some

of the drivers and barriers to innovation which could help to achieve more resilient farming systems. This agenda was pilot tested to ensure its effectiveness and thereafter shared with facilitators to guide workshop discussions. Whilst this agenda was provided, there was flexibility in how the facilitators delivered the workshop and engaged with actors, with some adapting the proposed agenda to suit the nature of the group, the flow of conversation, and the time available.

Facilitators employed a variety of methods to encourage interactive knowledge sharing to explore resilience in farming systems as experienced by stakeholders. Across all workshops, the most used method by facilitators was open plenary discussions, followed by using flipchart sheets to capture responses, exercises with post-it notes, and small breakout groups (Fig 1). Additionally, one-third of facilitators reported using PowerPoint presentations to supplement these activities. Facilitators found that plenary discussion was the most useful method to engage workshop participants, followed by use of flipchart sheets, use of post-it notes, small group discussion, and PowerPoint slides respectively.



Figure 1: Example of plenary discussion (left) and capturing output on flipchart sheets (centre) and using post it notes (right)

3.2 Preliminary Workshop Findings (first round)

Facilitators documented the output of the workshop discussions using a standardised reporting template. Reports from all 13 case studies were then coded and thematically analysed. Preliminary findings from this analysis show that ‘resilience’ is difficult to define and means different things to different people. Some common meanings or themes associated with the term ‘resilience’ in relation to livestock systems include: ‘robustness and continuity’, ‘sustainability and environmental impact’ and ‘creativity and open-mindedness’. The drivers and barriers to innovation for resilient farming systems varied from general to case study specific. Eighty-six barriers and 43 drivers to innovation were identified, all of which were of a social, economic, technological, political, ecological, and demographic nature. Some barriers include a lack of knowledge of the benefits of resilience, and lack of trust between actors within the wider farm system. Drivers include the desire to make a difference as well as the resulting benefits of more resilient systems such as production and financial gains.

3.3 Reflections of Facilitators (first round)

Facilitators were invited to reflect on the process of delivering the first stakeholder forum workshop for their case study group. It is noteworthy that this was the first experience of group facilitation for most of the facilitators. They reported a relatively good level of confidence in managing the case study workshops (average 7.9 out of 10 [ranging from 6 – 9], with 10 being ‘highly confident’) and most ‘enjoyed’ the facilitation process. When considering what ‘worked well’, facilitators highlighted active participation and discussion from workshop participants, hosting the workshop on-farm, and flexibility in workshop delivery. Facilitators reported that participants were enthusiastic and curious, and found that

farmers enjoyed the meetings and that the meetings were useful in giving farmers space to discuss and express their day-to-day problems.

Whilst largely positive, most (three quarters) facilitators noted challenges in the process which included participant attendance, organising logistics, and managing the group discussions. Securing participant attendance was a difficulty for over a third of facilitators, with facilitators noting that farmers especially were difficult to recruit as they have demanding schedules. Over half of the facilitators cited difficulties with organising logistics of the workshops which included finding a time, date, and location that suited most of the invitees to attend. Managing group discussions was a challenge for a third of facilitators, as they found it difficult to keep discussions on specific topics without stifling conversations or negatively impacting the quality of the participants experience. Other difficulties mentioned included introducing questions to guide the conversation on the right course, adapting the face-to-face session to an online session, and reminding participants that the facilitator was not part of the discussion (i.e. the facilitator maintaining a neutral position).

3.4 Final Reflections

Overall, the experience of the first round of workshops was positive. The facilitators adapted their methods to the realities of their situation while managing to address the core questions posed by the Re-Livestock project. The workshops facilitated a unique bringing together of stakeholders around the case study innovations, and many of these events included a high proportion of farmers, enabling a grounded discussion on the issues of the workshops. Learnings and experience of the first round have been used to shape and inform the design of subsequent stakeholder workshops.

4. Practical Implications

This research outlines practical methods to facilitate meaningful engagement of researchers with key AKIS actors. Establishing forums like these ensures that key stakeholder insights can be iteratively integrated into research. By improving the incorporation of continuous and mutual learning from AKIS stakeholders with research in relation to resilient farming systems, farm advisory services and research can benefit.

5. Theoretical Implications

This work enriches the discourse on embedding an iterative learning process connecting farmers and stakeholders voice to guiding messages for farming systems resilience. To the authors knowledge, this research addresses a current gap in the extension literature by providing practical, documented methods used to successfully identify and engage a diverse range of AKIS actors in the research processes.

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6. References

- J. L. Cruz, L. M. Albisu, J. P. Zamorano & S. Sayadi (2022). Agricultural interactive knowledge models: researchers' perceptions about farmers' knowledges and information sources in Spain, *The Journal of Agricultural Education and Extension*, 28:3, 325-340, DOI: 10.1080/1389224X.2021.1932537

Mertijn Moeyersons & Erik Mathijs (2024). The importance of microAKIS members in the strategic decisions of Flemish horticulture farmers, *The Journal of Agricultural Education and Extension*, 30:5, 733-752, DOI: 10.1080/1389224X.2023.2255173

Bridging the communication gap between Irish farmers and policy makers to support engagement in sustainable agriculture practices

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Short abstract

Farmers are under increasing pressure to adopt new practices and policies around sustainability. This project integrates a scoping review with qualitative insights from focus groups to examine the key issues that impede dialogue between farmers and policy makers. The scoping review surveyed research addressing farmers and policymakers in western industrialised countries to understand the experiences, values, and attitudes of these populations in relation to climate change adaptation – particularly in relation to topics that occasion ambivalence, dilemmas and controversy. In parallel, focus groups were conducted with three stakeholder groups: farmers; agricultural advisors; and policy makers.

Through the scoping review, positive views of the potential for adoption of climate-smart agriculture were found, and farmers showed a range of perspectives on climate adaptation. In the focus group, participants from the farming community reported feeling marginalized by policy directives that fail to account for operational challenges. Agricultural advisors and policymakers pointed to a need for improved tools that facilitate two-way knowledge exchange that would support farmers in adapting to new practices and for resolving ambivalence. Taken together these studies highlight critical issues in current communication practices and policy development and offer steps for developing inclusive and effective agricultural policies.

1. Purpose

Farmers are under increased pressure to adopt new practices and policies around climate change and sustainability. Climate change policy is needed both to reduce the impact that certain agricultural practices have on the environment, as well as the growing impact that climate change and environmental degradation is having on agri-food systems and food production (Kumar et al., 2022). Research has highlighted that agricultural workers, in addition to being a population that generally experiences high levels of stress, have identified climate change policy and its implications for the future of practice as a key stressor (Russell et al., 2023). In considering this, the need for effective communication and inclusive policy development, particularly in the context of escalating global climate change challenges, emerges as critical.

This project employed two components, the first being a scoping review of existing literature which was undertaken to map the extant literature dealing with the oft contrasting motivational perspectives of agricultural workers and agricultural policy makers within European high-income countries, in relation to the challenges posed by environmental degradation and climate change. This review focused additionally on identifying the key dilemmas that these stakeholders report grappling with in relation to developing and

adopting pro-environmental agricultural policies, in order to inform on the suitability and points of relevance that the counselling approach of Motivational Interviewing (MI; Miller et al., 2023), which offers evidence-based techniques for working with ambivalence and aiding in the resolution of dilemmas, has for these stakeholders with regards to improving communication on climate adaptation issues.

The project's second component used qualitative focus groups and one-to-one interviews to explore the key dilemmas and challenges Irish farmers currently face when adopting environmental sustainability practices, even when they may be financially viable. By involving agricultural advisors and policymakers in discussion groups, we also examined how existing communication practices and structures may impede or inhibit effective dialogue and collaboration between policymakers and farmers on the ground. Finally, we explored how communication and farmer engagement with pro-environmental agricultural policies could be improved using Motivational Interviewing techniques. Combined, the dual methodologies in this project were designed to provide evidence from both the existing literature and stakeholders, ultimately allowing us to understand systemic barriers to communication and identify strategies that will build trust, mutual respect, and the co-creation of policies that resonate with the lived experiences of the Irish farming community.

These studies are rooted more widely within the wider project titled 'Sow what?': Connecting Farmers and Policy Makers on Climate Change which is funded by the Irish Environmental Protection Agency and is being completed between the Agri Mental Health Group, which is composed of academics from University College Dublin, Technological University Dublin, and South East Technological University. The ultimate goal of this project is the creation and validation of two user-friendly, cost-effective and scalable dilemma-management protocols. One will be designed for delivery by farmers for farmers, as a means of sharing psychological tools to help troubleshoot climate change farming dilemmas. The second protocol will be designed to provide policy makers and agricultural advisors with a decision-making and communication toolbox that authentically factors in farmers' needs in ways that are both destigmatizing and inclusive.

2. Method

The scoping review surveyed existing research addressing the farmers and policymakers in western industrialised countries to understand the experiences, values, and attitudes of these populations in relation to climate change adaptation – particularly in relation to topics that occasion ambivalence, dilemmas and controversy. Following the preregistration of this review's methodology, a total of 5916 papers were acquired from academic sources hosted via PubMed, PsychINFO, Scopus, Agricola, Web of Science, and Sociological Abstracts, without restrictions on publication year but requirements for the studies to be peer-reviewed and available in the English language.

These articles were be screened by pairs of reviewers in accordance with strict inclusion criteria which required a sample composed of a majority of relevant stakeholder groups including farmers, farm workers, agricultural advisors, policymakers involved in climate change or agricultural policy, and climate activists, without limitation on farming industry in any of these stakeholder group types. Additionally, included studies were required to explore reactions from the target populations towards climate change or climate change policies, with reactions including general experience, attitudes, and values/concerns in relation to climate change or climate change policy.

The review considered experimental and quasi-experimental study designs including randomized controlled trials, non-randomized controlled trials, pre/post studies and interrupted time-series studies in addition to analytical observational studies including prospective and retrospective cohort studies, case-control studies and analytical cross-

sectional studies will be considered for inclusion. This review also considered descriptive observational study designs including case series, individual case reports and descriptive cross-sectional studies for inclusion. Qualitative studies were also considered that focus on qualitative data including, but not limited to, designs such as phenomenology, discourse analysis, grounded theory, ethnography, and qualitative description. Review papers, concept papers, opinion pieces, or any sources that do not include original data were excluded.

Following title and abstract screening as well as full text review, 1448 studies were removed from the original yield as they were duplicates, 4316 studies were removed at the title and abstract screening stage due to topic irrelevance or incorrect location, 72 studies were removed at the full text screening due to irrelevant location, 19 studies were removed at this stage due to incorrect sample composition, 15 studies were removed due to a lack of original data, leaving a final total of 46 studies for extraction. Extraction was performed by a team of four reviewers with full moderation of each study.

In parallel, the qualitative second component employed an exploratory research design using focus groups as the primary method of data collection, with one-to-one interviews used to collect data from participants who may be uncomfortable with group participation or are from hard-to-reach communities. Two homogeneous focus groups took place for farmers and two for agricultural advisors, consisting of between 4 and 5 participants in each. Participants were recruited through a stratified sampling strategy to ensure as much diversity as possible within the areas of gender, age, geographical location, farmer or advisor expertise. The final two focus groups contained a mix of environmental advocates, farm representatives and policymakers.

Discussions took place and were recorded within the Zoom software to support their accurate online transcription. Topic guides, in the form of specific questions, were developed beforehand in consultation with the 'Sow What?' Stakeholder Steering Group to ensure their relevance and ability to support effective engagement across farmers, advisors, and policymakers. These questions were used in the discussions in a naturalistic and semi-structured format, to probe perceptions regarding sustainable farming practices and the efficacy of current climate change policies. We also evaluated the viability of using Motivational Interviewing (MI) to uncover ambivalence and motivate behavioural change in farmers, by using pre-recorded demonstrations to generate feedback from participants across all focus groups.

Data from the focus groups and discussions was subsequently anonymised and uploaded to NVivo software to facilitate a thorough Thematic Analysis (TA) broadly following the systematic six-step process of Braun & Clarke (2006). However, we used TA in a functional and abductive manner where we also incorporated the information from the 'Sow What?' scoping review and principles of Motivational Interviewing within the early steps of their process. Researchers also remained open to any new and inductive insights from the participant's lived experiences, taking them at face value using interpretative phenomenological analysis to provide a discursive analysis. In this manner, a range of themes were identified which highlighted the modern Irish farmer experience, including ambivalence and dilemmas in the adoption of new practices, as well as the need for improved tools to facilitate two-way knowledge exchange between all stakeholders.

3. Findings

Data from the scoping review highlighted trends within the literature with regards to time of publication, sample size and composition of studies, the utilisation of theoretical frameworks

in research on this topic, information concerning the current knowledge and notable gaps concerning the experiences, attitudes and values of stakeholders with regards to climate change, as well as the common dilemmas experienced by participants with regards to this issue.

Of the final studies included, it was observed that a majority of 78% of published studies on this topic focus only on farmers or agricultural workers, with a very limited number of studies exploring the perspective of other key stakeholders including agricultural advisors and policymakers. Notably, very few studies reported population demographic information, meaning that when considering the perspectives of these stakeholders on climate issues, information such as the age or gender of the included samples is not clear. Among the included studies only 37% of studies included information on the age of participants and 46% of studies reporting information on gender proportions. 33% of studies employed an explicit theoretical framework, with the theory of planned behaviour being the most common and MI receiving little attention from existing research.

Through the scoping review, positive views of the potential for successful adoption of climate-smart agriculture in this sector were found, with policymakers seeing potential for collaboration (Raymond & Robinson, 2013) and farmers showing a range of heterogeneous ambivalent perspectives on climate adaptation relevant to the development of MI-based tools, but generally held values of care for nature and the environment (Barnes et al., 2013; Stupak et al., 2019). Recurring barriers to climate adaptation for farmers included financial concern, trust, disengagement in the development of governing policies, and sense of familial tradition. Recommendations for future research utilising specific techniques for engagement including MI are made, with suggestions for stronger reporting conventions and the exploration of specific theoretical frameworks given.

During the focus groups, both farmers and advisors reported awareness of agriculture's environmental responsibilities and also confidence in their ability to problem-solve or overcome any future challenges. Participants from the farming community reported feeling disconnected and marginalised from their urban neighbours and policymakers, who they felt no longer recognise the important role that farmers occupy in the food production chain. Farmers often highlighted "farming is a business" and in a lot of cases, its sustainability is likely to be most affected by financial instability or the struggle for a successful work/life balance. They regularly promoted that these factors had led to them "pulling back" or "cutting your cloth" in their attempt to improve financial or mental health. Farmers felt they received most support from their peers and community, with the role of agricultural advisors viewed as a support service for policy compliance. Agricultural advisors, on the other hand, promoted that their agricultural expertise, knowledge with policy, and interpersonal communication skillset successfully combined to promote positive practices and policy compliance among farmers. Both cohorts reported a communication disconnect between themselves and policymakers.

Our research indicates that publicly funded agricultural advisors are recognised for their important role in moderating and organising farmer discussion groups. These groups are viewed, by both the advisors and the farmers who engage with them, as being essential for farm knowledge transfer. For farmers outside of this network, informal peer or friend groups provide a similar function. Social media use for insights into dilemmas and problem-solving in technical areas is also an emerging source of information among farmers of all ages.

All focus groups reported that farmers are currently struggling with the ever-increasing complexity of the bureaucratic process, and the perceived increase in oversight, when

engaging with agricultural policy compliance. Additionally, the lack of feedback and the opportunity for farm income to be significantly affected due to submission errors or oversight on the part of either the farmer or the advisor has contributed to reportedly raised levels of anxiety for both, resulting in a reluctance to promote proactivity or scheme engagement. All focus groups recognised the need for a better way of translating complex scientific data into actionable guidance, ideally, one which facilitates a two-way knowledge exchange between policymakers, farmers and advisors.

4. Practical and theoretical implications

Over generations, through the active engagement of farmers with the social, technical, and financial support of government and farm representative groups, an established communication infrastructure already exists within the farming community. Currently, agricultural advisors, under direction from government, share technical and policy-related information to farmers through organised discussion groups and one-to-one consultations. For those outside of this support network, a country-wide farmer-to-farmer information sharing network exists that can be accessed by hard to reach, and maybe somewhat change-resistant, cohorts of farmers. Within the project, stakeholders from all three groups have expressed that current levels of farmer engagement and ambivalence in the area of environmental sustainability provide an opportunity to improve communication using Motivational Interviewing. Training farmers, advisors and policymakers in MI techniques will encourage the dialogue between the groups to be more open, facilitate collaborative problem-solving practices, and use the expertise of all parties to overcome the farming-related dilemmas posed by climate change.

Taken together, the combined insights from the scoping review and focus group discussions have illuminated critical issues in current communication practices and in policy development. Irish farmers feel that their expertise, contributions to date, and lived experience have not been incorporated into existing policy-related practices. Both farmers and advisors strongly advocate for generating a two-way communication pathway between government and those on the ground, where feedback and a renewed focus on evidence-based interventions can address the mistrust and disconnect between farmers and policy makers apparent within our study.

Finally, many stakeholders have reported a reluctance by both farmers and advisors to proactively engage with new or existing sustainability initiatives due to their perceived outcome uncertainty, levels of risk or investment, or simply bureaucratic workload and oversight. By grounding future policy development in the lived experience of farmers and employing communication strategies like MI, there is an opportunity to improve the credibility and acceptability of future climate change initiatives. Ultimately, we promote these findings as a roadmap for developing more inclusive, effective, and sustainable agricultural policies that not only support environmental goals but also uphold the values and livelihoods of the farming community.

5. References

- Barnes, A. P., Islam, M. M., & Toma, L. (2013). Heterogeneity in climate change risk perception amongst dairy farmers: A latent class clustering analysis. *Applied Geography (Sevenoaks)*, 41, 105–115. <https://doi.org/10.1016/j.apgeog.2013.03.011>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.

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- Kumar, L., Chhogyel, N., Gopalakrishnan, T., Hasan, M., Jayasinghe, S., Kariyawasam, C., Kipkemboi Kogo, B., Ratnayake, S. (2022). Climate change and future of agri-food production. *Future Foods*. 49-79.
- Miller, W. R., (2023). *Motivational interviewing: Helping people change and grow* (4th edition). Guilford.
- Raymond, C. M., & Robinson, G. M. (2013). Factors affecting rural landholders' adaptation to climate change: Insights from formal institutions and communities of practice. *Global Environmental Change*, 23(1), 103–114. <https://doi.org/10.1016/j.gloenvcha.2012.11.004>
- Russell, T., Stapleton, A., Markey, A., McHugh, L. (2023). Dying to Farm: Developing a Suicide Prevention Intervention for Farmers in Ireland. *Health Service Executive National Office for Suicide Prevention*.
- Stupak, N., Sanders, J., & Heinrich, B. (2019). The Role of Farmers' Understanding of Nature in Shaping their Uptake of Nature Protection Measures. *Ecological Economics*, 157, 301–311. <https://doi.org/10.1016/j.ecolecon.2018.11.02>
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Learning from collaboration in agricultural innovation systems: changing capabilities, opportunities, and motivation

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Short abstract

The DeSIRA Initiative, funded by the European Commission, has invested in collaborative approaches that bring together research institutions, government agencies, farmer organisations, private sector entities, and civil society in various configurations of collaborative platforms. This learning review examined eight diverse case studies to understand what makes these collaborative platforms effective. Guided by an analytical framework inspired by the Capabilities, Opportunities, and Motivation model for Behavioural change (COM-B), the review reveals that successful collaboration emerges from deliberate investment in three interconnected domains: building collaborative capabilities, enhancing opportunities for engagement and resource access, and continuously reaffirming the legitimacy of the collaborative process and its outcomes. The COM-B elements work together synergistically—improved capabilities help stakeholders better recognise and act on opportunities, while positive experiences strengthen motivation for continued engagement. Practical benefits (or the expectation thereof) for all stakeholders drive sustained engagement, whilst trust in the collaborative process is critical for overcoming differences and negotiating trade-offs. Working through existing structures, rather than creating parallel systems, proves more sustainable, while governance mechanisms must balance clarity with flexibility. Prioritising the building of strong collaborative foundations is key for future projects while maintaining flexibility to adapt to local contexts.

1. Purpose

The DeSIRA Learning Review aims to provide insight and practical knowledge to project designers and managers, as well as donors on how to assess and foster multistakeholder collaboration in innovation.

2. Design

The review process was guided by the following learning questions: What type of diversity in collaboration platforms do we see? Why do people and organisations engage in collaborative platforms? What enables and challenges collaboration in these platforms?

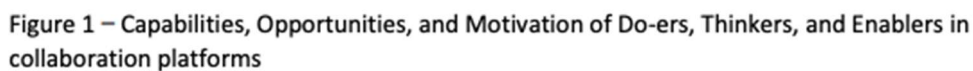
The analytical framework that was combined the following elements:

Trust and Legitimacy: The Foundations of Effective Collaboration - When organisations and individuals decide to work together they are driven by a complex array of motivations, chief among them being "legitimacy"—the perception that collaboration is an appropriate, effective, and justified approach to addressing their needs (Bäckstrand, 2005). One fundamental aspect is instrumental or “output” legitimacy—the belief that collaboration offers viable means to satisfy stakeholders' needs or protect their interests (Emerson & Nabatchi, 2015; Scharpf, 1999). This pragmatic view focuses on the anticipated benefits and returns on investment that partners expect to gain through working together rather than pursuing their goals independently. Alongside this is "procedural legitimacy," which concerns the fairness and inclusivity of the collaborative process itself (Horan, 2019; Koski et al., 2018; Scharpf, 1999). This dimension addresses questions about how the partnership is initiated, developed and maintained, emphasising aspects such as transparent decision-making, equitable participation, and adherence to shared values.

COM-B - While legitimacy provides motivation, the COM-B model for behavioural change, as described by Michie et al. (2011), suggests that successful collaboration requires two additional critical elements. Firstly, stakeholders need appropriate capabilities—the knowledge, skills and expertise necessary for effective partnership. These might include negotiation abilities, systems thinking, or technical knowledge relevant to the shared challenge. Secondly, collaboration requires suitable opportunities—the resources, authority and contextual conditions that enable joint work. These could encompass adequate funding, supportive organisational policies, or favourable regulatory environments. The COM-B model provides a useful framework for understanding how behaviour change occurs through the interaction of capabilities (C), opportunities (O) and motivation (M). This model has been increasingly adopted in impact evaluation and contribution analysis approaches (Mayne, 2021).

Do-ers, Thinkers, and Enablers - We categorised various types of stakeholders involved in collaborative platforms into three groups: Do-ers, Thinkers, and Enablers (Froebrich and Groot, 2023). Organisations directly implementing and developing innovation are labelled ‘Do-ers’. ‘Thinkers’ refer to research organisations involved in design of innovations and think tanks supporting policy makers. ‘Enablers’ are typically government and financiers or donors.

Phases of collaboration - We also distinguish between development phases of collaborative platforms. Following Brouwer et al. (2019), we describe these as the initiation phase, planning phase and collaboration phase. During these phases different the C-O-M for collaborative engagement develop and change. Figure 1 provides a visualisation of the COM elements and the phases in establishing collaborative platforms.



3. Findings

The cases studied proved to represent a rich diversity of collaboration platforms in various context³. Each of these cases offered valuable insights into different aspects of multi-stakeholder collaboration, from technical innovation to institutional transformation, and from market development to gender inclusion. This variation was useful for identifying common elements in collaboration across the cases and to extract overarching insights. These have been subsequently classified into three broad categories:

- a. Why collaborate in platforms?***

Addressing Complex Problems Together - For many participants, the most important motivating force is the prospect of addressing problems too complex for any single

organisation to tackle alone. This relates to the notion of outcome or instrumental legitimacy of collaboration. Most cases demonstrated how visible progress motivates continued participation. When stakeholders witnessed tangible benefits their commitment to collaborative processes deepened substantially.

Fair processes - Beyond tangible outcomes, procedural legitimacy—the fairness and transparency of the collaborative process—was also a key motivator. When stakeholders had access to objective information and spaces for open dialogue, they moved beyond suspicion toward collective problem-solving. Transparency serves as a foundation for trust, and trust as a foundation for collaboration. Fair distribution of benefits further sustained motivation. Successful collaborations effectively link individual interests with broader collective goals, ensuring that all participants see value in the process and results. Clear roles and responsibilities, regular progress updates, and shared decision-making processes create procedural legitimacy that sustains engagement. Fair distribution of benefits and tangible improvements for all stakeholders prove crucial for maintaining engagement.

A Cyclical Relationship - This motivational dynamic is particularly powerful when it connects to stakeholders' own interests while also serving the broader collective good. When participants can see how their individual objectives align with the shared vision and experience concrete benefits from working together, their motivation becomes more deeply rooted. What emerges is a cyclical relationship: initial collaboration creates the conditions for trust to develop, which enables deeper collaboration. While conventional wisdom might suggest that trust must precede collaboration, a more dynamic interplay unfolds. As collaboration develops, instrumental considerations typically gain importance. The partnership must demonstrate tangible progress toward collective goals to maintain momentum. Without visible results, even the most procedurally sound collaboration risks disintegration as partners question its value.

b. What enables collaboration in innovation?

Capabilities: Building Foundations for Collaboration - Motivation alone, however compelling, rarely suffices without the capabilities to collaborate effectively. Across the case studies, we observe deliberate investments in building individual and collective capabilities that enable meaningful participation. Effective collaboration also depends on leadership and facilitation. Skilled facilitators bridge institutional cultures, manage power dynamics, and maintain momentum. Clear governance structures ensure balanced representation. At its core, capability building involves knowledge exchange, mutual learning, and problem-solving. Through ongoing interaction, stakeholders develop shared understanding, analytical skills, and access to previously unavailable resources, forming a solid foundation for sustained collaboration.

Opportunities: Creating Spaces for Collaboration - Beyond motivation and capabilities, collaboration requires structured opportunities—spaces, institutional support, and resources for joint work. Collaboration platforms create trust and institutional arrangements—both formal (agreements, partnerships) and informal (ways of working together). These spaces allow resource pooling, strengthening joint initiatives that no single actor could achieve alone.

Interplay of Capabilities, Opportunities, and Motivation - The COM-B framework illustrates how these elements reinforce each other:

- Capabilities enable stakeholders to recognize and act on opportunities.
- Opportunities allow capabilities to be built and applied.
- Positive experiences enhance motivation, driving investment in collaboration.

Gaps in any element can undermine collaboration. Collaboration thrives when power imbalances are addressed, context-specific strategies are used, and sustainability is built into capability, opportunity, and motivation development.

4. Practical Implications

By examining diverse contexts, we identify key operational insights that enable effective collaborative platforms.

Building Trust and Legitimacy - Collaboration in agricultural systems is widely accepted, but structuring and governing it presents challenges. Addressing resistance head-on strengthens trust and commitment. This requires recognizing diverse motives, capabilities, and power imbalances. Neutral facilitation—often by research organizations—supports trust, while celebrating achievements maintains engagement.

Developing Collaboration and Facilitation Skills - Effective collaboration requires specific skills in listening, negotiation, and communication. Facilitation is critical for productive engagement, with structured training, mentorship, and partnerships enhancing effectiveness. Capability-building should be tailored to different stakeholders, ensuring marginalized groups receive adequate support.

Institutional Integration for Action - Collaboration must move beyond discussion to implementation, requiring institutional support. Liaison roles, secondments, and shared information systems can embed collaboration into structures. Regular reviews help identify barriers and advocate for institutional reforms.

Strategic Flexibility Amid Changing Contexts - Collaborations must adapt to shifting political, economic, and social landscapes. Horizon scanning, scenario planning, and structured learning enable responsiveness. Governance should balance stability with adaptability, using core teams for continuity and ad hoc groups for emerging issues.

Ensuring Long-term Sustainability - Sustaining collaboration requires maintaining capabilities, motivation, and opportunities beyond initial funding. Knowledge management, locally led training, and financial sustainability strategies (e.g., service models or institutional commitments) are crucial. Stakeholder engagement must be continually reinforced through tracking benefits and clear value communication.

Effective Communication and Knowledge Sharing - Collaboration thrives on accessible, multi-channel communication. Knowledge products should suit different audiences, while structured exchange events (e.g., learning journeys, communities of practice) promote shared learning. Tailored approaches ensure inclusivity across technological and linguistic differences.

Delivering Tangible Benefits - Sustained collaboration depends on delivering real benefits. Tracking systems ensure fair distribution, while staged implementation secures early wins.

Stakeholder feedback mechanisms adjust approaches, and clear benefit communication fosters continued engagement.

Holistic Evaluation for Impact - Evaluations should measure both tangible results (adoption of innovations, institutional changes) and collaborative processes (trust-building, power dynamics). The COM-B framework helps assessing capabilities, opportunities, and motivations. Crucially, the most meaningful evaluations often come from stakeholders themselves, as their continued engagement signals real success.

5. Theoretical Implications

We propose a new analytical framework that combines outcome and procedural legitimacy concerns with the COM B model for assessing the interplay and cyclic relations between capabilities, opportunities and motivational factors influencing and resulting from multistakeholder collaboration.

6. References

- Bäckstrand, K. (2006). Multi-stakeholder partnerships for sustainable development: rethinking legitimacy, accountability and effectiveness. *European environment*, 16(5), 290-306.
- Brouwer, H., Woodhill, J., Hemmati, M., Verhoosel, K., & Van Vugt, S. (2019). *The MSP guide: How to design and facilitate multi-stakeholder partnerships*. Practical Action Publishing. <https://library.wur.nl/WebQuery/wurpubs/580180>.
- Emerson, K., & Nabatchi, T. (2015). Evaluating the productivity of collaborative governance regimes: A performance matrix. *Public Performance & Management Review*, 38(4), 717-747.
- Froebrich, J. & Groot, A.E. (Eds) (2023). *REFOOTURE: Moving towards Regenerative Inclusive Food Systems*. Wageningen University & Research, The Netherlands. <https://doi.org/10.18174/629017>
- Horan, D. (2019). *A New Approach to Partnerships for SDG Transformations*.
- Koski, C., Siddiki, S., Sadiq, A. A., & Carboni, J. (2018). Representation in collaborative governance: A case study of a food policy council. *The American Review of Public Administration*, 48(4), 359- 373.
- Mayne, J. (2017). Theory of change analysis: Building robust theories of change. *Canadian Journal of Program Evaluation*, 32(2), 155–173. <https://doi.org/10.3138/cjpe.31122>
- Mayne, J. (2020). Contribution analysis and the long-term perspective: Challenges and opportunities. In K. Forss, I. Lindkvist, & M. McGillivray (Eds.), *Long term perspectives in evaluation. Increasing relevance and utility* (pp. 46–68). Routledge.
- Michie, S., van Stralen M. M. and R. West. (2011). The Behaviour Change Wheel: A New Method for Characterising and Designing Behaviour Change Interventions. *Implementation Science* 6 (1): 42. <https://doi.org/10.1186/1748-5908-6-42>
- Scharpf, F. W. (1999). *Governing in Europe: Effective and democratic?* Oxford University Press.
- Ton, G. (2021). *Development Policy and Impact Evaluation: Learning and Accountability in Private Sector Development*. 10.4337/9781839100871.00042

Enhancing Agricultural Advisory Services Through Impact Assessments: Lessons from the CARE r4d Project in West Africa

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Short abstract

Impact assessments are essential for enhancing agricultural advisory services by identifying effective practices and barriers to adoption. This study draws on insights from the CARE r4d project, which evaluated the long-term adoption of agroecological practices introduced by the ORM4Soil and IFWA projects in Mali, Burkina Faso, Benin, and Ghana. Using exploratory field surveys involving 417 farmers, the study assessed the uptake of *Gliricidia sepium* intercropping, organic soil amendments, and insect-based poultry feed. Adoption rates were high among direct project beneficiaries, particularly where practices led to visible improvements in yields, soil health, and poultry productivity. However, widespread adoption was hindered by practical constraints such as seed availability, labor shortages, and lack of technical knowledge. Transdisciplinary workshops were instrumental in translating these insights into actionable improvements in advisory strategies, including enhanced seed distribution, tailored training, and peer learning networks. This approach illustrates how participatory impact assessments can bridge research and practice, informing adaptive and context-sensitive extension services. The findings underline the importance of co-learning and farmer engagement in scaling agroecological innovations.

1. Purpose

Impact assessments of agroecological projects provide critical feedback for improving advisory services by identifying both adoption trends and barriers to uptake. This study examines how the Capitalization of Agroecological Research Evidence (CARE r4d) project assessed the long-term adoption of agroecological practices promoted by the Organic Resource Management for Soil Fertility (ORM4Soil) and Insect as Feed for West Africa (IFWA) projects. Surveys conducted in Mali, Burkina Faso, Benin, and Ghana revealed widespread adoption of these practices while highlighting key constraints that hindered their broader dissemination. The insights generated were used to refine extension strategies through transdisciplinary workshops involving researchers, extension officers, and farmers. This research underscores the value of participatory impact assessments in guiding adaptive extension systems. By systematically capturing and responding to farmer experiences, the study demonstrates how feedback-informed advisory models can better support the sustainable scaling of agroecological innovations.

2. Methodology

Field surveys were conducted in former ORM4Soil and IFWA intervention areas, assessing 417 farmers' adoption of techniques such as *Gliricidia sepium* intercropping, insect-based poultry feed, and organic resource application for soil fertility. A mix of direct project beneficiaries and other community members were interviewed to understand knowledge diffusion and

barriers to uptake. Transdisciplinary workshops then integrated these insights into the design of more targeted training programs for extension services.

3. Findings

Adoption rates varied by practice and country: in Mali and Ghana, nearly all ORM4Soil-trained farmers continued using Gliricidia intercropping due to improved yields and soil fertility benefits. However, farmers outside the project struggled with seed access and propagation issues, limiting further adoption. In Burkina Faso and Benin, 71–80% of IFWA-trained farmers continued insect-based poultry feed techniques, citing better poultry health and egg production as motivating factors. Non-adopters often faced skill gaps, lack of time, or poultry losses unrelated to the practice. Additionally, high Gliricidia mortality rates in Burkina Faso underscored the need for improved establishment support. Transdisciplinary workshops facilitated knowledge exchange and fine-tuned extension programs to address these adoption barriers, particularly through better seed distribution, training reinforcement, and farmer-to-farmer learning networks. A summary of the findings can be seen on table 1.

Table 1: Summary table with key results from the surveys in the four countries

Country	Respondents	N	Adoption rate	Reasons for adoption	Reasons for non-adoption
Mali	ORM4Soil farmers	15	100%	Soil fertility improvement; Source of fodder, Crop performance; Rapid growth	-
	Other farmers	20	0%	-	Lack of knowledge; Plant mortality; Difficult to protect from animals; Seeds did not germinate
Burkina Faso	IFWA farmers	41	71%	Important feed for poultry; Profitable; Poultry weight gains; Easy protein source;	Animal mortality; Lack of training, Lack of time; Health issues, Theft of animals
	Farmers trained by IFWA farmers	51	77%	Important feed for poultry; Easily available; Poultry weight gains; Nutritional quality	Animal mortality; Lack of training, Lack of time
	Farmers who received Gliricidia cuttings	74	34%	Soil fertility improvement; Source of fodder, Shade for animals; Beauty; Rapid growth; Wind-break	Plant mortality; Difficult to protect against animals; lack of management knowledge
Ghana	ORM4Soil farmers	11	91%	Better yields; Soil fertility improvement; Healthy crops	Shortage of labour
	Other farmers	26	77%	Better yields; Soil fertility improvement; Reduced costs (less chemical fertilizers); Better income	Not enough time; Not enough knowledge; Not aware
Benin	IFWA farmers	105	80%	Important feed for poultry; Profitable; Poultry weight gains; Easy to produce	Difficult process; labour intensive; strong odors

In Mali, all of the farmers (N=15) who tested the agroforestry technique (intercropping with the legume tree *Gliricidia sepium*) in the framework of ORM4Soil have been interviewed by the local partners, as well as 20 farmers from the same and neighboring villages, randomly chosen using the snowball sampling technique. In Ghana, the local team managed to interview 11 out of the 15 ORM4Soil farmers who experimented with the use of empty fruit bunches and cocoa pods as organic resources to enhance their soils, as well as 26 farmers from the same village and two neighboring villages, also using the snowball sampling technique. In Burkina Faso, a total of 91 IFWA farmers were interviewed, 41 of whom were directly trained by the project, and 51 were trained by other farmers. Additionally, the local partners have also interviewed 74 farmers who experimented with planting *Gliricidia sepium* after the Food Systems Caravan passed in the country in 2019. In Benin, the local partners interviewed 105 farmers who have been exposed to the IFWA techniques. The purpose of these explorative surveys was to draw a better picture of the impact of the ORM4Soil and IFWA projects 4 years after the completion of their activities, rather than a quantitative academic exercise. For this reason, there are slight discrepancies in the methodological approaches across countries. In Mali, all of the ORM4Soil farmers were still practicing the technique, especially because they consider that it increases crop yields, and provides both biomass to use as mulch for the soil and as fodder for animals. As for the 20 farmers that were not involved in the project, 18 had heard about *Gliricidia* and 2 had not. From those who heard about it, 6 decided to try it out and 12 did not, especially because they did not know where to get the seeds or didn't have enough information about it. From those who tried to use *Gliricidia*, none of them succeeded because either the seeds they obtained did not germinate, or the propagation by cuttings was not successful. In Ghana, of the 11 interviewed ORM4Soil farmers, 10 still used the techniques they learned with the project, and one did not, due to the lack of workforce in the household. Those who continued claimed that the technique improves yields and long-term soil fertility. In Burkina Faso, 71% of farmers who were directly trained by IFWA still practice the techniques (production of domestic fly larvae and termite trapping), especially because they see a gain in the weight and health of poultry, as well as a higher number of eggs. Those who did not continue the technique mentioned lack of time to dedicate to the process, or that they were not skilled enough, or a decrease in poultry quantities (non-related to the practice) that demotivated them from its use. Among those that were trained by other farmers, the percentage of adopters of the technique was comparable but slightly higher, at 77%, stating the same types of reasons for the adoption or non-adoption of the technique. Still in Burkina Faso, among the farmers to whom Tiipaalga provided *Gliricidia* trees, 25 among the 74 were still using it (same reasons as in Mali), while the remaining ones did not continue, because their trees died or were eaten by animals. It is important to note that the mortality rates of *Gliricidia* were also high in Mali, but the number of trees in the ORM4Soil plots was much higher than the number of trees provided by Tiipaalga to each of the 74 farmers in Burkina Faso. In Benin, the local team interviewed 105 IFWA farmers, and 80% of them have adopted the technique. The reasons for adoption or non-adoption are very similar to those mentioned by farmers in Burkina Faso.

4. Practical Implications

This study demonstrates that integrating impact assessments into the design and evolution of advisory services can significantly improve the relevance and effectiveness of agroecological extension programs. By analyzing real-world adoption challenges—such as

difficulties in seed propagation, labor limitations, and knowledge gaps—extension strategies were refined to offer more targeted, practical support. The use of transdisciplinary workshops involving researchers, extension officers, and farmers allowed for direct feedback loops, enabling advisory services to shift from top-down dissemination models to more responsive, farmer-driven approaches. This model encourages stronger knowledge diffusion, improves training uptake, and increases the likelihood of sustained practice adoption. Furthermore, leveraging farmer-to-farmer networks emerged as a low-cost and effective mechanism to reinforce adoption, especially in areas with limited formal extension presence. These insights are immediately applicable to similar advisory programs seeking to improve the impact and reach of sustainable agricultural practices in smallholder contexts.

5. Theoretical Implications

Theoretically, this study contributes to the literature on agricultural knowledge systems by emphasizing the role of participatory, feedback-oriented methodologies in enhancing the functionality of extension services. It challenges the conventional linear model of knowledge transfer by highlighting the iterative, co-constructed nature of agroecological innovation adoption. The findings support a systems-thinking perspective, wherein farmer engagement is not just a means of data collection, but a core component of adaptive learning and innovation diffusion. Additionally, the study underscores the value of transdisciplinary collaboration in bridging epistemological divides between scientific research and indigenous knowledge systems. By situating advisory services within a broader framework of social learning and co-creation, this research advocates for a reimagined extension paradigm—one that is context-sensitive, dynamically adaptive, and anchored in the lived realities of farming communities.

6. References

- Assefa, S., Alemneh, D. G., & Roriss, A. (2014). Diffusion of scientific knowledge in agriculture: The case of Africa. *Agricultural Information Worldwide*, 6, 34-47.
- Diawudeen, M. (2021). Effect of locally available organic resources on sorghum biomass production and soil properties (M. Phil. thesis). University of Ghana. [Master thesis in the framework of the ORM4Soil project]
- Doumbia, S., Dembele, S. G., Sissoko, F., Samake, O., Sousa, F., Cicek, H., Adamtey, N., & Fließbach, A. (2020). Alley cropped *Gliricidia sepium* (Jacq.) Kunth ex. Walp. enhance soil fertility and yields of cotton, maize, and sorghum in Mali. *International Journal of Food Science and Agriculture*, 4(3), 301-313.
- Edenakpo, K. A., Adjovi, N. A., Pomalegni, S. C. B., Anato, C. H., Amagnide, A., Aboh, A. B., & Mensah, G. A. (2020). Influence des rations alimentaires à base d'asticots sur la reproduction des poulets locaux au Bénin. *Agronomie Africaine*, 32(1), 15-24.
- Miller, S. A. (2021). Effect of locally available P organic resources on soil P-fractions, maize grain yield, and P uptake in the Kwaebibirem district of Ghana (M. Phil. thesis). University of Education Mampong Campus. [Master thesis in the framework of the ORM4Soil project]
- Sousa, F., Zingerli, C., & Pomalegni, S. C. (2024). Knowledge sharing to improve the sustainability of food systems in West Africa: Lessons learned from the Food Systems Caravan. *Knowledge Management for Development Journal*, 18(1), 13-30.
- Tenkorang, P. (2020). Effects of local organic resources for soil fertility improvement technology adoption on land intensification in the Kwaebibirem Municipality and Ada West District of Ghana (M. Phil. thesis). University of Ghana. [Master thesis in the framework of the ORM4Soil project]

Special Session 4B

Test the online PREMIERE repository with tools, tips and tricks for a multi-actor (MA) proposal writing process.

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Short abstract

The Horizon Europe project PREMIERE is building an online repository , designed to centralize tools, tips, and tricks that support a streamlined, cohesive, and efficient multi-actor (MA) proposal process. This organized, easily accessible platform aims to empower underrepresented actors, especially those with limited resources, such as small organizations or newcomers to Horizon Europe projects. Whether you're an experienced coordinator or a first-time participant, the repository offers low-threshold access to tailored resources that meet diverse needs.

A key focus is improving accessibility for harder-to-reach groups, including those with limited time or capacity. Their feedback is essential to shaping the platform.

During this special session, the repository and its development will be introduced and tested. Participants will be assigned or choose a role (e.g., MA newcomer from a small agri start-up) and identify a challenging task related to proposal development. They'll then explore the repository to find helpful tools or guidance. At the end, they'll reflect on their experience: What task did they focus on? Did the repository help? Was anything missing?

This feedback will directly inform improvements to the repository, with the first public version of the repository planned for release in September 2025.

Target group: We welcome both participants with experience in multi-actor projects, as well as non-experienced/newcomers to multi-actor projects who might be interested in joining a multi-actor proposal in the near future (this repository/tool is aimed at them). Preferably there is a presence of both academic as well as non-academic participants (the instrument is agnostic, but should be useful for both). There is no specific limit to the number of participants that can take part in this special session.

1. Purpose

The PREMIERE online repository was developed to address a critical gap in the accessibility and usability of resources for actors involved in Horizon Europe multi-actor (MA) projects. Horizon Europe emphasizes collaboration between diverse stakeholders, including academic institutions, SMEs, NGOs, public authorities, and civil society organizations. However, many of these actors—particularly those with limited experience, time, or resources—face significant barriers to participating effectively in European proposal development and project coordination (Fieldsend et al., 2021).

The repository aims to centralize and streamline access to tools, tips, and best practices that support a more inclusive and efficient MA proposal writing process. By offering a well-organized, user-friendly, and low-threshold digital platform, PREMIERE seeks to empower underrepresented groups and democratize access to Horizon Europe funding opportunities.

The ultimate goal is to foster more diverse, balanced, and innovative consortia that reflect the full spectrum of societal actors.

This initiative is grounded in the belief that knowledge sharing and capacity building are essential to achieving the broader goals of Horizon Europe, including sustainability, innovation, and societal impact. The repository is not only a technical tool but also a strategic intervention aimed at leveling the playing field for all potential contributors to European research and innovation.

2. Design Approach

The development of the PREMIERE repository followed a participatory and iterative design methodology, informed by user-centered design principles and co-creation practices. The process involved multiple phases. We iteratively build a database of tools which combined a rigorous scientific methodology to implement a desktop mapping of tools, i.e., systematic review (Zawacki-Richter et al., 2020), with an iterative, user-focused and Multi-Actor Approach (EIP-AGRI, 2017).

The result of the desktop mapping of tools/toolkits/guidelines resulted by January '25, in the identification of 204 individual tools. These tools were coded, triangulated by three researchers.

Tools were coded on: name, original databass, link, Reviewer, Target audience, Target audience, Type of tool, Proposal aspect, group dynamic, Project phase, Supported as a free to use tool / creative commons, Supported in the English language, Can be understood within reasonable timeframe (30min)

Additionally, all tools were also coded on carefully debated and elaborately defined multi-actor skills, based on PREMIERE sources and the input of consortium members:

1. Supports work with a diversity of professional backgrounds
2. Supports the recognition of, and work with, the limitations of different organisations
3. Supports the transparent communication about agenda's, expectations, and results
4. Supports being comfortable with co-ownership and responsibility of tasks, results, and outcomes
5. Supports gaining experience with multi-actor methods or practical engagements
6. Supports the balance of the needs of both yourself and the consortium as a whole
7. Supports collaboration within an equitable digital co-working space
8. Support a safe, open, and cohesive social culture
9. Supports the active participation of, and focus on end-users

The online platform was built using open-source technologies and designed for accessibility, with features such as search and filter functions and downloadable resources.

3. Practical Implications

3.1 Empowering underrepresented actors

By lowering the entry threshold, the repository enables participation from actors who are typically underrepresented in EU-funded projects. This includes small organizations, rural enterprises, grassroots NGOs, and first-time applicants. These groups often lack the institutional support or experience needed to navigate complex funding landscapes.

3.2 Enhancing proposal quality

Access to high-quality templates, examples, and guidance can significantly improve the quality of proposals submitted. This, in turn, contributes to more impactful and well-structured projects.

3.3 Supporting coordinators and consortia

Experienced coordinators can use the repository to onboard new partners, distribute tasks more effectively, and ensure compliance with Horizon Europe requirements.

3.4 Promoting inclusivity and diversity

The repository supports the European Commission's goals of fostering inclusive innovation ecosystems. By making tools and knowledge more accessible, it helps ensure that a wider range of voices and perspectives are represented in research and innovation activities.

3.5 Improvement through Feedback

Feedback during several pilto tests and a testing period until the end of the project allows users to suggest improvements, report issues, and request new resources. This ensures that the repository is build in a relevant and responsive manner to user needs.

4. Theoretical Implications

4.1 Knowledge democratization

The repository exemplifies the concept of knowledge democratization, where access to critical information and tools is not limited to elite institutions or experienced actors.

4.2 Capacity building in innovation ecosystems

The initiative supports the idea that innovation ecosystems thrive when all actors, regardless of size or experience, are equipped to contribute meaningfully.

5. References

- EIP-AGRI. (2017). Horizon 2020 multi-actor projects. Retrieved February 8, 2023, from https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_brochure_multi-actor_projects_2017_en_web.pdf.
- Fieldsend, A. F., Cronin, E., Varga, E., Biró, S., & Rogge, E. (2021). 'Sharing the space' in the agricultural knowledge and innovation system: Multi-actor innovation partnerships with farmers and foresters in Europe. *The Journal of Agricultural Education and Extension*, 27(4), 423–442. <https://doi.org/10.1080/1389224x.2021.1873156>
- Zawacki-Richter, O., Kerres, M., Bedenlier, S., Bond, M., & Buntins, K. (Eds.). (2020). *Systematic Reviews in Educational Research: Methodology, Perspectives and Application*. Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-27602-7_1

Session 4B LEARNING

Learning in large networks: developing a Dynamic Learning Agenda for climate smart advisors

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Short abstract

To facilitate formative and collective learning for climate smart advice, we developed an online Dynamic Learning Agenda (DLA). Our aim is twofold: use the DLA in learning for climate smart advice and reflect on ways in which the DLA can be of added value in strengthening learning and exchange in a large network.

Taking on a demand-driven approach, we collected learning questions in a large network of 1500 climate smart agricultural advisors. Six themes of questions emerged: 1) technical and practice-oriented; 2) process-oriented; 3) capacity development; 4) engagement and motivation; 5) the network; and 6) monitoring and impact.

Based on our experiences so far, we conclude that an online DLA can serve as a reflexive and practical tool to structure collective learning in large networks. As such, it serves a practical goal of providing an interactive and accessible space for learning and exchange in a large network. The potential added value of using a DLA for learning in large networks is fivefold: 1) focus the learning process; 2) connect participants who have similar learning questions; 3) create opportunity for in-depth learning; 4) document and share results; and 5) provide an overview of all learning questions and topics.

Keywords | Dynamic Learning Agenda, agricultural advice, large networks, social learning

1. Purpose

Innovations for climate smart agriculture require the cooperation and collective learning of all relevant actors. However, it can be challenging to facilitate formative, collaborative learning within large networks in an effective and impactful way. Drawing on the experiences within a HorizonEurope project, this paper explores the value of a Dynamic Learning Agenda (DLA) as a tool to support learning among agricultural advisors on climate smart agriculture in a large network. We reflect on the process of collectively identifying learning questions, the themes that emerged and the ways in which the DLA is being used to strengthen exchange and learning in the network.

2. Approach

The HorizonEurope project ClimateSmartAdvisors (CSA) focuses on the crucial role of advisors in the development and dissemination of Climate Smart (CS) innovations in the wider agri-system. It does so by mobilising the EU agricultural advisory community in a

network of 1500 advisors, connected through 260 national Communities of Practice (CoP). To facilitate learning within the EU network of 1500 agricultural advisors, we created an interactive, online DLA, which is part of the project websites' back-office (Figure 1). The DLA is an instrument to facilitate reflection and social learning, designed for use in complex and difficult processes of change, as introduced in the guide on Reflexive Monitoring by van Mierlo *et al.* (2010). The DLA assists in the learning process by formulation, recording and updating long-term challenges and associated actions (van Mierlo *et al.*, 2010). Social learning then happens in the process of co-creating knowledge, convergence of goals and change of behaviours and actions (Collins and Ison, 2009). The DLA design is a demand-driven and iterative approach to learning, allowing understanding of evolving demands and flexibly matching our projects' learning processes over time with appropriate support (Kilelu, 2024). The way we operationalised the DLA in our project differs from how van Mierlo *et al.* (2010) have described it. The flexibility of the DLA is that CoPs can use it for social learning, but at the network level the DLA also serves the purpose of facilitating learning and sharing insights and lessons learned at the project level. In that sense, we use the DLA in a more pragmatic, less strategic way than originally suggested by van Mierlo *et al.* (2010).



Figure 1: Screenshot of the 'landing page' of the CSA Dynamic Learning Agenda

The DLA is structured around the projects' three building blocks: capacity development, advisory practice and farming practice. Project members can pose learning questions related the three building blocks and share answers based on insights and good practices. Tags can be added to a question and answer to link a question or answer to thematic areas, CoPs, Work Packages or country. This allows searching the DLA easily by key word and/or area, CoP, Work package or country level. Repetition is minimised with regular 'housekeeping' of the DLA by the authors.

At this stage of the project, we have primarily collected learning questions and are now starting to collect answers in the form of good practices, examples and insights. In the next

section we present an analysis of themes of learning questions we collected and reflect on the DLA as a tool for collective learning.

3. Findings

Value of the DLA to facilitate learning in a large network

The DLA provides the basis for knowledge exchange sessions, surveys and in-depth thematic sessions convened within the network which in turn provide key opportunities to update, refine and expand the DLA. The DLA thus serves as a tool for learning and allows collecting and connecting learning questions and insights in different parts of the project to guide and support learning and exchange within the large network. Its online nature improves the ease of collecting, structuring and sharing learning questions and answers. However, for social learning to take place, active and in-depth exchange is additionally required to ensure questions and answers are addressed and developed. The tool needs moderation to check, cluster, order and merge submitted questions and answers.

The potential added value if the DLA then, is fivefold: 1) focus the learning process in the context of the overall objective of the network; 2) the possibility to connect people who are interested in the same learning question; 3) the possibility to create focussed spaces for more in-depth learning; and 4) the possibility to document and share results and insights from different learning spaces (e.g. workshops); and 5) provide an overview of all learning questions and topics in the CSA network that require additional attention and support but also white spots: topics that are neglected. Following this fifth point, we present an early analysis of the content of the DLA in the next section.

Content of the DLA around climate smart agriculture

At the moment of writing, the DLA consists of around 100 learning questions across the three building blocks. These learning questions were submitted by advisors and researchers within the project, with minimal editing for consolidation of similar questions while ensuring recognisability of one's own question. The learning questions are categorised across the three building blocks, but we analysed the learning questions across the three building blocks to gain insight in recurring themes. The analytical strategy is based on principles for inductive thematic analysis (Braun and Clark, 2009; Braun *et al.*, 2015). In this context, themes are understood as patterns that capture something meaningful in relation to the main aim, in this case elucidating the main overarching themes in the DLA. This resulted in identification of questions addressing six cross-cutting themes: 1) technical and practice-oriented questions; 2) process-oriented questions; 3) capacity development questions; 4) questions around engagement and motivation; 5) questions about the network; and 6) questions around monitoring and impact. As capacity development is central to the project, this also emerged as a theme in the DLA. Table 1 below provides an overview of the six emergent themes, with key words per themes and examples of learning questions from the DLA.

Table 1: Themes of learning questions with examples

Theme	Key words per theme	Example learning questions
Technical practices	Tools, techniques, practical application, adaptation & mitigation measures	<ul style="list-style-type: none"> • What are specific climate smart farming practices? • What strategies can be implemented to scale up successful water management practices to other regions? • What is the impact of fertilisation techniques on farm profitability and emissions?
Process	Group communication, co-creation, facilitation, trust-building, soft skills	<ul style="list-style-type: none"> • How to deal with multiple perspectives in the CoP? • How to mobilise and organise access to knowledge and resources in the CoP? • How to balance between soft skills and technical content?
Capacity development	Training, upskilling, awareness, competence	<ul style="list-style-type: none"> • How to raise awareness about climate smart advice among a wider group of advisors? • How to include a systems perspective and appreciation of complexity? • How to train climate smart advisors to quickly understand the context of a farm?
Engagement / motivation	Engaging farmers, behaviour change, incentives, relevance, mindsets	<ul style="list-style-type: none"> • How to motivate farmers for Climate Smart Farming? • How to engage the "average" farmer in climate smart farming? • How can advisors show farmers the added value of being climate smart?
Network	Multi-actor networks, AKIS, collaboration, Community of Practice	<ul style="list-style-type: none"> • How to involve food chain actors for systemic change? • How can farmers' knowledge be acknowledged by science and policy? • How to ensure CoPs contribute to the EU wide network of Climate Smart Advisors?
Monitoring and impact	Assessment, data, connecting policy to practice	<ul style="list-style-type: none"> • How to measure risks of change in practice versus benefits? • How to properly monitor climate action and results? • How to evaluate the whole farm effect of techniques (economical, environmental and social)?

Our analysis of the DLA to date shows that the learning questions cover both technical and non-technical elements of CS advice. The challenge now is to continue the collective learning within the project and fill the DLA with answers, insights and examples ('good' and 'less good') in response to the learning questions. We deliberately include the 'less good' in order to learn from all experiences of contributors.

Several elements require further attention in terms of design, process and outcomes of the DLA. For example: going beyond 'obvious' questions and text-based answers to develop richer, nuanced and meaningful answers relevant to diverse contexts. Understanding and using the DLA as a means to an end and not a technical goal in itself. Perhaps most importantly, ensuring the project learns about the specificities of *climate smart* advice. Some

questions and answers in the DLA are relevant to agriculture in general such as good soil management strategies. Others are focussed on climate adaptations specifically. Through analysis of the DLA, insights will be possible on what, if anything, makes climate smart advice different from other agricultural advice and how can it be boosted to accelerate the adoption of climate-smart farming practices across Europe.

4. Practical implications

The online DLA is an emerging tool to structure and capture learning and facilitate knowledge exchange in large networks. It serves a practical goal of providing an interactive and accessible space for learning and exchange to both shape and be shaped by advisors' experiences and practices on climate smart farming. However, we also recognise that additional facilitation which situates the DLA in a wider learning process is required for effective and impactful learning for climate smart agriculture. In the CSA project, we do so by organising training, learning and exchange sessions centred on the learning questions. As the DLA matures, it will also inform development of online learning materials for advisors beyond the project.

5. References

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Braun, V., Clarke, V., and Gareth, T., 2015. Thematic Analysis. In: P. Rohleder and A.C. Lyons, eds. *Qualitative Research in Clinical and Health Psychology*. Macmillan International Higher Education, 95-114.
- Collins, K., & Ison, R. (2009). Jumping off Arnstein's ladder: social learning as a new policy paradigm for climate change adaptation. *Environmental policy and governance*, 19(6), 358-373.
- Kilelu, C. W., Klerkx, L., & Leeuwis, C. (2014). How dynamics of learning are linked to innovation support services: insights from a smallholder commercialization project in Kenya. *The Journal of Agricultural Education and Extension*, 20(2), 213-232.
- Van Mierlo, B. C., Regeer, B., van Amstel, M., Arkesteijn, M. C. M., Beekman, V., Bunders, J. F. G., ... & Leeuwis, C. (2010). *Reflexive monitoring in action. A guide for monitoring system innovation projects*. Communication and Innovation Studies, WUR; Athena Institute, VU.

Integrating routinised and reflective learning to enhance collaborative knowledge development on large dairy farms

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Short abstract

This study aims to explore the learning processes among employees on large dairy farms. It investigates the potential for learning and employee-driven innovation (EDI) to contribute to sustainable dairy production from animal welfare, social responsibility, and economic

perspectives. Data were collected through semi-structured group interviews with employees on three large dairy farms in Sweden. The interview material was analysed qualitatively using thematic analysis and linked to Ellström's theories on routinised and reflective learning at the workplace. Employee learning on large dairy farms was strongly related to the individual's work tasks and often took place where the aim was to find a practical solution to maintain work routines. Learning in these agricultural settings was primarily a social process. It was mainly based on the experiences of employees and colleagues and focused on routinised learning rather than reflective learning.

As learning occurs in a social context, there is an untapped potential for shared knowledge development among employees, farmers, and advisors in these workplaces. For this to happen, there is a need to shape the organisational settings and management to transform large dairy farms into reflective learning workplaces and strengthen employee capabilities to contribute to resilience.

1. Purpose

Over the past 30 years, Swedish milk production has undergone structural changes. The number of dairy farms has decreased, while the remaining farms have expanded in both the number of cows and acreage (Martiin, 2024). Larger dairy farms with employed staff responsible for the daily care of the herd have replaced the traditional family farms. The change toward larger farms, the demands on management, leadership, and human resource strategies (Nettle, 2018), and the importance of employees for successful production outcomes (Durst et al., 2018) cannot be overlooked. The staff on large dairy farms often have diverse backgrounds concerning education, work experience, cultural background and language, contributing to a more complex working situation (Sischo et al., 2019). Additionally, there are difficulties in recruiting and retaining skilled staff (KSLA, 2023). Today, milk-producing farms face challenges in meeting high production and efficiency standards necessary for economic profitability. Several factors, including animal health, affect milk production (Gross, 2022; Segeers et al., 2003). Health and productivity are also influenced by how animals are handled and managed (De Vliegheer, 2012; Schuster et al., 2020). Routine daily work with animals is essential for maintaining consistency and uniformity in the delivery of animal care, which is a desirable outcome (O'Brien, 2012; Barragan et al., 2016; Sun et al., 2022). Therefore, employees play an important role in the daily work of large herds, performing numerous routine tasks such as milking, calf care, and feeding. However, the changing structure of today's dairy farms with employed staff places new demands on all participants to achieve the above-mentioned goals. Can employed staff play a more important role in the development and innovation work on the farms? Therefore, it is valuable to explore the learning processes among employees on dairy farms and the potential for learning and employee-driven innovation (EDI) as a way to contribute to a more sustainable dairy production, including animal welfare, social responsibility, and economic aspects.

2. Design

2.1 Analytical and theoretical framework

This study explores learning processes among employees on large dairy farms, workplaces characterised by a high degree of routine work. We have drawn on Ellström's theories on routinised and reflective learning to explore the learning situation and development potential of EDI (Ellström, 2010). Several diverse aspects, like individual and organisational factors, including the organisation's activities and culture, affect workplace learning

(Ellström, 2005). Ellström (1996, 2005, 2011) developed a workplace learning model that focuses on informal learning, consisting of both routinised and reflective learning, which are distinct yet interconnected processes.

Routinised learning takes place during the performance of specific tasks. It is linked to the handling of situations and solving of problems that may arise during routine tasks and often answers the question "how" (Ellström, 2005). Working with animals demands the ability to perform the work task effectively and with minimal variation, as well as to solve acute problems to maintain routines and production. The routines give the employee security and a sense of control of the work situation. Although routine learning is connected to the individual work task, it is constructed in a social context. The routines contribute to constructing shared norms and values in the workplace. The other aspect of routinised learning is the limitation of flexibility. However, the knowledge constructed through routinised learning is the foundation for making reflections. Reflective learning involves asking the questions "why" and "what", and involves questioning existing conditions, such as routines, to test alternatives and reflect on the outcomes (Ellström, 2011). It is crucial for learning and development in the workplace that both routinised and reflective learning are present, depending on the different situations.

Ellström also presents organisational prerequisites and a conducive environment for learning at both individual and organisational levels according to the logic of production and the logic of development. The logic of production is characterised by stability, standardisation and efficiency in task performance, thus aligned with routinised learning and is the dominant logic (Ellström, 2005, 2011). Large dairy farms can be considered workplaces strongly characterised by routines and the logic of production. In contrast, the logic of development is characterised by heterogeneity, reflection and the testing of alternative ways of working. In order to promote this developmental logic, it is essential that there is a positive attitude towards reflective learning and opportunities for such learning.

The concept of EDI can be brought into the discussion by considering the workplace as a place for learning and development. EDI processes may originate from problematic circumstances or suboptimal work routines encountered by employees during their daily tasks, specifically in executing work tasks. Work processes are composed of two dimensions: explicit and implicit. The explicit dimensions refer to the written job descriptions and prescriptions while, the implicit dimensions encompass the actual performance of a task. These implicit actions are often expressed through improvisations and deviations from the explicit guideline. The discrepancy between implicit and explicit work processes is a key factor (Ellström, 2010). Other factors like the willingness and participation of the individual to engage in learning, and the conditions for learning in the workplace are significant factors in determining the presence and extent of EDI processes within an organisation (Lemmetty & Billet, 2023).

2.2 Qualitative research

The study used a qualitative approach to investigate knowledge based on individuals' different experiences and perspectives within a specific context (Yin, 2013). The methods used were semi-structured group interviews and qualitative data analysis.

2.3 Sampling

The choice of farms was based on a conscious selection process and thus belongs to what is referred to as deliberate in qualitative research. The selection criteria were that they should be milk-producing farms with employed staff carrying out daily care routines. The farms were located in the southeast part of Sweden. The number of cows on each farm varied somewhat. Farm A had 550 dairy cows. Farm B had 770 cows, and Farm C had 800 cows. The

number of employees varied from five on Farm A to 10 on Farms B and C, respectively. The selection of participating farms in the study was delimited by their size and geographical location. This could constitute a limitation on the study's validity. Yin (2013) emphasizes the significance of selecting interviewees from a diverse range to prevent one-sided bias. Therefore, all employees working with the animals were asked to participate in the group interviews. All participants received written and verbal information about the study and were asked to hand in a signed consent form.

2.4 Data collection

Data were collected through semi-structured group interviews with employees during the autumn of 2023. An interview guide was created and consisted of two sections addressing knowledge and learning. Fifteen employees, divided into four groups, were interviewed on four different occasions. The group interviews took place on the farms, and one was conducted with the assistance of a Polish-speaking interpreter. The interviews lasted from 52 to 94 minutes. All group interviews were recorded and transcribed into Word documents. In connection with the transcription, the interview material was anonymised.

2.5 Data analysis

The interview material was subjected to qualitative analysis employing the thematic analysis technique (Bryman, 2018), which was linked to theories of workplace learning (Ellström, 1995, 2005, 2011). The thematic analysis resulted in three overarching themes based on the interview material and considering the context. These three themes were utilised to analyse workplace learning and identify opportunities for development within this context. The analysis was initiated by applying Ellström's (2005, 2011) routinised and reflective learning theory. The choice of Ellström's theoretical model is based on the idea that dairy farms with several employees can be viewed as workplaces that require routines to ensure the well-being of the animals and are characterised by the logic of production.

2.6 Ethical considerations

The Ethical Review of Research Involving Human Subjects Act (SFS 2003:460) approved an ethics application for this data collection (No. 2021-05686-01). Data collection also adhered to the Swedish University of Agricultural Sciences' guidelines regarding data management. All participants received written and oral information, and written consent was obtained from each participant.

3. Findings

The findings showed that employee learning on large dairy farms was strongly related to the individual's work tasks, performing animal care routines, and often took place where the aim was to find a practical solution to maintain work routines or as a newly hired employee. The performance of such routine tasks contributed to developing the employees' skills and a sense of autonomy in the work situation.

What motivates the employee to learn on dairy farms?

The employee's learning is strongly related to the individual work task, which depends on the specific farm's organisation. The majority of the work tasks the employees perform on milking farms are characterised by routine and standardisation, aiming to contribute to the well-being of the animals. Most work tasks, like milking, feeding, and taking care of the calves, are daily routines with varying intervals. Furthermore, much of the learning that takes place is unplanned. Unexpected situations that occur during work initiated a learning process. In these situations, the primary goal is to find a practical solution to maintain the

caring procedures for calves and cows. Therefore, what employees learn is frequently shaped by the needs of the business.

However, business needs are not the only factors influencing employee learning. Employees' interests also play a crucial role. Many employees expressed a desire to learn more and be able to work autonomously, performing daily routines and in unexpected situations. The employees indicated that autonomy had a positive effect on their self-esteem. Furthermore, understanding the reasons behind specific work tasks is important for employees as they perform daily routines and make decisions related to animal health. For them, contributing to animal well-being was essential in developing knowledge and capability.

How does the employee learn in daily work?

Learning among milking farm employees comes to pass in a social context. Employees seek knowledge from individuals they trust and consider having knowledge and experience. Depending on the farms, these individuals may be fellow employees or occasionally the farmer. The informants expressed that trust in each other is important in creating a favourable climate in the workgroup and thus facilitating learning in the work situation. The trust between colleagues is founded upon the professional skills of more experienced colleagues and their attitude towards teaching. A socially safe environment was emphasised, as it gave employees the courage to ask questions and thus reveal areas where they seek to improve their understanding.

Most learning takes place in a social context when employees are working together. The learning mainly involves how to perform the work task. In these situations, the more experienced colleague tells and shows how to do the task, followed by the less experienced colleague performing the task. It is important to perform the task in the learning process. The combination of watching, listening, and having the opportunity to perform the work task is of great importance to individual learning.

Employees can learn in other ways, although most learning occurs in a social context. For example, there are learning situations where the individual relies on previously acquired knowledge and experience to solve problems or practical situations without the help of a colleague.

However, some factors negatively affect the learning process. The employees mentioned stressful situations and a lack of time as such factors.

When does learning take place on dairy farms?

The learning among employees on large dairy farms occurs during two different circumstances. The first involves the daily routine of performing tasks and caring for the animals. In this context, employees learn by addressing unexpected practical problems and managing their work routines, which helps them improve their skills. The second prominent situation for learning is when a new employee is introduced and becomes a member of the working community. This situation is characterised by learning from more experienced employees or the farmers. The primary focus for the new employee is to learn how to manage work routines and tasks as quickly as possible to meet the organisation's needs.

To conclude, the predominant learning mode in the workplace is routinised learning and problem solving among the employees. Shared reflective learning on an organisational level is not present in the material. This fact provides a foundation for exploring the possibilities for developing shared reflective learning on large dairy farms.

4. Practical Implications

Large dairy farms are characterised by the logic of production, with precise requirements for efficiency and production. However, at the same time, it also provides the conditions for

routinised learning and skills enhancement. As learning occurs in a social context, there is an untapped potential for shared knowledge development among employees, farmers, and advisors in these workplaces. For this to happen, there is a need to shape the organisational settings and management to transform large dairy farms into reflective learning workplaces and strengthen employee capabilities to contribute to resilience. If not, companies will not be able to harness the experiential knowledge of their employees and develop their overall organisational knowledge.

5. Theoretical Implications

Several potential pathways for future learning development emerge from the theoretical model of routinised learning, reflective learning and EDI. The development of work routines affects production and is facilitated by setting clear objectives (Ellström, 2005). Ellström's theory of reflective learning (2005, 2011) offers a framework for workplace learning that utilises the knowledge and skills employees have gained through routine learning. This theory encourages shared reflection among employees, allowing them to build on their collective experiences. Building on employees' experiential knowledge and adding external and new knowledge creates opportunities for shared reflective learning in the workplace. Further knowledge about the perspective of advisors and the farmers is needed to understand the complete learning situation at large dairy farms and the potential for reflective learning and EDI on these farms. Future studies include investigating the role of advisors and how they can contribute to joint reflective learning in the current context, thereby contributing to sustainable production (both socially, including animal welfare, and economically) for individual employees and dairy farms as a business.

6. References

- Barragan, A. A., Workman, J. D., Bas, S., Proudfoot, K. L., & Schuenemann, G. M. (2016). Assessment of an application for touchscreen devices to record calving-related events in dairy herds and monitor personnel performance. *Journal of Dairy Science*, 99(7), 5662–5670. <https://doi.org/10.3168/jds.2015-10841>
- De Vliegher, S., Fox, L. K., Piepers, S., McDougall, S., & Barkema, H. W. (2012). Invited review: Mastitis in dairy heifers: Nature of the disease, potential impact, prevention, and control. *Journal of Dairy Science*, 95(3), 1025–1040. <https://doi.org/10.3168/jds.2010-4074>
- Durst, P. T., Moore, S. J., Ritter, C., & Barkema, H. W. (2018). Evaluation by employees of employee management on large US dairy farms (vol 101, pg 7450, 2018). *Journal of Dairy Science*, 101(9), 8617–8617. <https://doi.org/10.3168/jds.2018-101-9-8617>
- Ellström, P.-E., Gustafsson, B., and Larsson, S. (1996), *Livslångt lärande*, Studentlitteratur, Lund.
- Ellström, P.-E. (2005). Arbetsplatslärandets janusansikte. *Pedagogisk forskning i Sverige*, 10(3/4), 182-.
- Ellstrom, P.-E. (2010). Practice-based innovation: a learning perspective. *The Journal of Workplace Learning*, 22(1/2), 27–40. <https://doi.org/10.1108/13665621011012834>
- Ellström, P.-E., Evans, K., Malloch, M., Cairns, L., & O'Connor, B. N. (2011). Informal Learning at Work: Conditions, Processes and Logics. In *The SAGE Handbook of Workplace Learning* (pp. 105–119). SAGE Publications, Limited. <https://doi.org/10.4135/9781446200940.n8>
- Gross, J. J. (2022). Limiting factors for milk production in dairy cows: perspectives from physiology and nutrition. *Journal of Animal Science*, 100(3). <https://doi.org/10.1093/jas/skac044>
- KSLA. (2023), "Kompetensförsörjning – en förutsättning för att utveckla svensk mjölkproduktion", available at: Rapport (ksla.se) (accessed spring 2023)

- Lemmetty, S., & Billet, S. (2023). Employee-driven learning and innovation (EDLI) as a phenomenon of continuous learning at work. *The Journal of Workplace Learning*, 35(9), 162–176. <https://doi.org/10.1108/JWL-12-2022-0175>
- Martiin, C. (2024). *Svensk mjölkproduktion under 40 år: förhållanden, händelser och konsekvenser, 1980-2020*. <https://doi.org/10.54612/a.742u6tbro2>
- Nettle, R. (2018). Attractive careers and people management on dairy farms: two sides of the same coin. In *International Agricultural Workforce Conference, July* (pp. 76–81).
- O'Brien, B., Jago, J., Edwards, J. P., Lopez-Villalobos, N., & McCoy, F. (2012). Milking parlour size, pre-milking routine and stage of lactation affect efficiency of milking in single-operator herringbone parlours. *Journal of Dairy Research*, 79(2), 216–223. <https://doi.org/10.1017/S0022029912000088>
- Schuster, J. C., Barkema, H. W., De Vries, A., Kelton, D. F., & Orsel, K. (2020). Invited review: Academic and applied approach to evaluating longevity in dairy cows. *Journal of Dairy Science*, 103(12), 11008–11024. <https://doi.org/10.3168/jds.2020-19043>
- Seegers, H., Fourichon, C., & Beaudeau, F. (2003). Production effects related to mastitis and mastitis economics in dairy cattle herds: Mastitis of dairy ruminants. *Veterinary Research (Paris)*, 34(5), 475–491.
- Sischo, W. M., Moore, D. A., Pereira, R., Warnick, L., Moore, D. L., Vanegas, J., & Davis, M. A. (2019). Calf care personnel on dairy farms and their educational opportunities. *Journal of Dairy Science*, 102(4), 3501–3511.
- Sun, L., Lundh, Å., Höjer, A., Bernes, G., Nilsson, D., Johansson, M., Hetta, M., Gustafsson, A. H., Saedén, K. H., & Dicksved, J. (2022). Milking system and premilking routines have a strong effect on the microbial community in bulk tank milk. *Journal of Dairy Science*, 105(1), 123–139. <https://doi.org/10.3168/jds.2021-20661>
- Yin, R.K. (2010), *Qualitative Research from Start to Finish*. Guilford Publications.

Integrating codified and tacit knowledge in advisory services for medicinal plant cultivation: challenges and opportunities in Basilicata Region

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Short abstract

Despite growing interest in medicinal and aromatic plants (MAPs) and the increasing demand for advisory support in this topic, knowledge related to these species is often transmitted informally due to the wild nature of many of them. This poses challenges for both farmers and advisors in accessing up-to-date technical and scientific guidance. This study explores how advisory service providers in the Basilicata region of Italy integrate both codified (formal) and tacit (informal) knowledge to support the cultivation and innovation of MAPs. A mixed-methods approach was employed, combining desk research with primary data collected through an online survey and peer-to-peer exchange meetings involving advisors and regional experts. The findings reveal that advisory providers face significant challenges in acquiring the interdisciplinary skills essential for MAPs cultivation—ranging

from agronomic and regulatory to economic and nutraceutical knowledge—alongside soft skills needed for networking and innovation. The study also highlights a reliance on diverse but fragmented knowledge sources, with a lack of specialized academic programs and limited financial resources hindering effective knowledge dissemination. Furthermore, it underscores the importance of early definition of crop end-use and the need for generational renewal through coaching and mentoring initiatives.

Keywords: Medical plants, Advisory services, innovation support services, AKIS, tacit knowledge.

1. Purpose

This study examines how advisory service providers in Basilicata, Italy, integrate codified and tacit knowledge to support farmers in cultivating medicinal and aromatic plants (MAPs). Despite the growing interest in MAPs and the existence of supportive policies, traditional knowledge often flows informally, rooted in community use and passed down through generations due to the wild nature of many species (Kala, 2005; Estomba et al., 2006; Schippmann et al., 2006). This creates challenges for modern farmers and advisors that struggle to access effective information and up-to-date technical expertise. In fact, advisors must navigate a complex ecosystem where scientific, technical, and market knowledge intersect with codified and experiential knowledge. Drawing on Klerkx et al. (2013), the study deep into how advisors combine formal (codified) knowledge with practical (tacit) know-how to foster innovative and economically viable MAPs cultivation.

2. Methodology

The study employs a mixed-methods approach, combining desk research and primary data collection. Desk research involved reviewing relevant literature and other documents and databases that helped mapping MAPs cultivations, actors, and knowledge flows (e.g. database of EIP-Agri operational groups). Primary data were gathered through an online survey (CAWI) conducted between July and September 2023. The survey collected information on the education, experience, and advisory methods of service providers in the medicinal plant sector (Cristiano et al, 2023). To complement this, two online peer-to-peer exchange meetings were held with advisors from Basilicata and experts from Sardinia, Calabria, and Marche regions. These sessions provided qualitative insights into improving advisory services by mapping competencies required for production phases, available knowledge sources, advisory tools, and stakeholder networks.

3. Findings

The study highlights significant challenges faced by advisory providers in acquiring interdisciplinary skills essential for supporting MAPs cultivation. Historically, knowledge in this sector has been passed down informally among producers, often bypassing formal knowledge circuits (Leonti et al., 2015; Mathez-Stiefel and Vandebroek, 2011). Key competencies identified (Table 1) include agronomic expertise for species selection, regulatory knowledge for harvesting compliance, economic skills for profitability assessment, nutraceutical expertise for processing stages, and soft skills for networking and innovation brokering. Advisory services currently rely on diverse but fragmented knowledge sources such as universities, research centers, germplasm banks, ethnobotanical conservatories, and professional organizations. However, limited specialized academic programs and scarce financial resources hinder effective dissemination. Peer-to-peer exchanges revealed that defining crop use early in planning stages is critical to determining required competencies.

Table 1: Key Knowledge Areas Supporting Advisory Services on MAPs

Introduction phase of the MAP	Information, knowledge and skills	Sources	Tools	Network
Initial idea/design	<ul style="list-style-type: none"> Contextual elements to consider: age, background, trigger motivation Specific agronomic skills Expertise on available European/national/regional funds Nutraceutical information Economic and financial skills Skills to facilitate co-operative innovation 	<ul style="list-style-type: none"> Universities, research institutions Farms themselves (e.g. for ecotype maintenance) National Rural Network/CAP Network web portal: www.innovarurale.it Suppliers of quality inputs (seeds) Germplasm bank 	<ul style="list-style-type: none"> Pilot testing in small areas Context/territorial analysis and land value Analysis of the target market (e.g. organic) Business plan Financial resources and public support for farmers 	<ul style="list-style-type: none"> Relations with/knowledge of research organisations/universities Relationship with/knowledge of other MAPs farms
Cultivation/preparation	<ul style="list-style-type: none"> Assessment of equipment/means necessary for MAPs cultivation Authorisations for collecting wild species Specific training on aggregation (required for bidding) Comparisons with other realities (including foreign) Skills on Quality Certification regulations/protocols 	<ul style="list-style-type: none"> Conservatory of Ethnobotany Scientific studies Manuals and results of ethnobotanical research Universities/ research institutions/ local authorities Applicable national/regional legislation Regulations, Protocols and Specifications for Certification 	<ul style="list-style-type: none"> Workshops and equipment for Financial resources and public support for farmers 	<ul style="list-style-type: none"> Relations with/knowledge of research organisations/universities Relations with quality certification bodies Network with providers of laboratory analysis services
Fielding	<ul style="list-style-type: none"> Specific regulatory competences Skills on Quality Certification regulations/protocols Disciplinary skills other than agronomy (e.g. marketing and commerce) 	<ul style="list-style-type: none"> Specialist degree courses (medicinal plants, pharmacy, pharmacology, biology, ...) Professional and specialised post-graduate training courses Training/information course for farms (MEPLASUS) on MAPs specific regulations and indications 	<ul style="list-style-type: none"> Sowing and transplanting techniques Financial resources and public support for farmers, research and experimentation 	<ul style="list-style-type: none"> Relationships and networks with specialised consultants in other fields (e.g. chemical, pharmacological/ herbal, botanical) Creation of a knowledge network for continuous updating Networking with the various components of the supply chain Network with laboratory testing service providers

				<ul style="list-style-type: none"> Aggregation of producers for use of means, certain buyer, use of subcontracting
Harvesting and processing	<ul style="list-style-type: none"> Knowledge of medicinal plants for suitable processing, taking into account the final object of marketing (dried, extraction of essential oils, supplements, agropharmaceuticals with processing waste, organic fertilisers, etc.) and use: <ul style="list-style-type: none"> Food Use Nutraceutical use Use for cosmetics Use for pesticides Competences in the field of: <ul style="list-style-type: none"> manual or mechanised harvesting operations and machinery maintenance* monitoring the degree of maturity of plants different techniques of plant preservation and storage implementation and control of refrigeration and storage evaluation of product quality care of the cultivation of medicinal and aromatic plants and optimal growing conditions (e.g. germination and growth control) Distinction between wild plant collection and cultivated plant collection Wild plants require more expertise to comply with harvesting regulations Pool of nationally trained collectors (with licence) Knowledge of the entire supply chain 	<ul style="list-style-type: none"> WHO Manual of Good Agricultural and Collection Practices (GACP). General hygiene and self-control procedures and protocols (HACCP protocol) Regulatory aspects of the collection of food, aromatic and officinal plants for use in gastronomy Labelling Standards 	<ul style="list-style-type: none"> Appropriate equipment and containers for collection and storage Labellers Innovative plant harvesting machinery with digital recognition system Financial resources and public support for farmers Manuals of techniques, procedures and checklists for post-harvest processing of plants Visual monitoring techniques Techniques and tools of foliar diagnostics biological and integrated control protocols pest control techniques 	
Marketing	<ul style="list-style-type: none"> Understanding the market outlet Cooperation with other cooperatives/farmers (at national and international level) 	<ul style="list-style-type: none"> Vocational training organisations European projects on advisory services and support for 	<ul style="list-style-type: none"> Marketing Plan with reference to the medicinal, aromatic and food plants market 	<ul style="list-style-type: none"> Creation of producer networks, aggregation centres, integration into the supply chain

	<ul style="list-style-type: none"> Specific competences on aggregation/cooperation of companies (soft skills) Specific training on corporate diversification 	<ul style="list-style-type: none"> innovation processes (2connect, ATTRACTISS) Professional training courses on botany, processing techniques, obtaining essential oils 	<ul style="list-style-type: none"> Action/business plan for public subsidies to farms (granted regardless of the outcome of the preliminary investigation and then ex-post verification) with much shorter implementation times Financial resources and public support of different actors at territorial level (e.g. multi-regional operational programmes) Farms diversification mechanisms to protect income or damage prevention with guarantee measures Multi-actor working groups for supply chain measures 	<ul style="list-style-type: none"> Networks with foreign players in the supply chain Cooperation agreements also protecting the producer (with planned cultivation, clear allocation of roles, machinery use, definition of quantities to be produced) Links/conventions with research organisations with specific MAPs relevance, collaboration between research and production on different aspects
Dissemination	<ul style="list-style-type: none"> Definition of the target groups Awareness of the target market Knowledge of funding/resource opportunities Specific training for agricultural extension workers Generational transition between advisors (e.g. coaching, mentoring) 	<ul style="list-style-type: none"> Universities (agriculture, pharmacy, biology) Professional Orders 	<ul style="list-style-type: none"> Financial resources and public support of different actors at territorial level Sustainability Report: Spreading the benefits of medicinal plants in terms of CO2 sequestration 	<ul style="list-style-type: none"> Design with the involvement of large companies Include MAPs in the agricultural development agencies activities Networking among advisors

Source: our elaborations on advisors' training events (October - November 2023) and Atlas of Labour and Occupations (INAPP, 2019)

4. Practical Implications

The findings underscore the need for generational renewal in advisory services through coaching and mentoring programs to build expertise. Moreover, enhancing technical competencies and soft skills, along with fostering structured networks that integrate both tacit and codified knowledge, can significantly contribute to advancing innovation, facilitating knowledge transfer, and improving the overall quality of advisory services in the MAPs sector.

5. Theoretical Implications

Theoretically, this study contributes to understanding how codified and tacit knowledge interact within advisory systems. It emphasizes building integrated networks that combine cross-disciplinary expertise to provide high quality support services. Strengthening these mechanisms can improve knowledge transfer in MAPs cultivation while addressing gaps in skills and specialization levels among advisors.

6. References

- Klerkx, L., & Proctor, A. (2013) Beyond fragmentation and disconnect: Networks for knowledge exchange in the English land management advisory system, Land Use Policy, Volume 30, Issue 1, 2013, Pages 13-24, ISSN 0264- 8377, <https://doi.org/10.1016/j.landusepol.2012.02.003>.
- Cristiano, S., Carta, V., Serra, G., D'Oronzio, M.A., Romaniello, A. L. (2023) Analisi dei fabbisogni dei consulenti. ISBN 9788833853390
- Estomba, Diego & Ladio, Ana & Lozada, Mariana. (2006). Medicinal Wild Plant Knowledge and Gathering Patterns in a Mapuche Community from Northwestern Patagonia. Journal of ethnopharmacology. 103. 109-19. 10.1016/j.jep.2005.07.015.
- Kala, C. P. (2005). Current Status of Medicinal Plants Used by Traditional Vaidyas in Uttaranchal State of India. Ethnobotany Research and Applications, 3, 267-278.
- Leonti, M., Staub P. O., Cabras S., Castellanos M.E., Casu L. (2015) From cumulative cultural transmission to evidence-based medicine: evolution of medicinal plant knowledge in Southern Italy. Frontiers in Pharmacology, VOLUME=6, YEAR=2015, URL=<https://www.frontiersin.org/journals/pharmacology/articles/10.3389/fphar.2015.00207>. DOI=10.3389/fphar.2015.00207. ISSN=1663-9812

-
- Schippmann, U., Leaman, D. J., & Cunningham, A. B. (2006). A Comparison of Cultivation and Wild Collection of Medicinal and Aromatic Plants Under Sustainability Aspects. *Frontis*, 7, 75-95.
- Mathez-Stiefel SL, Vandebroek I. (2012) Distribution and transmission of medicinal plant knowledge in the andean highlands: a case study from Peru and Bolivia. *Evid Based Complement Alternat Med*. 2012;2012:959285. doi: 10.1155/2012/959285. Epub 2011 Nov 29. PMID: 22203885; PMCID: PMC3235884.
- Mathez-Stiefel SL, Vandebroek I. Distribution and transmission of medicinal plant knowledge in the andean highlands: a case study from peru and bolivia. *Evid Based Complement Alternat Med*. 2012;2012:959285. doi: 10.1155/2012/959285. Epub 2011 Nov 29. PMID: 22203885; PMCID: PMC3235884.
- Salmerón-Manzano E., Garrido-Cardenas JA, Manzano-Agugliaro F. Worldwide Research Trends on Medicinal Plants. *Int J Environ Res Public Health*. 2020 May 12;17(10):3376. doi: 10.3390/ijerph17103376. PMID: 32408690; PMCID: PMC7277765.
- Verrascina M., D'Oronzio M.A., Ricciardi D., De Luca D., Romaniello A.L. (2023), Le aziende lucane del comparto delle piante officinali: Analisi dei principali fabbisogni tecnologici e formativi. ISBN 9788833852867
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How can we assess the plural adoption processes of a digital technology in agriculture and the systemic changes induced ? Proposal of a methodological framework applied to the SoYield® case in Senegal

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Short Abstract

The link between digital technologies adoption process and the multidimensional changes they induce at farm level is rarely addressed. This study addresses that gap by proposing a methodological framework for the systemic evaluation of farmers' adoption of digital technologies including barriers, triggers and outcomes of use. Based on a literature review, we developed the PEDRO-TIC (Proposition, Encounters, Dispositions, Responses, Outcomes – Technologies of Information and Communication) framework which combines adoption process analysis and outcomes evaluation. We applied the PEDRO-TIC framework to the case of the SoYield® application in Senegal, an improved beta-version designed for estimating mango yields. This helped identify four types of farmers responses to the introduction of this technology: use, non-use, use then abandonment and use and detour. It also revealed how the characteristics of the technology ("proposition"), the individual "dispositions" of farmers and the modalities of introduction of the technology ("encounters") shaped these

responses. Based on 27 semi-structured interviews with both designers and users, we identified the social, economic and technical outcomes of SoYield®, comparing them with the designers' initial ambitions. The study provides practical insights for improving deployment strategies and highlights the theoretical relevance of PEDRO-TIC for better understanding the dynamics of digital technology adoption in agriculture.

Keywords: Digital Agriculture, Impact Assessment Frameworks, Artificial Intelligence (AI), West Africa

1. Purpose

This study aims to contribute to a paradigm shift in impact evaluation by proposing an original methodological framework for the systemic evaluation of farmers' adoption of digital technologies (including an analysis of barriers and triggers) and the changes induced by these technologies at farm level. Among other things, the framework aims to provide information on the mechanisms that contribute to generate or constrain these changes, in order to improve the design and deployment of digital technologies and produce the changes initially expected by technology designers.

2. Approach

We followed a four (4) step approach.

- First, we conducted a literature review on approaches and frameworks allowing for the analysis of technology adoption processes by farmers and of the changes induced, including in the specific case of digital technologies.
- Our objective was to overcome the limitations of frameworks proposing a binary, non-systemic and non-processual view of technology adoption, and failing to assess the medium-term changes or long-term impact to which the appropriation of a technology contributes. In this view, we then built a framework for a systemic, actor-centric analysis of digital technology adoption processes and the changes they generate. This framework is a combination of the “Propositions, Encounters, Dispositions and Responses” (PEDR) framework of Glover *et al.* 2019 and the framework of Van Dijk (2013) on digital technologies, which we call PEDRO-TIC (for Proposition, Encounters, Dispositions, Responses, Outcomes - in the case of Technologies of Information and Communication).
- Third, we tested this framework on the case of the SoYield® digital application in Senegal. This application was designed to respond to an issue of lack of reliable data for estimating mango yields, which would prevent small-scale farmers from optimizing their sales and maximizing their profit and income. It was developed based on an iterative process of user-centric design, that initiated in 2015. The beta-version of the digital application was tested on-field in 2022 in the Niayes region in Senegal, then refined, and tested again in the same region in 2024. The PEDRO-TIC framework was used to assess the adoption process of this improved beta-version of the SoYield® application and the changes at farm level that it contributed to generate. The evaluation was conducted in order for designers to compare results with the theory of change they initially build, and to draw out lessons learned to improve the properties of this technology and its mode of deployment. The evaluation was conducted, between April and July 2024, based on a series of twenty-seven (27) semi-structured interviews with the people in charge of designing and deploying the technology (researchers, a private start-up, and extensionists), and with users of the technology (mango farmers).
- Then, from August to February 2025, we interpreted and discussed the results of the evaluation in a reflexive way, to identify how and why farmers used (or not) the digital application, what were the changes produced (expected in the original theory of change or not; positive or not); and how the designers could improve the properties of the

technology and its mode of deployment on the field to better fit farmers' demands and contribute to generate positive changes.

3. Findings

In the first part, we present the PEDRO-TIC analysis framework (see figure after description) and then provide overall results of the evaluation of the case of the SoYield® technology. The PEDRO-TIC framework relies on 5 analytical components.

The "Proposition" component aims at characterizing the technology (including the resources required for its use), identifying by whom and how it was conceived and developed, and analysing how the technology's designers plan to make it known to potential users and introduce it on field. The "Encounter" component seeks to characterize the way (formal or informal) and moments of interactions through which farmers discover the technology or are trained to use it. The third component, "Disposition", integrates the various factors (individual, technological and organizational) that influence the way farmers react to the technology. It is complemented here by Van Dijk's (2013) digital frame, including an analysis of farmers' digital capacities. The "Responses" component encompasses all the possible reactions/responses that farmers may have to the technology, not just adoption or non-adoption. The final component, "Outcomes", assesses the social, economic and technical changes at farm level that the digital technology contributed to generate.

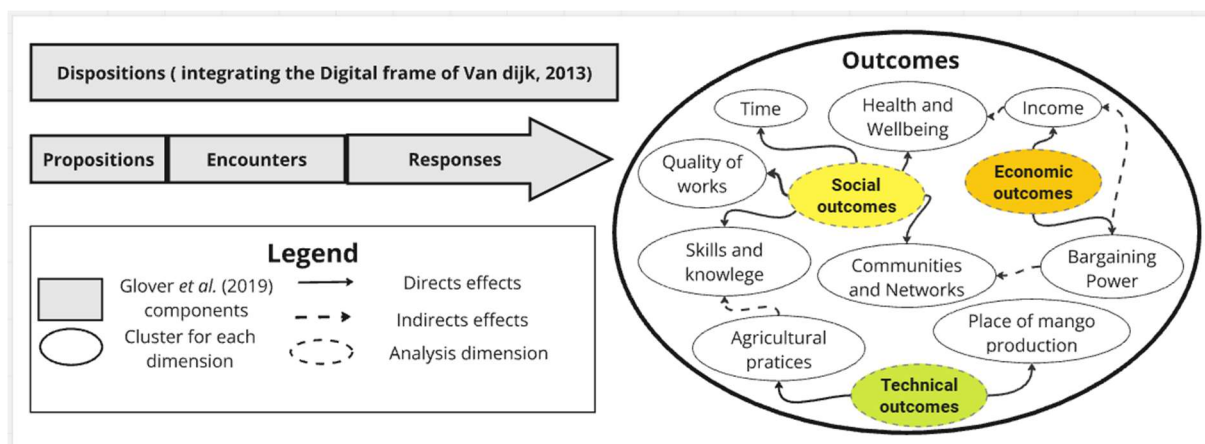


Figure 1: PEDRO-TIC framework analysis

The application of the PEDRO-TIC framework to the case of the SoYield® application in Senegal enabled us to identify four types of farmers responses to the introduction of this technology: (1) use, (2) non-use, (3) use then abandonment and (4) use and detour. The evaluation also made it possible to identify the characteristics of the technology ("proposition"), the individual dispositions of farmers ("dispositions") and the modalities of introduction of the technology ("encounters") that influenced or favored one or other of these types of response. We then identified the changes to which the adoption of these technologies contributed and compared them with the ambitions initially sought by the technology's designers. This comparison put forward that the SoYield® decision-support tool induced both changes that were not anticipated in the initial theory of change, notably on the social dimension (time saving, modification of interactions with actors in the value chain and improved job satisfaction) and changes from the said theory of change (i.e.: increased bargaining power and income). It also highlighted that the application could induce other negative changes beyond those expected in the theory of change, such as the deterioration of relations between farmers and traders.

4. Practical implications

On a practical level, the study suggests that the mode of technology deployment envisaged by the technology's designers has not facilitated farmers' appropriation of the technology. The designers should provide several in-field training sessions for the farmers, regular monitoring of farmers and availability of the application in at least one of the languages spoken in the country where the application is deployed. In addition, it would be essential to optimize the user experience by improving the technology's user path. This would help to reduce the technical bugs encountered by farmers, which prevent its use.

5. Theoretical implications

On a theoretical level, we have shown how the PEDRO-TIC framework has been useful in improving the design and deployment process of the technology under development. Future studies could test the usefulness of this framework for other types of technology or with other data collection methods. It could be used to assess the long-term impacts generated by appropriation of more mature technologies, as was done by Blundo-Canto *et al.* (2024). The PEDRO-TIC framework, which proposes a model of technology adoption and the changes it generates, would also lend itself to quantitative evaluation approaches, enabling us to identify regularities in each of the framework's dimensions, on a larger sample.

6. References

- Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. In J. Kuhl and J. Beckmann (Ed.), *Action Control: From Cognition to Behavior* (p. 11-39). Springer Berlin Heidelberg.
- Alexandre, C., Tresch, L., Sarron, J., Lavarenne, J. Bringer, G., Chaham, H.R., Bendahou, H. *et al.* (2023). Creating shared value(s) from On-Farm Experimentation: ten key lessons learned from the development of the SoYield® digital solution in Africa. *Agronomy for Sustainable Development*, 43 (38), 1-18. <https://doi.org/10.1007/s13593-023-00888-7>
- Bechtet, N. (2024). *Qui évalue les technologies numériques appliquées à l'agriculture et comment? Une analyse du rôle des intermédiaires dans la production de connaissances sur des outils de l'agriculture de précision* [Thèse de doctorat]. Université de Toulouse.
- Bendahou, H., Faye, E. (2021). *SoYield® pour estimer et suivre les rendements des cultures fruitières*.
- Blundo-Canto, G., Mathé, S., & Fatoumata, B. (2024). Heterogeneous pathways of technological change in marginalised rural areas: the case for fuller accounts of adoption. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, 45(3), 498-520. <https://doi.org/10.1080/02255189.2024.2375268>
- Bonnet, P., Cesaro, J-D., Alexandre, C., Sow, A., Roche, M., Paget, N. Une agriculture numérique inclusive? Le cas de l'agriculture familiale en Afrique de l'Ouest. *Les Annales des Mines*, (19), 148-156.
- Boru, Z. (2022). *Reprise d'une entreprise arboricole: Le GAEC du Louet* [Mémoire de Master]. L'Institut Agro Rennes Angers.
- Du, X., Wang, X., and Hatzenbuehler, P. (2022). Digital technology in agriculture: a review of issues, applications and methodologies. *China Agricultural Economic Review*, 15(1), 95-108. <https://doi.org/10.1108/CAER-01-2022-0009>
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13(3), 319-340. <https://doi.org/10.2307/249008>
- Fishbein, M., and Ajzen, I. (1975). *Belief, attitude, intention and behaviour: An introduction to theory and research*. Reading, MA: Addison-Wesley.

- Florez, M., Gobrecht, A. (2024). *WP 4 Cost & Benefits assessment of digitalisation at farm level*. CODECS
- Gavard-Perret, M-L., Gotteland, D., Haon, C., Jolibert, A., Aubert, B., Avenier, M-J., Duymedjian, R. et al. (2012). *Méthodologie de la recherche en sciences de gestion. Réussir son mémoire ou sa thèse* (2^{ème} ed.). Pearson France
- Glover, D., Sumberg, J., Ton, G., Andersson, J., & Badstue, L. (2019). Rethinking technological change in smallholder agriculture. *Outlook on Agriculture*, 48(3), 169-180. <https://doi.org/10.1177/0030727019864978>
- Hameed, M.A., Counsell, S., Swift, S. (2012). A conceptual model for the process of IT innovation adoption in organizations. *Journal of Engineering and Technology Management*, 29 (3), 359-390. <https://doi.org/10.1016/j.jengtecman.2012.03.007>
- Hanitravelo, G.L.J. (2020). *Impacts des technologies numériques sur les exploitations agricoles en France* [Thèse de doctorat]. L'Institut Agro-Agrocampus Ouest.
- Klerkx, L., and Rose, D. (2020). Dealing with the game-changing technologies of Agriculture 4.0: How do we manage diversity and responsibility in food system transition pathways? *Global Food Security*, 24, 1-7. <https://doi.org/10.1016/j.gfs.2019.100347>
- Labarthe, P. (2022). Quel effet de la digitalisation de l'agriculture sur les services de conseil? *Annales des Mines*, 19, 47-52.
- Prause, L. (2021). Digital Agriculture and Labor: A Few Challenges for Social Sustainability. *Sustainability*, 13(11), 1-14. <https://doi.org/10.3390/su13115980>
- Rijswijk, K., Klerkx, L., Bacco, M., Bartolini, F., Bulten, E., Debruyne, L., Dessein, J. et al. (2021). Digital transformation of agriculture and rural areas: A socio-cyber-physical system framework to support responsabilisation. *Journal of Rural Studies* 85,79-46. <https://doi.org/10.1016/j.jrurstud.2021.05.003>
- Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed). Free Press, Collier Macmillan.
- Rogers, E.M. (2003). *Diffusion of innovations* (5th ed). Free Press.
- Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *Turkish Online Journal of Educational Technology-TOJET*, 5(2), 14-23.
- Shang, L., Heckelei, T., Gerullis, M. K., Börner, J., and Rasch, S. (2021). Adoption and diffusion of digital farming technologies-integrating farm-level evidence and system interaction. *Agricultural systems*, 190,1-17. <https://doi.org/10.1016/j.agsy.2021.103074>
- Rolandi, S., Brunori, G., Bacco, M., and Scotti, I. (2021). The digitalization of agriculture and rural areas: towards a taxonomy of the Impacts. *Sustainability*, 13 (9), 1-16. <https://doi.org/10.3390/su13095172>
- Ryan, M. (2022). The social and ethical impacts of artificial intelligence in agriculture: mapping the agricultural AI literature. *AI & Society*, 28, 2473-2485. <https://doi.org/10.1007/s00146-021-01377-9>
- Sarron, J. (2019). *Estimation spatialisée des rendements d'une culture pérenne en Afrique de l'Ouest: le cas du manguié au Sénégal* [Thèse de doctorat]. Université de Montpellier.
- Van Dijk, J. A. (2013). A theory of the digital divide 1. In *The digital divide* (pp. 29-51). Routledge.
- Weber, R., Frank, M., Braun, J. (2021). Digitalisation in agriculture and its impact on social sustainability. *International journal on food system dynamics*, 74-79. <http://dx.doi.org/10.18461/pfsd.2021.2009>
- Weißhuhn, P., Helming, K., and Ferretti, J. (2017). Research impact assessment in agriculture, A review of approaches and impact areas. *Research Evaluation*, 27(1),36-42. <https://doi.org/10.1093/reseval/rvx034>

-
- Wolfe, R. A. (1994). Organizational innovation: review, critique and suggested research directions. *Journal of management studies*, 31(3), 405-431. <https://doi.org/10.1111/j.1467-6486.1994.tb00624.x>
- Ye, L., and Yang, H. (2020). *From Digital Divide to Social Inclusion: A Tale of Mobile Platform Empowerment in Rural Areas*. *Sustainability*, 12(6), 1-16. <https://doi.org/10.3390/su12062424>
- Yin, R. K. (2018). *Case Study Research and Applications, Design and Methods (6th ed)*. SAGE Publications, Inc.
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PERSONA: Development of a Hybrid Human-AI personalised learning path for VET for innovation in agriculture

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Short abstract

The purpose of this project (PERSONA) is to create a micro-credential programme for farmers and agricultural extensionists in innovation process management in agriculture. This project employed a mixed methods approach consisting of surveys, interviews, and focus groups with small and medium sized farms, TVET (Technical and Vocational Education and Training) providers, and agricultural extensionists located in Belgium, Cyprus, Czech Republic, Ireland, Italy, Slovenia, and Spain. A survey (n= 42), semi-structured interviews (n=28), and focus groups (n=28) were conducted initially to: (i) assess the training needs of farmers and agricultural extensionists with regard to innovation process management in agriculture; and (ii) investigate the complexities of current micro-credential systems within agricultural knowledge systems. The agricultural education programme in innovation process management developed consists of six modules: (i) Agricultural Financial Management; (ii) Agricultural Software Support Tools; (iii) Agricultural Sustainability; (iv) Farm Entrepreneurship; (v) The Role of Groups in Agriculture; and (vi) Robotics in Agriculture. The international peer reviews confirmed and validated the content and the learning outcomes for each module. This project provides agricultural education and CPD opportunities for farmers, agricultural extensionists and the wider AKIS.

1. Purpose

PERSONA aims to create a micro-credential programme for farmers and agricultural extensionists in innovation process management in agriculture. The developed programme will promote innovation within the agricultural sector through the implementation of new practices, technologies and knowledge. Continuous professional development (CPD) and Agricultural TVET education are crucial for providing farmers with the knowledge, skills, and attitudes to adapt to change. The project aims to improve the innovate learning processes, products and services as well as enhancing the ability of agricultural TVET education to integrate innovation into their agricultural education deliveries as well as providing transversal and technical skills for innovation and strengthening relationships between Agricultural TVET Education and other AKIS actors at a European level.

2. Methodology

This project employed a mixed methods approach consisting of surveys, interviews, and focus groups with small and medium sized farms, TVET (Technical and Vocational Education and Training) providers, and agricultural extensionists located in Belgium, Cyprus, Czech Republic, Ireland, Italy, Slovenia, and Spain. A survey (n= 42), semi-structured interviews (n=28), and focus groups (n=28) were conducted initially to: (i) assess the training needs of farmers and agricultural extensionists with regard to innovation process management in agriculture; and (ii) investigate the complexities of current micro-credential systems within agricultural knowledge systems. An agricultural education programme on Innovation Process Management was designed and developed based on the primary data collected. Focus groups (n=10) were conducted to internationally peer review the programme developed.

The peer review process was carried out by each partner with a one-week interval between each focus group. Participants involved were purposively selected by each partner in their respective country. Focus group participants included farmers, postgraduate agricultural students, undergraduate agricultural degree students, agricultural EQF level 5 students, agricultural advisors, research farm/technician worker, and members of young farmer representative organisations. Each module was reviewed, amended, and finalised following the peer review process.

3. Findings

The study identified competencies required by farmers, TVET (Technical and Vocational Education and Training) providers, and agricultural extensionists with regard to innovation process management in agriculture. Examples of the competencies included in module development were: (i) digital and technological skills; (ii) communication and interpersonal skills; (iii) policy and regulatory knowledge; (iv) adaptability and openness to change; (v) communication and interpersonal skills; and (vi) business and financial management. The agricultural education programme in innovation process management that was developed consists of six modules spanning each of the competencies identified: (i) Agricultural Financial Management; (ii) Agricultural Software Support Tools; (iii) Agricultural Sustainability; (iv) Farm Entrepreneurship; (v); Robotics in Agriculture and (vi) The Role of Groups in Agriculture.

Module development was readily informed from earlier research carried out in WP1 of the PERSONA project. This work package was focused around the analysis of the European microcredentials system in agricultural TVET Education. The objectives were to analyse national strategies for the structure of the national Agricultural Knowledge and Innovation systems as well as analysing the provision of innovation programmes in Agricultural TVET Education. Developing a microcredential common framework in Agricultural TVET Education was also required. Within WP1 an assessment of professional needs within innovation process management was conducted. This task aimed to investigate the complexities of small and medium sized farms in terms of the use of short learning programmes with verifiable microcredentials for CPD in terms of implementing innovation process management on farms.

The findings from this task were used to inform the development of PERSONA microcredential modules. The research found that farmers were aware of the benefits of innovation in terms of increasing productivity and reducing environmental impact. Although farmers were aware of the advantages, they stated there were challenges arising in the process such as information overload and poor digital literacy for example. Farmers identified the need for more accessible financial assistance and information. The need for

farmer education and engagement was outlined as a key metric for fostering innovation amongst farmers. Several competencies were identified that were said to be crucial for innovation uptake. These included technical knowledge, data interpretation and digital literacy. Other essential skills included entrepreneurship, management and communication abilities for example.

With the data collected during this phase, the six modules: (i) Agricultural Financial Management; (ii) Agricultural Software Support Tools; (iii) Agricultural Sustainability; (iv) Farm Entrepreneurship; (v) Robotics in Agriculture; and (vi) The Role of Groups in Agriculture; were developed in order to fulfil the competencies that had been identified earlier in the project.

Each module consists of a number of the identified competencies necessary for the implementation of innovation process management.

1. Agricultural Financial Management – Data and analytical skills, business and financial management, and problem solving and critical thinking.
2. Agricultural Software Support Tools – Digital and technological skills, data and analytical skills, training and education, agricultural innovation and technology adoption, digital and IT knowledge and future orientated vision and growth.
3. Agricultural Sustainability – Agronomy and sustainable farming, policy and regulatory knowledge, sustainable and regenerative farming practices, climate change and environmental impact, adaptability and openness to change, commitment to sustainability.
4. Farm Entrepreneurship – Critical thinking and problem solving, adaptability and openness to change, entrepreneurial and innovative mindset, innovation awareness, agriculture innovation and technology adoption, entrepreneurship and marketing, business and financial management, problem solving and critical thinking.
5. Robotics in Agriculture – Digital and technological skills, technology adoption, sustainable and regenerative farming practices, digital and IT knowledge, innovation awareness, entrepreneurial and innovative mindset, adaptability and openness to change.
6. The role of Groups in Agriculture – Collaboration and knowledge sharing, critical thinking and problem solving, adaptability and openness to change, communication and information sharing, managerial and leadership skills, networking and relationship building, problem solving and critical thinking, and communication and information sharing.

In summary, an agricultural education programme on Innovation Process Management in Agriculture which addresses the knowledge, skills, and attitudinal requirements of farmers, TVET (Technical and Vocational Education and Training) providers, and agricultural extensionists across Europe was developed based on the key competencies that were identified to have a role to play in innovation uptake.

4. Practical Implications

As the agri-food sector becomes increasingly knowledge-intensive, the need for comprehensive education and continuous skills development is critical to its success and sustainability (Parrella et al., 2023; Pigford et al., 2018). This project offers a wide range of agricultural education and CPD opportunities aimed at farmers, agricultural extensionists, and the broader Agricultural Knowledge and Innovation System (AKIS).

The program plays a pivotal role in empowering farmers to navigate and adapt to technological advancements and evolving policy frameworks, which can have a significantly positive impact on the economy, society, and environment. The interactive online learning

platform is particularly well-suited to meet the needs of a diverse set of stakeholders within the AKIS—ranging from farmers to students—by providing them with accessible and flexible learning opportunities. These opportunities will not only foster knowledge exchange but also equip participants with innovative strategies that can enhance farm systems.

As the agricultural industry faces growing volatility and rapid change, this program is designed to support the sector in adapting to new challenges and seizing emerging opportunities by improving the students' knowledge, skills and attitudes in key areas of agricultural systems such as financial management, sustainability, robotics, software, human interactions and entrepreneurship. In doing so, it contributes to the resilience and sustainability of both individual farms and the broader agricultural community.

5. Theoretical Implications

This study encompassed several competencies based on knowledge, skills and attitudes that are required for the adoption of innovation process management. There was a wide range of identified competencies ranging from digital and technology literacy to competence on areas such as communication and interpersonal skills to business and financial management competencies. The results obtained during this project and the online e-learning element complement previous literature which suggests different modes of agricultural education delivery should be made available to students and farmers seeking to broaden and expand their knowledge skills and attitudes (Parrella et al., 2023).

6. References

- Dayana Andrade 2020, Laurance, W. F., Silva, J. M. C., Corpo, U. D., Götsch, E., Buttel, F. H., Foley, J. A., Ellis, E. C., Crutzen, P. J., Steffen, W., Ipcc, Hoekstra, A. Y., Rockstrom, J., Vermeulen, S. J., Thompson, V. A., Fao, ... Altieri, M. A. (2020, Sept. 6). *Syntropy and innovation in agriculture*. Current Opinion in Environmental Sustainability. <https://www.sciencedirect.com/science/article/abs/pii/S1877343520300579?via%3Dihub>
- O'Donoghue, & Heanue, K. (2018). The impact of formal agricultural education on farm level innovation and management practices. *Journal of Technology Transfer*, 43(4), 844-863. doi: <https://doi.org/10.1007/s10961-016-9529-9>
- Parrella, J. A., Esquivel, C., Leggette, H. R., & Murphrey, T, P (2023). Preparing agricultural leaders: an assessment of agricultural students' perceived importance and development of employability skills. *The Journal of Agricultural Education and Extension*, (1–23) <https://doi.org/10.1080/1389224x.2023.2179086>
- Pigford, A.-A. E., Hickey, G. M., & Klerkx, L. (2018). Beyond agricultural innovation systems? exploring an agricultural innovation ecosystems approach for niche design and development in sustainability transitions [Review of beyond agricultural innovation systems? Exploring an agricultural innovation ecosystems approach for niche design and development in sustainability transitions]. ScienceDirectELSEVIER<https://www.sciencedirect.com/ucd.idm.oclc.org/science/article/pii/S0308521X1731020X>

Session 5B

METHODS & TOOLS 1

Social learning videos: Exploring potentials of a transdisciplinary method for the EU-project GOV4ALL

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Short abstract

To solve severe societal problems like degraded soils in Europe several actors need to be involved. They hold diverse interests, knowledge, and communication styles. That is why the EU-project “Governance and business models for living labs: Rural regeneration hubs for tackling soil health challenges in the Mediterranean region GOV4ALL” (2024 – 2028) chose multi actor approaches to foster social learning by working with living labs (LL) and social learning videos (SLV). The SLV method was developed in Switzerland⁵ to find and share successful transformation knowledge on sustainable land use by farmers. This involved working with multi-stakeholder discussion groups (MDG), co-producing videos on farmers’ AHA moments, and viewing them in group discussions. This production process enabled social learning among farmers as well as within the multi stakeholder discussion group which lead to organizational learning. We argue that the combination of LL and SLV will allow to catalyze social and transformative learning within the GOV4ALL project and beyond.

Keywords: Transdisciplinarity, social learning video, multi-stakeholder discussion group, transformation knowledge, AHA Moments.

1. Purpose

About 60-70% of the European Union's soils are degraded due to unsustainable agriculture. Solving this complex problem requires addressing actors with diverse perspectives, knowledge, and interests. We need to “unpack” sustainability and make visible what challenges there are and what possible solutions could look like. There are different perspectives and scales for sustainable development, it is always a negotiation process among different stakeholders in a specific context. In the EU-project “Governance and business models for living labs: Rural regeneration hubs for tackling soil health challenges in the Mediterranean region GOV4ALL” multi-actor approaches are used to foster social learning by working with living labs and social learning videos. These methods build on co-creating knowledge. Different views and perceptions of soil by several actor groups shall be connected and sustainable land use systems are tested. Systemic transformations of integrative soil management will be demonstrated.

We first present the EU-project GOV4ALL in combination with living labs (LL) and the social learning video method (SLV). Then we summarise the experiences made in Switzerland from

⁵ The first author of this paper initiated and developed the project series “From farmer to farmer”.

2001 to 2010 with this method. Third we formulate the potential this method has for EU-projects and what challenges need to be faced. And forth, we ask whether such peer-to-peer approaches can be included in farmer's professional education and further training, to meet the needs for transformation due to climate change and biodiversity loss.

2. Design

GOV4ALL is a Soil Mission project funded by the EU from 2024 to 2028. It focuses on inspiring rural communities to participate in the identification, testing and dissemination of regenerative soil management practices. With five LL GOV4ALL will connect farmers, scientists, NGOs, policymakers and the public towards developing a vision for the future of agriculture in which farming systems can generate incomes for the rural communities while protecting natural resources, with a focus on regenerating the soil⁶. The project brings together 35 partners, including universities, research companies, and cooperatives from six countries — Spain, Greece, France, Austria, the Netherlands and Switzerland.

Three main approaches were chosen to co-create solutions and transformation knowledge in GOV4ALL: 1) Living labs (LL) where farmers, researchers, NGOs, policymakers, and the public co-create and validate soil health solutions. 2) Rural regeneration hubs which provide tailored services, business models and knowledge exchange between stakeholders and policymakers at regional, national and EU levels. 3) Collaborative research which establishes soil monitoring protocols and validated soil health management systems.

The project has established five Mediterranean LL: Solvi'Terra Living Lab, located in southeastern France; Altiplano Estepario Living Lab, located in southern Spain; Menorca Living Lab, located on the Balearic Island of Menorca in Spain; Aegean Living Lab, located on the island of Lesbos in Greece and Thyrea Living Lab, located in central Greece.

What challenges do we face in GOV4ALL? Stakeholders from different fields have different perspectives on sustainability, depending on their aims, methods and context of work and on the scale on which sustainable actions are discussed. Therefore, sustainability must be negotiated by stakeholders to define its meaning in each specific context and how it can be implemented. Another challenge is the question of how we can combine the system knowledge from soil scientists with the transformation knowledge of farmers. How can the new tacit knowledge generated in this EU-project be shared and conveyed? A further challenge is related to the social aspect of behavior change. We often hear from farmers that they feel isolated when conversing to organic farming for instance. Coping with the farmer's social stress is a major challenge.

Living Labs (LL)

Living labs can be defined as: "user-centered, open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings" (ENoLL). With multi-stakeholder participation a broad spectrum of stakeholders is engaged from four sectors of society: public sector (government and administration), academia, private sector, and citizens or civil society (Quadruple Helix Model). This diverse involvement enriches the innovation process, allowing for a balanced perspective and collaborative synergy (ENoLL).

LL are a suitable method to engage with different stakeholders over a longer time. Working together in local settings and interacting socially supports building of trust and credibility, bridging the gap between science and practice and sharing tacit knowledge as well.

⁶ from www.GOV4ALL.eu

Social learning video (SLV)

The first author co-developed this method by first creating the “From Farmer to Farmer” project⁷ on sustainable soil management and land use between 2001 and 2010 in Switzerland (Schneider et al. 2009). The aim was to analyse and share successful transformation knowledge with authentic AHA Moments of farmers (Sutherland et al. 2012). After several projects, this method was documented as the SLV method (Fry, 2018).

The SLV method involves three elements: (a) setting up a multi-stakeholder discussion group (MDG), (b) co-producing the videos and (c) distributing these videos and organizing moderated video screenings for further social learning (Fry and Thieme 2019). The first step is to set up a MDG where representatives of the public sector (administration), academia, private sector (e.g. farmers), and civil society (citizens) co-produce the SLV (Fry, 2018; Schneider et al., 2009). In a second step, the video team facilitates the MDG in round table discussions and field excursions to select soil health solutions and farmers to be interviewed and filmed (Fry, 2018; Schneider et al., 2009). The criterion for their selection is that they ‘have a story to tell’ regarding their implementation of the practices selected by the MDG. During filming they share, in an unscripted format, their most important experiences while showing their techniques in their working environment. At every production step, the MDG and filmed practitioners provide feedback and contribute to the iterative development of the videos (Fry, 2018). In a third step, the videos will be made accessible through online portals, where they can be shared with the wider farming community as well as with technical colleges to provide mutual learning opportunities (Fry and Thieme 2019).

In GOV4ALL the potential of the co-design workshops within the LL are maximized by applying the SLV method to support the first round of innovation co-design where farmers exchange with soil scientists and validate practices for soil health. In all LL 1-2 persons were selected to film selected examples and to co-produce SLV with the MDG. This process and the editing of 10 videos is supervised by the authors from BFH of this extended abstract. The SLV method will stimulate and document parts of the negotiation process among stakeholders with respect to soil health action and sustainable development. Also, this method allows to characterise successful transformation knowledge of farmers which is in line with scientific results. Because the farmers portrayed in the videos talk in their practitioners’ language, they are considered credible and trustworthy and can serve as role models for peers. SLV have proven to be a bridge building tool between the different actors, as they explore farmer arguments aligned with ecology, economy, agronomy, sociology, etc. SLV will be used to further engage stakeholders, create awareness of project outcomes and for alluring their active participation in the second round of solutions exploration (proposal GOV4ALL).

3. Recapitulated findings from Switzerland

In this chapter we showcase selected farmer transformation knowledge on sustainable soil use in Switzerland as well as observed learning processes by the MDG.

It was noticeable that farmers do not only relate to soil in a disciplinary sense but use a broad argumentation with economic, ecological, agronomic, social and aesthetic dimensions, as noted by Schneider et al. (2010). So, soil protection becomes one among many other issues, and economic arguments can also lead to sustainable soil management (Fry and Thieme 2019). Farmers encounter obstacles and difficulties on the social side as well. Green cover, for example, can be aesthetically a provocation for family and community, leading to

⁷ www.fromfarmertofarmer.ch

negative peer pressure. *“For my father's generation, herbicides were a big step forward. They were upset at the sight of our vineyard and all the grass. They said it doesn't look nice at all; one should be ashamed of it. It was really a huge conflict. But gradually they saw that we were rather successful with it (Green cover in viticulture/19).”* (cited in Fry and Thieme 2019) The videos were very well received owing to their proximity to practice, their authenticity, the ease with which the narrative could be followed, and the ways in which they stimulated viewers' reflections. However, farmers did voice their criticisms of the videos when important discussions were missing, when colleagues were criticised, and challenges weren't mentioned (Fry and Thieme 2019). These videos enhanced learning processes at the individual and organisational level (Schneider et al 2009). For instance, the films contributed to a more positive connotation of soil protection in agriculture. Several participants who were in regular contact with the Federal Office for Agriculture observed that it became easier to debate questions related to soil protection with this federal office. The representative of the Federal office for Environment stated that while interacting with farmers in the field he learned about their reality and thus critically reflected on their own institutional implementation strategy as too limited: *“After (the group meetings) I saw much clearer how direct drilling works. Of course one had read about it before. But when you are there yourself you see how the farmers explain the machines. When you are with the farmers on their fields you also see the difficulties: The complexity of their decisions, with heavy soils for instance. Mostly we confront them with a specific problem, and they must cope with the whole crop rotation, the weather, that they get it done in time”* Cited in Schneider et al 2009

When viewed commonly in discussion groups, these videos were powerful triggers for social learning among farmers as well as within MDG. Presentations of the films allowed learning processes to emerge among the other members of the organisations by positively influencing the institutional environment, resulting in more positive connotations associated with soil issues and farmers' respective knowledge about it (Schneider et al 2009).

The experience in the project overall confirmed that it is important to identify and share sustainable transformation knowledge and not to try to transfer information about isolated soil properties and soil system knowledge when addressing practitioners. The factual knowledge is relatively easy to acquire, and information on soil quality is not enough to elicit change. Social interaction during transition phases is crucial. This is especially important for soil protection agencies and advisory organizations who are trying to deliver laws on soil protection. Generally, the videos promoting sustainable soil management disseminated to farmers focus on system and target knowledge but do not capture farmer transformation knowledge – which is what is specifically enabled by the SLV method.

4. Practical Implications and expectations for GOV4ALL and for education and extension in general

What are the chances and possible pitfalls when co-producing SLV on an EU level covering three countries and five living labs?

Working with LL and SLV method has a huge potential to create, find and share relevant soil transformation knowledge because the LL cover the whole value chain from producing, selling and cooking food, and - together with Gov4all - they create a co-creative environment where learning and sharing knowledge will be fostered. SLV build on the multi-stakeholder processes of each LL and make farmer transformation knowledge visible, tangible and sharable. This transformation knowledge will be robust, meaningful and reliable. There is potential to integrate diverse farmers, with different gender, age and education. Farmers will reflect on their practices when being filmed, watch first video-cuts and there will be joint screenings with the MSG. The SLV will act like a process tool first within the consortium of

GOV4ALL and then also in farmer associations, administration and other organisations. Therefore, we assume that this approach will lead to more sustainable solutions. By using it in different contexts and within EU-projects this method will be developed further.

However, the SLV method is time consuming and costly. To keep the production costs minimal video teams from each LL will use smartphones or simple cameras. Covering three different countries with different languages is also demanding and relies on language skills of the team and linguistic support. We see specific challenges for facilitating knowledge sharing between soil scientists and farmers and the quite short period farmers have for learning. Learning processes often take time and not everything leads to an immediate AHA experience. We will analyse the AHA moments that took place during this time and how the scientific knowledge was exchanged with the farmers. Some of the five LL were initiated by farmers (Alvelal LL), some by scientists (Solvi terra LL) and others by grass root movements (Thyrea LL). It will be interesting to see whether the origin has an influence on the co-creation processes and how knowledge exchange is orchestrated. And finally, the exchange of knowledge also depends on the characteristics of the agricultural knowledge and innovation system AKIS (Knierim et al. 2015). In Switzerland we have a very active knowledge exchange within the AKIS, and it was generally open to the SLV. However, one expert from a soil protection agency was skeptical because the main knowledge producers – scientists – did not speak in the videos. Therefore, we will analyse the influence of the different LL on the co-creation processes as well as study how the different AKIS react to facilitating knowledge sharing and learning with unconventional methods, such as SLV.

Can such peer-to-peer approaches help adapting farmer education as well as fostering the exchange among experienced farmers to the needs for transformation due to climate change and biodiversity loss? Education and extension are undergoing significant transformations with respect to sustainability-oriented transitions (Cristóvão et al. 2012, Labarthe et al. 2021). Soil protection and saving biodiversity are not primary goals for all farmers. So, system and target knowledge need to be “translated” into farmer transformation knowledge. Top-down methods are not appealing because they lack translation into meaningful practices for farmers (Koutsouris 2018). Experts working in consultation and education often have a disciplinary background which make them speak about biodiversity and climate adaptation measures in a language and style that stems from biology and other natural sciences. Such language is difficult for farmers to relate with (Rust et al. 2022). When moderating working groups, it is required that the consultants stay open. They don’t determine the topics but must leave room for the farmers to decide. This also requires a certain skill and, above all, a different self-image of the moderator (Thieme and Fry 2023).

We believe that these peer-to-peer approaches help to adapt the education of farmers and other stakeholders to the needs for transformation due to climate change and biodiversity loss. It is important to include peer to peer learning into education to cover this very specific transformation knowledge and to build on role models. For instance, when new consultation formats are implemented from advisory services it is crucial to analyse what the farmers are really learning. “It was interesting” can often mean “I didn’t understand most of it”, or “I don’t know yet what this means for my farm”, or: “I am sure I will not use this”. We also believe that peer-to-peer approaches help fostering the exchange between experienced and less experienced farmers to the needs for transformation due to climate change and biodiversity loss. With this approach both innovative methods and role models are shared in the community. Bringing together experienced pioneers and newcomers allows for social engagement. The social isolation in rural regions is the greater challenge to cope with, not the actual sustainable method as such. Could the notion “from the sage on the stage to the

guide on the side” catalyze a transition and enable more effective, inclusive, and fair approaches in teaching and extension? (Thieme and Fry 2023)

5. Theoretical Implications

This work is based on transdisciplinary approaches working with MDG and using different knowledge forms. The SLV draws on theories coming from philosophy of science like “Thought style and thought collectives” (Fleck 1979, Fry 2023) and tacit knowledge (Polanyi 2012). The social learning video method builds on the idea of learning as a social process, embedded in social relations and networks (Barnes et al. 2017; Bos et al. 2013). Farmers are often keen to interact socially, and they use social networks to compare and to formulate their own opinion, by accepting or rejecting others’ knowledge (Morgan et al. 2002) and the respected experts within social networks are seen as role models. Learning through role models has been reported to be effective in many contexts, and opinion leaders are often seen as drivers for social innovation (Bandura, 2004).

6. References

- Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, 31, 143-164. <https://doi.org/10.1177/1090198104263660>.
- Barnes, M., Bodin, Ö., Guerrero, A., McAllister, R., Alexander, S., & Robins, G. (2017). The social structural foundations of adaptation and transformation in social–ecological systems. *Ecology and Society*, 22(4), 16. <https://doi.org/10.5751/ES-09769-220416>.
- Bos, J., Brown, R. R., & Farrelly, M. A. (2013). A design framework for creating social learning situations. *Global Environmental Change*, 23, 398-412. <https://doi.org/10.1016/j.gloenvcha.2012.12.003>.
- Brand, U. (2016). “Transformation” as a new critical orthodoxy: ENoLL (2025). Living Lab origins, developments and future perspectives. Published by the European Network of Living Labs (ENoLL), [D. Schuurman, M.I. DeLosRios-White, M. Desole (eds)]. Licensed under CC BY-NC 4.0. <https://doi.org/10.5281/zenodo.14764597>.
- Cristóvão, A., Koutsouris, A., & Kügler, M. (2012). Extension systems and change facilitation for agricultural and rural development. In *Farming systems research into the 21st century: The new dynamic* (pp. 201-227). Dordrecht: Springer Netherlands.
- Fleck, L. (1979). *Genesis and Development of a Scientific Fact*. Chicago/London: University of Chicago Press.
- Fry, P. E. (2023). Gesellschaftliche Akteursgruppen als Denkkollektive verstehen und verbinden. *GAIA-Ecological Perspectives for Science and Society*, 32(4), 349-352. <https://doi.org/10.14512/gaia.32.4.3>
- Fry, P. (2018): Social learning videos: A Method for successful collaboration between science and practice. In: Padmanabhan, Martina (editor). *Transdisciplinarity: How research is changing to meet the challenges of sustainability. Routledge Series: Studies in Environment, Culture and Society*. Editors: Bernhard Glaeser & Heike Egner. <https://doi.org/10.4324/9781315441481-6>
- Fry, P., & Thieme, S. (2019). A social learning video method: Identifying and sharing successful transformation knowledge for sustainable soil management in Switzerland. *Soil use and management*, 35(1), 185-194. <https://doi.org/10.1111/sum.12505>
- King, A. (1993). From sage on the stage to guide on the side. *College teaching*, 41(1), 30-35. <https://doi.org/10.1080/87567555.1993.9926781>
- Knierim, A., Boenning, K., Caggiano, M., Cristóvão, A., Dirimanova, V., Koehnen, T., ... & Prager, K. (2015). The AKIS concept and its relevance in selected EU member states. *Outlook on Agriculture*, 44(1), 29-36.

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- Koutsouris, A. (2018). Role of Extension in Agricultural Technology Transfer: A Critical Review. In: Kalaitzandonakes, N., Carayannis, E., Grigoroudis, E., Rozakis, S. (eds) From Agriscience to Agribusiness. Innovation, Technology, and Knowledge Management. Springer, Cham. https://doi.org/10.1007/978-3-319-67958-7_16
- Labarthe, P., Prager, K., Leloup, H., Elzen, B., Collins, K., Laurant, C., ... & van Raaij, M. (2021). Deliverable 5.7. Policy Recommendations Report.: Strengthening farm advice for innovation and Sustainability. European Commission.
- Morgan, M. G., Fischhoff, B., Bostrom, A., & Atman, C. J. (2002). Risk communication: A mental models approach. Cambridge, UK: Cambridge University Press.
- Polanyi, M. (2012). Personal knowledge. Routledge.
- Rust, N. A., Stankovics, P., Jarvis, R. M., Morris-Trainor, Z., de Vries, J. R., Ingram, J., ... & Reed, M. S. (2022). Have farmers had enough of experts? *Environmental management*, 1-14.
- Schneider, F., Ledermann, T., Fry, P., & Rist, S. (2010). Soil conservation in Swiss agriculture—Approaching abstract and symbolic meanings in farmers' life-worlds. *Land Use Policy*, 27(2), 332-339.
- Schneider, F., Fry, P., Ledermann, T., & Rist, S. (2009). Social learning processes in Swiss soil protection—the 'from farmer-to farmer 'project. *Human ecology*, 37, 475-489. <https://doi.org/10.1007/s10745-009-9262-1>
- Sutherland, L. A., Burton, R. J., Ingram, J., Blackstock, K., Slee, B., & Gotts, N. (2012). Triggering change: Towards a conceptualisation of major change processes in farm decision-making. *Journal of environmental management*, 104, 142-151. <https://doi.org/10.1016/j.jenvman.2012.03.013>
- Thieme, S., & Fry, P. E. (2023). Teaching transdisciplinary competencies for sustainability transformation by co-producing social learning videos. *GAIA-Ecological Perspectives for Science and Society*, 32(1), 154-161. <https://doi.org/10.14512/gaia.32.1.13>

The Farmer & Advisory Journey: A Reflective Tool for Supporting Change in Farming Practices

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Short abstract

This article introduces the "Farmer & Advisory Journey," a tool developed within the ClimateSmart Advisors (CSA) project to support agricultural advisors in reflecting on their role in promoting climate-smart transitions. Built upon behavioural change models and results from focus groups, the tool uses a visual and participatory format to map the non-linear process of change from the farmer's perspective. It includes cards representing farmer stages, advisory interventions, and enabling factors.

Four case studies illustrate its application : (1) the training of 40 advisors within the CSA project (Dublin, 2024) (2) a workshop during the Carbon Farming Summit (Dublin, 2025); (3) a training of advisors in the Organic Climate Net project that helped reposition their advisory practices beyond technical content (Paris, 2025); and (4) its use in higher education to frame

advisory work as a dynamic process (Ireland, 2024). Across these contexts, the tool proved effective in fostering reflection, peer learning, and strategic thinking.

We argue that the Farmer & Advisory Journey can contribute meaningfully to lifelong learning, training design, and policymaker awareness. It highlights the complexity of change and promotes more holistic and tailored advisory support. Future developments could include its transformation into a self-assessment and skills development tool.

1. Purpose: The Need for Reflexivity in Agricultural Advisory

The transition towards sustainable and climate-resilient agriculture is accelerating across Europe and globally. Farmers are confronted with increasingly complex decisions that require not only technical knowledge, but also shifts in practices, mental models, and business strategies. Agricultural advisors, situated at the intersection of science, policy, and practice, play a key role in supporting this transition. Within this evolving context, the project Climate Smart Advisors (CSA) explores how advisory services can become more effective agents of change. One output of this work is the "Farmer & Advisory Journey"—a conceptual and practical tool designed to help advisors reflect on their own interventions and the process of farmer learning. The tool has been applied in various training and workshop settings across Europe. This paper introduces its structure, documents applications, and discusses its added value as a reflective and capacity-building tool for advisors.

2. The Farmer & Advisory Journey: Principles and Design

The "Farmer & Advisory Journey" was developed during the CSA project based on insights from 10 focus groups held in different European countries. These focus groups engaged advisors in reflecting on how they support farmers adopting climate-smart practices and revealed wide diversity in strategies and perceived roles. Drawing on these findings and theoretical frameworks such as the ADKAR model (Awareness, Desire, Knowledge, Ability, Reinforcement), the diffusion of innovation, and decision-making models (Nettle et al. (2022), Rose et al. (2018), Wreford et al. (2017).), the Journey represents a nonlinear, realistic pathway of behavioral change. The tool aims to encourage advisors to map their actions along this complex process, rather than defaulting to linear assumptions. The tool includes three types of cards:

- **Farmer Journey Cards:** representing phases such as doubt, awareness, experimentation, dropout, and commitment.
- **Advisory Activity Cards:** interventions ranging from technical advice to peer learning facilitation or showcasing success stories.
- **Enabling Factors & Motivations Cards:** highlighting internal and external drivers such as profitability, trust in the advisor, or future-proofing concerns.

The enabling factors and motivation cards were added by a partner when developing the workshop for the Carbon Farming Summit. The set-up is modular and adaptative: it can be added by the facilitators or participants. The farmer cards can be set already as a « given » preliminary to shorten the process or focus more on the advisory activities. The guidelines for facilitating the workshop and the cards are available under <https://www.farmingforclimate.eu/details/162>.

3. Insights from the four use cases

3.1 Train-the-Trainer course in the ClimateSmartAdvisor project (Dublin, March 2024)

The 3-hours workshop was part of a 3-days training of 40 advisors from all over Europe who would then become ClimateSmartCoaches of the project. A ClimateSmartCoach leads a community of practice of 5 advisors who work together, learn and reflect on how to improve their advisory practice in the field of climate-smart farming.

The participants were put in groups of 3 to 5 persons of geographical proximity and/or language. They were given cards for the farmer journey only first and asked to place them on a paperboard, make links and arrows to represent a typical journey of a farmer through change. They had empty cards to add. Then journeys were compared and discussed between groups. There were many differences both in terms of starting point and loops. Then the groups were given cards for advisory interventions to place and reflect on how those interventions can help the farmer in its journey. Groups were then discussing and comparing their journeys two and two.

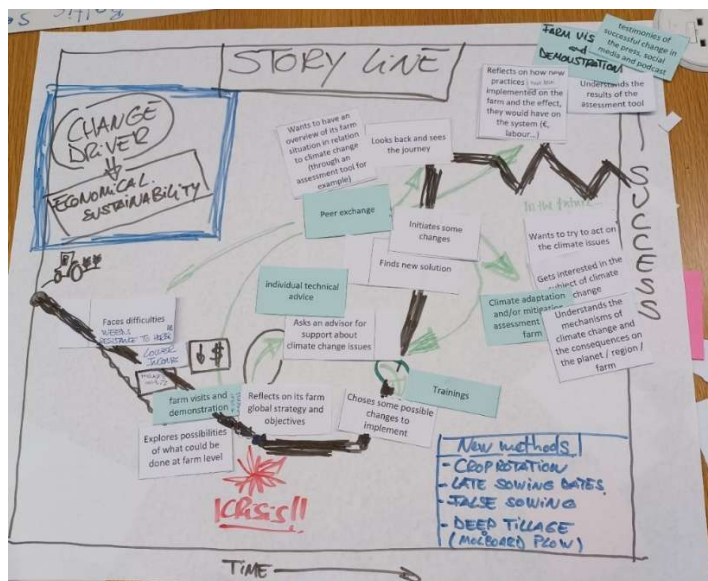


Image 1: Farmer's and advisory journey as built by a group of participants during the first "Train The Trainer" course of the ClimateSmartAdvisors project (Dublin, March 2024)

Several advisors expressed that the exercise had been interesting and allowed them to take a step back and reflect about their practices. Some of them also mentioned that they would use it in their community of practice to identify together strengths and weaknesses of the advisors in their network.

3.2. Carbon Farming Summit Workshop (Dublin, March 2025)

At the Carbon Farming Summit in Dublin, the tool was presented during a 30-minute interactive workshop attended by 30 participants, including farmers, advisors, researchers, and policymakers. The session was part of a longer panel exploring farmer motivations, innovative advisory tools, and reward mechanisms for carbon farming.

In small groups, participants used the Journey and card sets to place advisory interventions and motivational levers along the farmer's path to change and to select and discuss their top three advisory methods, motivations, and enabling factors.

The top motivations identified were peer exchange, profitability, and futureproofing of the farm. Enabling factors included trust in the advisor, clarity of advice, and consistent messaging. High-impact advisory activities were showcasing practical and economic benefits, using farmer testimonies, and illustrating action impacts with relatable examples.

Key insights: The exercise highlighted the central role of advisors and the need for better training on the Carbon Removal Certification Framework and related regulations. Participants recognized that advisors must be empowered with tools and policy literacy to explain climate actions and their implications. They also discussed that the tool could help

conveying to policymakers the complexity of change and the limitations of one-off interventions or policy instruments.

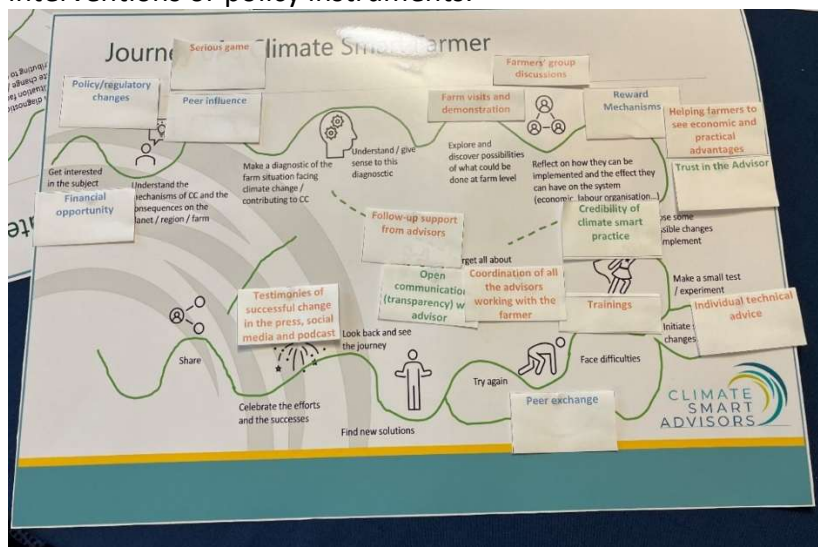


Image 2: Journey as used during the Carbon Farming Summit (Dublin, March 2025)

3.3. Organic Climate Net Advisor Training (France, February 2025)

The Journey was also used in a two-day training session for advisors involved in the Organic Climate Net project. The training aimed to improve facilitation techniques and support for farmers developing carbon strategies. In this context, only the Farmer Journey and Advisory Action cards were used. Advisors were grouped by country to allow discussion in their native language and asked to choose a real or fictional farmer and map their journey and to identify relevant advisory strategies and reflect on their own practice.

Key insights: After initial skepticism, advisors enthusiastically engaged with the exercise, drawing links between advisory roles and farmers' mindsets. The method enabled them to step back from a purely technical perspective and consider psychological dimensions of change (e.g. the need to "celebrate" intermediate achievements). Advisors appreciated the creative, non-prescriptive format, which promoted peer learning and team cohesion. However, clearer instructions and a proper debriefing were identified as areas for improvement.

This session helped participants reframe their advisory role as one that also involves psychological support and personalized guidance, not just technical advice. It created a shared language for discussing advisory dilemmas and priorities.

3.4. Use with Students in Higher Education (Ireland, autumn 2024)

In academic settings, the tool was used as part of lectures on advisory systems and behavior change. Students were asked to explore the stages of farmer decision-making and identify where different advisory approaches (individual visits, group learning, digital tools) fit in. The Journey helped students understand that transitions are not linear and that successful change requires multi-layered, long-term support. As one educator put it, *"We don't often talk about the advisor's activity in terms of positioning within a change process. This model helps conceptualise it."*

4. Discussion: A Reflexive and Flexible Tool

The Farmer & Advisory Journey has proved valuable in diverse settings as a:

- **Reflective tool:** allowing advisors to reassess their roles and strategies.

- **Training aid:** helping structure learning around behavior change dynamics.
 - **Communication device:** conveying to policymakers the complexity of change and the limitations of one-off interventions or policy instruments.

Its strength lies in showing that change is a *messy, iterative, and emotional* process. Rather than prescribing "what works," the tool invites contextualized thinking. For many users, it also enabled recognition of rarely addressed dimensions of advisory work—such as trust-building, timing, and emotional support. Some challenges remain as the approach requires experienced facilitation and time constraints can limit depth of discussion.

Future developments could include:

- Turning the model into a self-assessment tool for identifying training needs of advisors.
- Developing pathways to help advisors access relevant trainings or shadowing opportunities.
- Identify different type of farmers (the one who doesn't like to work in groups, the ones who are far from advisors and don't trust them...) and discuss how the advisory activities can be adapted to them.

5. Theoretical Implications

Behavioural change is often conceptualised as a linear process as in the 'Change towards Integration of Agri-environmental Practices' (CIAEP) framework (Dumont et al. (2025)). The experience of the advisors who were part of the workshops depict farmers' change as a « messy » / iterative process with trials, fall back and returns. It would be relevant for further studies to develop theories which better reflect this.

Advisory interventions for facilitating farmers' change of practices can be some of the « triggers » which will finally lead to awareness or intention to test new practices. To our knowledge, the tailoring of such interventions (as demo events, individual technical advice, peer-to-peer groups, forecasting exercises...) to the stage of the farmer's journey could be investigated and documented further.

6. Conclusion

The Farmer & Advisory Journey offers an innovative, intuitive way to engage advisors in reflective practice and strategic planning. It has demonstrated flexibility across contexts—from research to advisor training and education settings. By framing advisory work as part of a dynamic, multi-faceted process, the tool helps strengthen the contribution of advisors to sustainable and climate-resilient farming. Rather than simplifying the advisory role, it honours its complexity—and equips advisors to better support farmers through it.

The next steps include integrating this tool into broader advisor training programs and exploring how it can support professional development, policy design, and the co-construction of transition strategies.

7. References

- Dumont, A., Ruiz, J., Campeau, S (2025) The Change towards the Integration of Agri-environmental Practices (CIAEP) into farmer's practices system: An affective, cognitive, and behavioural process, *Journal of Rural Studies*, 113. DOI 10.1016/j.jrurstud.2024.103479
- Nettle, R., Major, J., Turner, L., & Harris, J. (2022) Selecting methods of agricultural extension to support diverse adoption pathways: a review and case studies. *Animal Production Science*, <https://doi.org/10.1071/AN22329>
- Rose, D. C., Keating, C., & Morris, C. (2018). Understanding how to influence farmers' decision-making behaviour: a social science literature review. *Agriculture and Horticulture Development Board*.

Wreford, Anita & Ignaciuk, Adriana & Gruere, Guillaume. (2017). Overcoming Barriers to the Adoption of Climate-Friendly Practices in Agriculture. 10.1787/97767de8-en.

The “Game of Left-Behind Territories”: A Strategy for Enhancing Collective Learning Pathways and Driving Systemic Change

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Short abstract

Transforming agri-food systems under the pressure of growing climate and socio-political crises requires innovative social-ecological frameworks and collective learning strategies. This paper presents the *Game of Left-Behind Territories*, a participatory, agent-based learning tool grounded in human ecology and developed from the previously established *RuSTIC* model. Designed for rural young entrepreneurs and key stakeholders, the game fosters co-creation of place-based solutions and experimentation with sustainability transitions. Using a mixed-methods exploratory sequential design, thematic analysis of 46 interviews shaped the game’s structure around 36 thematic cards spanning six dimensions of social-ecological transformative innovation. Playtests with 116 participants across diverse Portuguese mainland territorial contexts demonstrated its capacity to promote strategic thinking, collaboration, and adaptive learning for sustainable rural development across disciplinary and sectoral boundaries. The game operationalizes the concept of *knowledge commoning*, which emerged inductively during the development of the theoretical framework, bridging local knowledge with global sustainability development goals. It also supports participatory governance and place-based policy experimentation, focusing on the recent Portuguese legal figure, the *Jovem Empresário Rural*. This card game advances both theoretical and practical understanding of collective desirable social-ecological transformations, offering a replicable methodology for enhancing resilience, agency, and assess rural innovation capabilities in local communities.

1. Purpose

Transforming agri-food systems amid climate, political, and socio-economic crises demands integrated scientific, social-ecological, and policy innovations, alongside new modes of collective learning and capacity development. These are crucial for driving structural changes that foster social justice, local experimentation, and sustainability in the face of escalating climate, environmental, political, and socio-economic challenges (Barrett et al., 2020; Weber et al., 2020). This paper presents *The Game of Left-Behind Territories*, a novel participatory agent-based learning tool developed within the framework of doctoral research in Human Ecology. This tool is derived from the *RuSTIC* model, a systemic framework designed for assessing social-ecological transformative innovation within rural contexts (Parreira & Pires, 2025). Fundamentally, the game aims to cultivate collective learning pathways, identified as "a core capacity for resilience and adaptation and sustainability and transformation" (Bruckmeier & Pires, 2018, p. 212). The *Game of Left-*

Behind Territories is understood as a participatory intelligent governance tool that facilitates the experimentation of place-based policies, social-ecological transformative innovation, and sustainability transitions. It is designed to reflect rural and agri-food complexities, including the unintended consequences of the nuanced "dark side of social innovations" (Larsson & Brandsen, 2016: p. 300), where formal practices can inadvertently propagate further complexities (Brandsen et al., 2016). Targeting rural young entrepreneurs (18–40) and key stakeholders, the game facilitates the co-creation of place-based solutions and experimentation with sustainability transitions. It also operationalizes the entrepreneurial potential of the Portuguese *Jovem Empresário Rural* (JER) statute and demonstrates how board games can foster *knowledge commoning*, an emergent concept in this doctoral research. It enables inclusive and exploratory measurement and monitoring of local social innovation capabilities, providing an interactive nexus for assessing social-ecological challenges, co-creating innovative and inclusive metrics towards desirable sustainable transitions, and supporting locally grounded social innovation initiatives.

2. Design

This study adopts an exploratory sequential mixed-methods design, combining a human ecology conceptual framework about social innovation with participatory action research. The game was developed through thematic analysis of 46 interviews with rural young entrepreneurs, academics, government entities, NGOs, and local associations. This analysis yielded 36 thematic codes grouped into six key dimensions and 30 subdimensions, reflecting socio-ecological dimensions and capabilities for transformative innovation in rural contexts. These elements structured the game's design (Figure 1), and its dynamic in three phases: (1) selecting five out of 36 thematic cards to identify local priorities, (2) rating each on a 1–5 Likert scale to assess development levels, and (3) co-creating narratives by exploring interdependencies between selected themes. Grounded in participatory and design thinking methodologies, the game integrates a collective ideation and problem-solving approach, providing a low-risk environment for stakeholders to negotiate their perspectives on local capabilities for rural social innovation through interactive dialogues. It has been playtested in 9 focus groups with young entrepreneurs/innovators (ages 18-40) and key stakeholders in local communities where their initiatives are underway, being the first one by our initiative. Since then, the other 8 tests were carried out by expression of interest or invitation, which is an indicator of the interest shown in the game's potential. Two of those 9 tests were tested in formal university classrooms, particularly in Rural Geography and Economics classrooms, both in urban contexts. Each playtesting session involved groups of 6 to 15 participants and lasted approximately 90 minutes. Iterative refinements to the game design have been made based on feedback from all 116 participants, including enhancements to game flow, facilitation strategies, and accessibility (e.g., conceptual support).

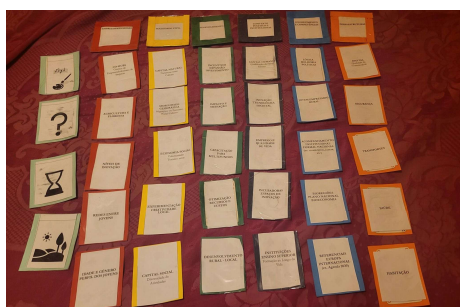


Figure 1: Cards of the Game of Left-Behind Territories: Let's Play and Create?

Source: Own Elaboration

3. Findings

Pilot tests of *The Game of Left-Behind Territories* across diverse rural and urban contexts confirmed its effectiveness in empowering youth and stakeholders in complex decision-making. By simulating real-world challenges, the game enabled participants to explore interdependencies among social-ecological dimensions, fostering adaptive, context-specific learning. Its flexible design allowed for local customization, promoting inter- and transdisciplinary collaboration and enhancing understanding of collective action in sustainable transformation. Participants reported increased strategic awareness and a stronger sense of agency in addressing rural challenges, also in a rural-urban continuum. The game facilitated dialogue around sustainability transitions and encouraged place-based innovative, cooperative solutions. It also fostered cross-scale linkages, connecting grassroots experimentation with broader frameworks such as the European Innovation Scoreboard, OECD, and Agenda 2030 indicators. Through collaborative problem-solving and role-playing, the game illustrated the potential of "knowledge commoning" as an *ecology of practices* (Stengers, 2005). Despite its success, some challenges emerged, particularly in larger groups where discussions became fragmented. Refinements such as smaller group settings and structured facilitation improved inclusivity, while U- or O-shaped seating arrangements enhanced communication. Overall, the game supports collective learning and multi-actor and multi-sectoral dialogue, offering a participatory tool for social-ecological transformative innovation and locally grounded policy experimentation and co-creation.

4. Practical Implications

The "Game of Left-Behind Territories" acts as a catalytic tool (Bayrack, 2019) for developing organizational and collective learning capabilities critical to agri-food innovation and sustainability transitions. It bridges top-down policies and grassroots innovation, aligning with Stengers' (2005) "ecology of practices" to support transformative agricultural education and experimental rural governance initiatives. The game operationalizes the emergent concept of knowledge *commoning* and youth agency while prototyping participatory decision-making and place-based policy frameworks. Across nine test sessions involving 116 participants, it fostered strategic awareness, enhanced agency, and deeper understanding of complex concepts and normative and policy frameworks, such as the JER statute and biodistricts, often unknown to the involved 116 participants. This underscores its value in translating abstract concepts into locally meaningful practices. Interpreted as an agent-based learning environment, the game simulates complex adaptive systems, enabling players to embody diverse territorial roles and explore social-ecological dynamics via structured interaction. By integrating subjective local insights with global indicators (INE, Agenda 2030, ODS Local, ESG, GRI), the game strengthens multi-level governance and fosters context-specific social-ecological transformative innovation. It offers an agile, participatory methodology for supporting desirable systemic transformation in rural territories through reflective practice and experimental collective learning.

5. Theoretical Implications

The "Game of Left-Behind Territories" offers a practical and theoretically grounded framework for fostering collective social-ecological transformative innovation (Bruckmeier & Pires, 2018). Rooted in human ecology, the game operationalizes *knowledge commoning* as an *ecology of practices* (Stengers, 2005), emphasizing the co-creation of knowledge through diverse epistemologies and situated experiences. It contributes to Nicolescu's (2005) call for *transdisciplinary epistemologies*, advancing the concept of "knowledge in vivo" generated through lived experience and community empowerment. This research also

enriches the emerging field of serious games in interdisciplinary rural development for sustainability, demonstrating how tabletop mechanics can model complex adaptive systems and participatory governance processes. By linking social innovation, human ecology, and rural development studies, the game functions as an agent-based learning environment that makes interdependencies, feedback loops, and institutional constraints more tangible. Its design supports reflexive, multi-actor, multi-sectoral collaborations and learning in uncertain social-ecological contexts. Finally, this exploratory sequential design contributes methodologically by positioning serious games as boundary objects that support the co-production of knowledge, strategic foresight, and participatory policy experimentation for rural resilience and territorial cohesion.

6. References

- Barrett, C. B., Benton, T. G., Cooper, K. A., Fanzo, J., Gandhi, R., Herrero, M., ... & Wood, S. (2020). Bundling innovations to transform agri-food systems. *Nature Sustainability*, 3(12), 974–976. <https://doi.org/10.1038/s41893-020-00661-8>
- Bayrak, A. T. (2019). Games as a catalyst for design for social innovation: Unlocking legendary tools. *The Design Journal*, 22(sup1), 1409–1422. <https://doi.org/10.1080/14606925.2019.1594966>
- Bock, B. (2012). Social innovation and sustainability: How to disentangle the buzzword and its application in the field of agriculture and rural development. *Studies in Agricultural Economics*, 114(2), 57–63.
- Brandsen, T., Evers, A., Cattacin, S., & Zimmer, A. (2016). The good, the bad and the ugly in social innovation. In *Social innovations in the urban context* (pp. 303–319). Springer. https://doi.org/10.1007/978-3-319-21551-8_25
- Bruckmeier, K., & Pires, I. (2018). Innovation as transformation: Integrating the socio-ecological perspectives of resilience and sustainability. In *Resilience and regional dynamics* (pp. 209–231). Springer. https://doi.org/10.1007/978-3-319-95135-5_11
- Kemmis, S., Edwards-Groves, C., Wilkinson, J., & Hardy, I. (2012). Ecologies of practices. In *Practice, learning and change* (pp. 33–49). Springer.
- Larsson, O. S., & Brandsen, T. (2016). The implicit normative assumptions of social innovation research: Embracing the dark side. In *Social innovations in the urban context* (pp. 293–302). Springer. https://doi.org/10.1007/978-3-319-21551-8_24
- Nicolescu, B. (2005). Towards transdisciplinary education and learning. In *Science and religion: Global perspectives* (pp. 1–12).
- Parreira, M. J. H., & Freitas, M. (2022). Social innovation and young rural entrepreneurship: Identifying an integrated research in less favored Portuguese rural territories. *Social Entrepreneurship, Innovation and Finance: Theory and Practice in Challenging Times* (SIBRM9), 0(0), 1-15
- Parreira, M. J., & Pires, I. (2025). Empowering rural communities on Rural Pact implementation: A human–ecological perspective on social innovation and rural young entrepreneurship. *Proceedings*, 113(1), 2. <https://doi.org/10.3390/proceedings11301002>
- Sept, A. (2020). Thinking together digitalization and social innovation in rural areas: An exploration of rural digitalization projects in Germany. *European Countryside*, 12(2), 193–208.
- Stengers, I. (2005). Introductory notes on an ecology of practices. *Cultural Studies Review*, 11(1), 183–196. <https://doi.org/10.5130/csr.v11i1.3459>
- Weber, H., Poeggel, K., Eakin, H., Fischer, D., Lang, D., von Wehrden, H., & Wiek, A. (2020). What are the ingredients for food systems change towards sustainability? Insights from

the literature. *Environmental Research Letters*, 15(11). <https://doi.org/10.1088/1748-9326/ab99fd>

Games-based learning for aggregate farming in Western Kenya

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Short abstract

Aggregated farm models offer the opportunity for fragmented smallholder landscapes to function at a larger scale, which is more conducive to both resilient livelihoods and good environmental stewardship but requires skills development among farmers in coordination and collective action. Experimental games provide opportunities for both research and experiential learning in agricultural systems. The games create hypothetical ‘action situations’ that bring none of the costs and risks of real-life action situations while still providing exposure to learning opportunities and potentially triggering learning with real-life utility. We developed a novel experimental game called ‘SharedCropping’ using the ELM lab’s Netlogo-based ‘FarmSquares’ platform that presented challenges of farming and grazing in an openly shared space and played it with farmers in the initial stages of launching an aggregated farming scheme in Kisumu and Vihiga Counties in Western, Kenya, supported by the CGIAR Research Initiative on Nature-Positive Solutions. In SharedCropping, players interact via tablet computers connected over a mobile hotspot to choose how a shared landscape should be allocated to different farming activities over time. We used SharedCropping in an intervention that varied how players earned points across treatments – according to their earnings, according to the group’s lowest-earning player, and according to the outcome of group decision – and that included a pre- and post-game discrete choice experiment framed around agricultural losses and time use. We found farmers’ attention shifting to view group efforts more favorably after playing the game, particularly in the face of higher agricultural losses. Through the game play and post-game debrief discussion, we observed some evidence of direct, technical literal learning from the game, with players focusing attention on mechanisms for maintaining soil health, including diversifying land use. We also found evidence of learning around the challenges of group coordination and the sharing of responsibilities and benefits that persisted through a six-month follow-up visit, with better performance in game play by mixed-gender groups resonating with participants as an important consideration in their current and future aggregate farming efforts.

1. Purpose

Achieving positive agroecological or environmental outcomes at a landscape scale can be a challenge in any smallholder-dominated farming system, such as those found across low- and middle-income countries in Africa and elsewhere, including Kenya. In such systems, the high degree of land fragmentation, coupled with differing capabilities and interests for farming approaches, mean that coordination and collective action are both critical, and

increasingly challenging to achieve. In Kenya, land size has been shrinking gradually in the post-colonial era. As the population increases, families divide inherited land among siblings, resulting in fragmentation. Thus, generational land subdivisions lead to farm sizes becoming too small to sustainably accommodate economic, social, and environmental demands and pressures.

Aggregation models therefore offer a promising approach to supporting smallholder farms in transitioning toward a nature-based or nature-positive system that is more economically meaningful and environmentally sustainable. In such models, farmers pool resources such as land, labor, and inputs for a common goal (Gammelgaard et al., 2021; Landesa, 2019). However, even in close-knit communities of western Kenya, collective farming is new to most farmers who have always been private small-scale producers. This study supports an exploratory endeavor to establish “aggregated farms” in three communities in western Kenya through informing the design and implementation decisions with actionable research results (e.g., improved understanding of farm members’ perceptions and preferences and underpinning community norms) and directly influencing participants’ mindsets and group dynamics through personal experience.

In Kenya, the [CGIAR Nature-Positive Solutions Research Initiative](#) (NATURE+) has been working with farmers to establish aggregated farms. Farmers in Lyanaginga in Vihiga County and Agoro East and Jimo East in Kisumu County in the Lake Victoria Basin are creating collective nature-positive farms by aggregating their land. Eligible farmers voluntarily signed up for the collective farming effort, motivated not only by the prospect of greater financial return to land but also by the potential environmental benefits promised by nature-positive solutions. However, farming cooperatively requires a lot of trust, coordination, and rules. To inform and support the process, this action research sought to understand these critical issues and design and implement an experiential learning intervention using group behavioral games.

Our objectives in the work presented here are twofold:

- 1) To advance research on behavioral experiments in the socio-ecological systems space. In particular, we aim to improve the understanding of farmers’ perceptions and preferences and the norms and conditions (including financial incentive mechanisms) under which groups overcome cooperation challenges to balance economic and environmental outcomes.
- 2) To assess the potential of game-based intervention to facilitate experiential learning for farmers about coordination and cooperation in their aggregated farms.

2. Design and Methods

The NATURE+ project (Fadda & Nikiema, 2021) builds on previous projects and partnerships with local communities in Lyanaginga in Vihiga County and Agoro East and Jimo East in Kisumu County in Western Kenya. The sites were selected for the importance of agriculture, threats to nature, enabling policy environment, and the existence of partnerships.

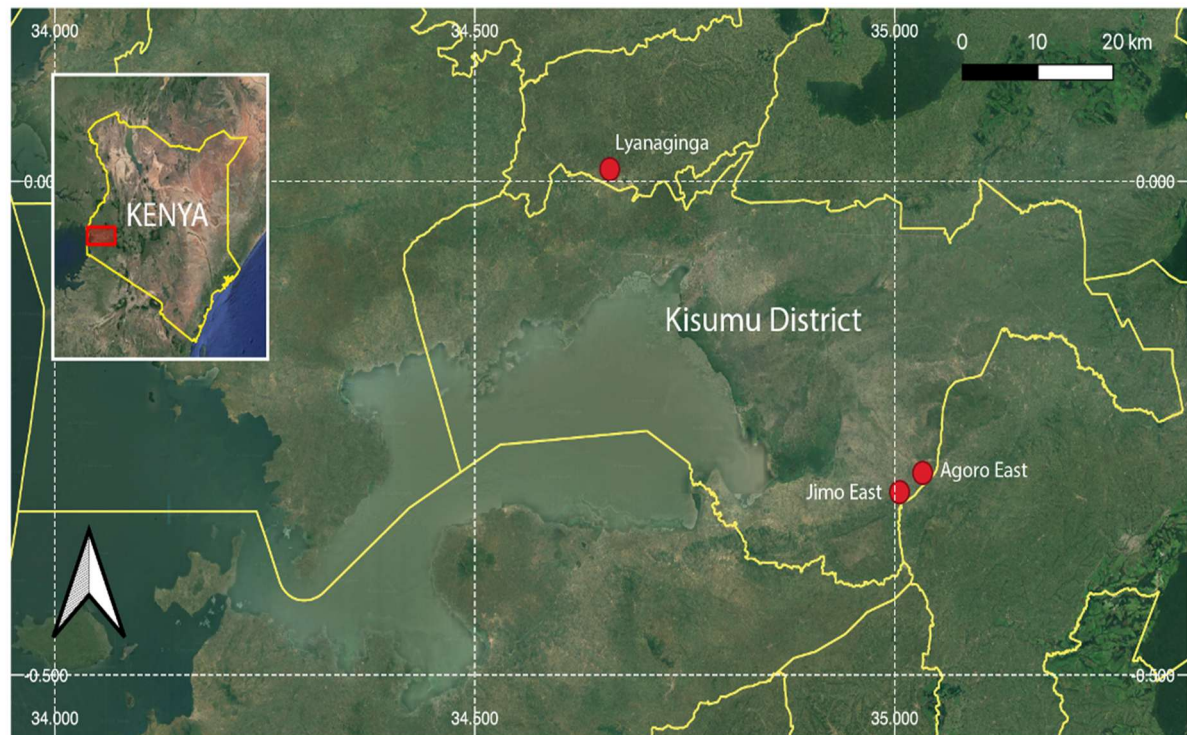


Figure 1: Map of the study site. Source: Boundary data from GADM.org; Google maps base layer

Our initial study design was informed by interactions with NATURE+ local team members and local partners supporting the interventions, a scoping visit in December 2023, and a baseline household and community survey and qualitative study conducted between May and July 2023 (Boukaka et al., 2024; Kinuthia et al., 2024).

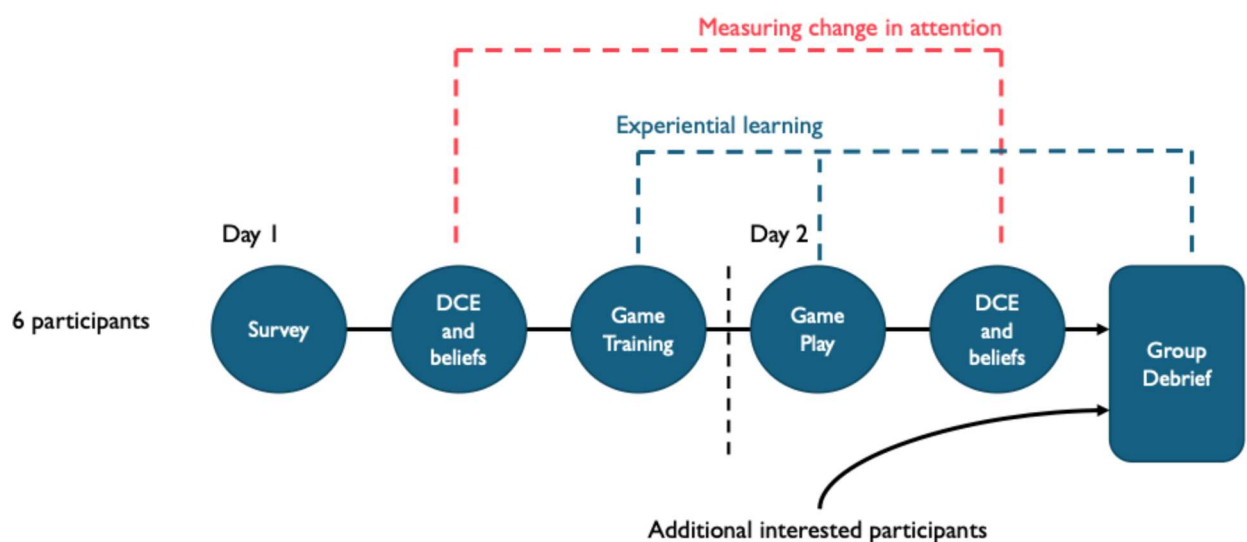


Figure 2: Intervention Structure

The experiential learning intervention comprised two parts: 1) a group game called 'SharedCropping', and 2) a plenary debriefing meeting. The game, built using the Netlogo-based 'FarmSquares' platform, used tablets connected through a local network, facilitated by a trained game facilitator and supported by a research assistant using local languages (Dholuo and Luhya) and Swahili. We conducted two half-day sessions each day of our intervention - a morning session and an afternoon session.

On day one, we carried out i) a short individual survey and discrete choice experiment implemented using Kobo Collect on Android tablets; and ii) a one-hour training exercise to learn about the NetLogo game ‘SharedCropping’ implemented on tablet PCs. On day two, we implemented iii) a one-hour group game with the same group trained on the previous day; iv) a repeat of the discrete choice experiment; and vi) a debriefing discussion with all participants who played games at the same time.

The DCE was intended to help us understand how motivations of income security and environmental care may shape farmer willingness to give up autonomy and share farm outcomes; and how the experience of the game may change this. We planned a design on the choice of a livelihood described by the five attributes of i) time invested in farm production for self-use and income only; ii) time invested in farm production for shared use and income; iii) income level in a typical year (expressed relative to actual typical income); iv) income level in a 1-in-5-year bad year (expressed relative to actual 1-in-5-year bad year income); and v) number of years in 10 years that a typical plot is allowed to rest or fallow.

We conducted a 2x2 between-subjects game design and varying group gender composition. We implemented three game sessions simultaneously in each site per day (all six players' game sessions), with participants from all game sessions participating in the debriefing discussion. We cross-randomized gender diversity in game sessions, such that one session in each day (randomized to be morning or afternoon) maximized gender diversity (2 men and 4 women or 4 men and 2 women in each 6-player game), while the other sessions were simple random assignment to game sessions of other players (All men or all women in the 6-player game). In the experiment, participants played several different game conditions, in which the costs and benefits of undertaking activities within the game varied along the session. We observed from players how gameplay relates to their thoughts about shared farming exercises. We compared game outcomes (points earned, and variation in points earned, e.g.) across the 2x2 conditions, to understand the interaction of gender diversity in shaping cooperative outcomes.

The debriefing, held among all participants who played the game on the same day, aimed to connect the game experience or lessons with real-life experience and to stimulate discussion about possible ways forward as well as any implications for the aggregated farm effort farmers were starting. The facilitator asked open questions without hinting at solutions.

The experiential learning intervention was implemented in April 2024. The team returned in October 2024 to conduct an end-line revisit of all three sites. The end-line included 1) self-facilitated, semi-structured small group discussion (six people per group, the same as the game player groups), reflecting on what is salient, what is different, and what possible impacts the game and debriefing may have had on the participants, their aggregated farm endeavor, and/or their communities, 2) a facilitated, semi-structured plenary session comprising of small groups reporting back and group discussion, and 3) presentation of the game results and plenary discussion. The purpose of the revisit was to follow up with the participants of the intervention and learn if (and in what ways) what they learned or experienced during the intervention has influenced what they do now.

3. Findings and Implications

Game groups seem to respond strongly to treatment conditions, sharing benefits more equally in treatments where payments were based on group averages or lowest-score outcomes. These findings are not surprising but coupled with other findings such as the greater reliance on grazing by those who rely more strongly on cattle for income in their real lives, and with participants' own statements in our debrief, add confidence that the game

presents a meaningful construct for the real-life action situation of interest in our intervention.

We saw in general a pattern that groups with more or all women were more successful in managing the landscape, with greater use of low-intensity farming and lower impacts on soil health. This opens a window through which we can see the gender dynamics and the explicit role of gender inclusivity in aggregated farming models. Discussion of these findings evoked discussion in both our debrief and follow-up sessions on the importance of unity across genders in agricultural contexts where roles are often gendered and separate.

We measured two sets of quantities before and after the gameplay – participants ‘beliefs’ via Likert-scale agreement with a module of statements about community and collective action, and participants’ stated preferences as expressed utility on attributes of their livelihood via a DCE. We observed a slight ‘hardening’ of some beliefs from pre- to post-game play but no change in the medians of their overall distributions. We saw shifts in the models that best explained stated preferences from pre- to post-game play; specifically, we observed an interaction between bad-year losses and effort spent on farming for community benefit in the post-game DCE that was not present in the pre-game DCE. One interpretation of this is attention focused on investing in the community, particularly when losses are steep in bad years. In further engagement with the group of participants as their aggregate farming ventures develop, we hope to continue assessments of these same stated preferences, as well as to identify if and where these attention shifts may contribute to longer-term attention, shifting mental models, and experiences in the aggregate farm.

3.1 Evidence of learning

We observed some evidence of direct, technical literal learning from the game, with players focusing attention on mechanisms for maintaining soil health, including diversifying land use. We also see evidence of learning around the challenges of group coordination and the sharing of responsibilities and benefits that persisted through the 6-month follow-up visit.

One mechanism in the game in particular – that all land squares in the grid were always open for all players to use – struck some players as unrealistic, possibly evoking underlying norms around property and use rights, but also threaded into real challenges the farmers face as they begin work as an aggregate farm. Some groups are struggling to reach shared understanding of contributions, efforts, and the sharing of benefits, trying directly to this mechanism in the game. While one view of the open land use mechanism may be that one player might harvest the crops grown by another, or graze animals in land prepared by another for cropping, another view is that the mechanism widens the possibilities for shared responsibility and benefits. It is noteworthy that some players hold this mechanism in focus 6 months after game play, as groups grapple with developing new norms for land use and responsibility in the aggregate farm.

A limitation of our design is that we did not have the possibility for a counterfactual group – a separate group of communities in similar production environments and contexts entering aggregate farm contracts with whom we could maintain engagement without our game’s intervention. We are thus unable to estimate the impact of our game’s intervention in the manner of a randomized controlled trial, which would be an ideal focus for future work. In the present engagement with Nature+ farmers in Kenya, we can identify through DCE, survey, and debrief findings, that i) the game application functioned as a meaningful and valid construct for the challenges of aggregate farming; and ii) we observe issues in resource and benefit sharing operationalized within the game to persist as real-life action situation challenges among farmers through the period of our 6-month follow-up visit.

4. References

- Boukaka, S. A., Azzarri, C., Davis, K., & De Falcis, E. (2024). *Nature-Positive Solutions Initiative baseline evaluation survey report : Kenya* (Issue July). <https://cgspace.cgiar.org/server/api/core/bitstreams/354fd361-3392-48b0-9ef3-804f1f56b934/content>
- Fadda, C., & Nikiema, J. (2021). *Nature-positive Solutions for Shifting Agrifood Systems to More Resilient and Sustainable Pathways*. <https://cgspace.cgiar.org/server/api/core/bitstreams/c59d8617-042c-4255-9a71-631fa49f5d58/content>
- Gammelgaard, J., Haakonsson, S., & Just, S. N. (2021). Linking Malawi's agricultural sector to global value chains: The case for community governance. *Journal of International Business Policy*, 4(4), 523–540. <https://doi.org/10.1057/s42214-021-00101-0>
- Kinuthia, D., Oingo, B., Bryan, E., Davis, K., Wallin, E., & Bukachi, S. (2024). *IFPRI Discussion Paper 02319 Nature-Positive Agriculture for People and the Planet A Qualitative Analysis from Kenya Dickson Kinuthia Balentine Oingo* (02319; IFPRI Discussion Paper Series, Issue December). <https://cgspace.cgiar.org/server/api/core/bitstreams/05d9776f-c2f7-4feb-bd9e-2e1f12ec1d37/content>
- Landesa. (2019). *Case Study: Phata Cooperative*. <https://cdn.landesa.org/wp-content/uploads/Phata-Case-Study-9.6.19-FINAL.pdf>

What do agricultural advisors need from a Decision Support Tool to drive agroecological transitions? The case of Ntui Living Lab, Cameroon

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Short abstract

Digital tools supporting advisory services have been deployed to facilitate the adoption of agroecological innovations. To increase the adaptation of those tools to the final user needs, user-oriented design is necessary. The purpose of this contribution is to illustrate the process of co-designing a decision support tool for agricultural extension agents that supports them in the dissemination of agro-ecological innovation processes. The development process of the Agroecology Decision Support Tool included five steps: i) identification of needs by end users (researchers, farm advisors, cooperatives); ii) a review of existing digital tools in similar contexts to identify potential existing alternatives that would suit the objectives of the tool; iv) the development of a concept iv) a requirements' elicitation process to define the expected functionalities and features and v) the first prototype assessed by extension agents in Ntui Living Lab, Cameroon in the context of the implementation of CANALLS project. The process. We identified a range of advisory organizations with different expectations and activities. Despite the multiple objectives observed, common needs identified were: the

reporting of extension activities, the need for agreed understanding on how agroecology is implemented at the local level, and the access to offline-compatible tools to support daily advisory work. Additionally, the design of the tool should aim to improve the advisors' technical and methodological competencies and skills.

Keywords: Extension agents, agroecology, Decision Support Tool, design-thinking, Cameroon, living lab

1. Purpose

The rapid development of digital agriculture, which is accelerating with artificial intelligence, is at the center of several "promises" of accelerating technological transformations in African agriculture (Nubukpo et al., 2020). One of them is to functionalize their use to solidify and strengthen the innovations that accompany the agroecological transformation of practices. Digital tools supporting advisory services in agriculture are a growing lever for the adoption of new agricultural technologies and potentially agroecological innovations. Literature review on the adoption of digital tools notes a low adoption of the tools (in terms of applications) by farmers in Africa (Alexandre, 2023). Beyond the weakness of the infrastructure (networks in certain areas), this low adoption can be described by their high cost for small farmers, by the lack of skills to use them, which refers to the lack of adaptation of these tools to the needs and conditions of use local.

The literature also questions the question posed (Bonnet et al., 2022) how the design of these tools can be specified to really support an agroecological transformation and not do the opposite. For example, they can also be designed by digital firms, the chemical or agro-industrial agricultural supply industry with the aim of optimising their own market (Paget et al, 2022). The question we ask is how and in what way the design of a "tool" can be a lever for the transformation of techniques adapted to the operating needs of innovation platforms agroecological (living lab)? To answer that question, we are presenting a case study of design of a decision-making tool for agricultural extension agents in order to re-examine how the use of this tool can accompany the change in adoption scales of agroecological innovation identified by a living lab.

2. Design

A co-creation process was used with an initial collection of needs, requirements, expectations, and experiences was done with the different users (country teams, farm advisory representatives), according to their current co-creation process. The process of development of the first concept of the DST was conducted following a design-thinking approach in three stages: design, prototyping, and validation. Given the particular circumstances of the co-creation process in the Living Labs, we initiated the involvement of the Ntui Living Lab in Cameroon.

For the methodology we followed several steps. In the step 1, a first identification of user needs was conducted between March and May 2024, carrying on in depth-interviews to potential users (country teams, farm advisors) to identify needs, expectations, and experiences. During step 2, we reviewed existing digital tools and explored possible avenues for its development through online meetings at different levels in CANALLS. In step 3, a requirements engineering process was conducted to clearly define the project functions and requirement. In Step 4, we developed the initial concept and prototype by integrating existing tools with the priorities identified by end-users and researchers. The concept was created using an adapted combination of agroecological frameworks, considering the 10 elements of agroecology of FAO (2016), the 13 principles of agroecology from Wezel (2020), and the questionnaire developed by Biovision- FACT tool (2019). This development process

was guided by the key requirements prioritized in the preceding exercise. The prototype underwent several iterations, during which the agroecological diagnostic approach was refined. The different components were integrated to form the first version of the CANALLS Decision Support Tool. This first version was assessed with a group of extension agents from different organizations in Cameroon, and recommendations for improvement were collected including the opinions of different partners in CANALLS.

3. Results

We identified three main results of the process: identification of needs, identification of prioritization of requirements and determining the concept in which information and knowledge flows are defined.

3.1 Identification of needs

After developing and testing the prototype of the Agroecological Decision Support Tool, we identified a range of advisory organizations with different expectations and activities, shaping the specific needs related to such tool: advisors from private companies, national extension agencies, cooperatives and local consultants. Looking closely to the relation extension agent- farmer, we identified 5 different types of extension service systems, with different tools, skills, activities, objectives and expected impacts (Figure 1).

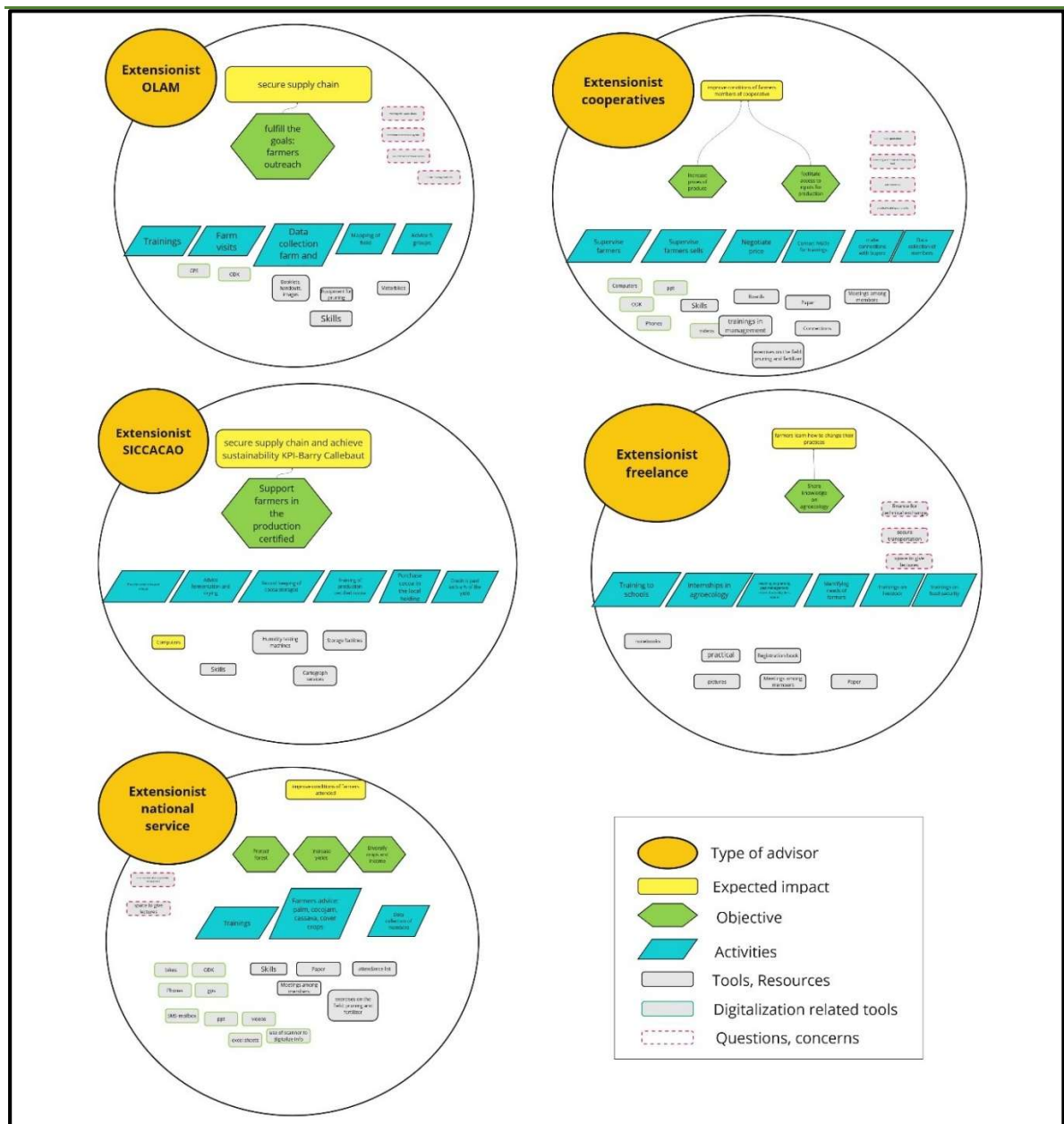


Figure1: Different types of extension agents with activities, objectives, tools, and expected impacts

The analysis revealed that extension services operate in varied extension services landscapes with numerous actors having diverse objectives and interests. Additionally, interviewees emphasized the need to account for limitations in infrastructure, electricity, and internet access, as well as the specific challenges faced by extension services in promoting agroecology in the ALLs.. This step highlighted the interests, challenges, and primary issues to address, which led to the identification of key design characteristics.

3.2 Requirements elicitation and prioritization

After identifying needs and mapping workload flows, core requirements were identified and crosschecked with user needs (Table 1).

Table 1: Requirements identified according to user needs

	Core Requirements							
	Data-driven recommendations *	Training materials and resources **	Success stories repository ***	Reporting and data transformation *	Appointment management ***	Route optimization ***	Networking and collaboration platform **	Real-time data correction and management ***
Users needs								
Improve advisors' collaboration with farmers		•			•	•		
Improve advisory activities for farmers	•	•						
Improve farmers' knowledge and work	•	•	•					
Show success of advisory activities			•	•				
Facilitate and digitalize advisory activities	•			•				•
Improve skills/knowledge of advisors		•	•				•	
Improve collaboration with other advisors						•	•	
Improve research data and findings				•				•
Generate relevant reports for supervisors				•				•

*Must ; ** Shall ; ***May

The tool has been designed to facilitate the dialogue and advisory work with farmers, offering support through a combination of digital and printed educational materials. This makes learning accessible to a wide range of users. Importantly, the system is able to operate without an internet connection during field visits, making it highly adaptable in regions with limited or challenging communication infrastructure. The agroecology frameworks reviewed included.

Concept and information flows

The information and knowledge flows were determined according to the requirements determined previously. As a result of the analysis and information matrix was determined which constitutes the basis of the type of information which is managed within the system (Table 2).

Table 2: Information matrix which is shared and collected within the system and their alignment with the 13 Agroecological Principles

		Agroecology principles												
		1	2	3	4	5	6	7	8	9	10	11	12	13
I Advisory work activities														
1.2	Individual visits													
1.3	Group events													
II Agroecological Diagnostic														
The farm														
1.1	Soil	•	•	•		•	•							
1.2	Water	•	•	•	•	•	•							
1.3	Crops	•	•	•	•	•	•	•						
1.4	Livestock	•	•	•	•	•	•	•						
1.5	Trees	•	•	•	•	•	•	•						
1.6	Pest and disease	•	•	•	•	•	•	•						
1.7	Energy	•	•											
1.8	Household							•	•	•	•		•	
1.9	Workers										•			
The food system														
2.1	Community							•	•	•	•	•	•	•
2.2	Value chain							•				•		
2.3	Policy												•	•

This information matrix was translated in to the concept whcihc involved three major componentes: mobile tool, web-based tool and printed tool (Figure 2).

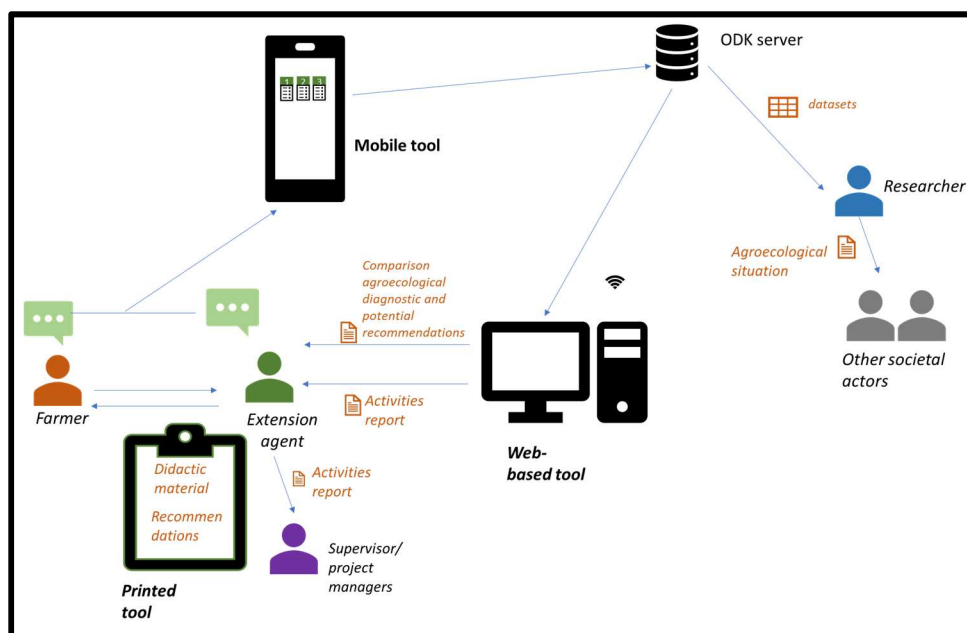


Figure 2: Information flows derived from the decision-support tool

3.3 Assessment by extension agents

Extension agents assessed three different tools—web-based, mobile, and printed—for agroecological learning and support. They appreciated the web-based tool for its ability to generate reports, serve as a virtual tutor, and offer agroecological content. However, they noted limitations such as dependence on internet access, lack of computer ownership, and insufficient digital literacy among users. To address these issues, they recommended offline functionality and user training. The development team proposed enhancing this tool by improving report outputs, incorporating graphs and tables, and designing a dashboard.

The mobile tool was praised for its practicality, ease of use, and ability to verify agroecological practices, though concerns were raised about complex language, Android-only compatibility, and limited smartphone access. Suggestions included simplifying language and training users, with future development focused on adapting indicators to local contexts.

Meanwhile, the printed tool was valued for its offline accessibility and role as supplementary material, despite concerns over high costs. Recommendations included creating handbooks, calendars, and additional printed guides, with project teams exploring ideas for further printed resource development.

4. Implications

4.1 Practical implications

From a practical point of view, co-design processes of digital tools for advisors in developing countries increase the chances that the tools meet real-world needs and avoid risks of digitalization. The ADST provides a mean to operationalize complex conceptual frameworks of agroecology in advisory work. To ensure usability for practitioners, the prototype will continue to evolve in iteration cycles and final versions adapted in specific contexts will be developed. This process will involve expanding testing across diverse farming contexts. For direct application in advisory work, many of the frameworks used in agroecology are very complex. The challenge is adapting these frameworks, originally designed for research, so they are useful and practical for extension work, where real-world guidance and actionable insights are needed. To make this transition smoother, it's essential to concretize (make abstract concepts more tangible) and simplify the language used, ensuring that complex theories are communicated in a clear, practical way that practitioners can easily understand and apply. This helps make the advice more accessible and implementable in real-world scenarios.

4.2 Theoretical Implications

Extension systems and innovation support services are highly diverse, depending on geographical, cultural, and economic contexts. Developing a single tool or platform that can meet the needs of a broad range of these systems is difficult because each system may have different requirements, challenges, and objectives.

By starting small and iterating, the development process becomes more flexible. This flexibility allows the tool to be continuously adapted based on feedback and evolving requirements. A central element of the implementation of agroecology is to strengthen the capacity for collective co-creation of innovation from local resources. We therefore believe that the tool strengthens local innovation capacities more by activating agroecological resources than conventional resources. The verification of this result does, however, require confirmation by subsequent ex-post impact assessments on the effective adoption of the proposed tool.

5. References

- Alexandre, C. (2023). Les technologies numériques: des outils au potentiel inexploité pour faciliter les apprentissages des agriculteurs. Une étude de onze services numériques de conseil agricole au Burkina Faso. *Innovations*, 70(1), 49-81.
- Biovision. Agroecology Info Pool. F-ACT: FARM-LEVEL AGROECOLOGY CRITERIA TOOL. Retrieved December 23, 2025, from <https://www.agroecology-pool.org/fact/>

-
- Biovision- FARM-LEVEL AGROECOLOGY CRITERIA TOOL (2019). Available under <https://www.agroecology-pool.org/fact/>
- Bonnet Pascal, Cesaro Jean-Daniel, Alexandre Chloé, Sow Anna Prisca, Roche Mathieu, Paget Nicolas. 2022. Une agriculture numérique inclusive? Le cas de l'agriculture familiale en Afrique de l'Ouest. Enjeux numériques
- FAO (2019). TAPE Tool for Agroecology Performance Evaluation 2019 – Process of development and guidelines for application. Test version, Rome.
- Paget Nicolas, Nacambo Idrissa Sompagnimdi, Fournier Stéphane, Moumouni Moussa Ismail. 2022. Traque des innovations numériques au service de la transition agroécologique au Bénin. Cahiers Agricultures, 31:13, 10 p. <https://doi.org/10.1051/cagri/2022009>
- Nubukpo K., Temple L. Alexandre C. 2020. Innovation numérique et transformation structurelle des économies africaines francophones, opportunités risquées. Master Thesis.
- Wezel, A., Gemmil-Herren, B., Kerr, R., Barrios, E., Rodrigues, G., Sinclair, F. (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems: A review. *Agronomy for Sustainable Development* 40(40). DOI: <http://dx.doi.org/10.1007/s13593-020-00646-z>

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Understanding Effective Follower Behaviors: A GLOB(E)al Perspective

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Short abstract

Too often, organizations take a follower with a proven track record and transplant that person into a global arena, expecting the same level of performance abroad. Unfortunately, the skills needed to be a successful follower and leader in one's country of origin are not necessarily the same skills a person needs to be successful internationally. This exploratory study aimed to understand the perspective on effective follower behavior from the viewpoints of middle managers within an international organization. Sixty-one participants identified behaviors they considered essential for effective followers to exhibit. Participants provided 74 effective follower behaviors. From the 121 total data chunks, the inductive analysis yielded seven emergent themes. In this international organization, middle managers identified that effective followers engage in task behaviors and show competence in relational behaviors.

Keywords | followership, agricultural organizations, GLOBE study, leadership development

1. Purpose

Too often, organizations take a follower with a proven track record and transplant that person into a global arena, expecting the same level of performance to be maintained abroad. Unfortunately, the skills needed to be a successful follower and leader in one's country of origin are not necessarily the same skills a person needs to be successful internationally (Littrell & Minelgaite, 2018). The conceptual framework of this study is the GLOBE Model. House's (2004) GLOBE Model analyzes leaders' organizational norms, values, and beliefs by geographic location. The GLOBE is the standard for the culturalization of international leadership, but it falls short of providing a comprehensive picture of organizational success. Most leadership research has fallen prey to the same issue, failing to include the follower, yet the follower contributes the overwhelming majority of organizational work and success (Uhl-Bien, 2009). There is a plethora of research on the development and implementation of international agricultural leadership development programs, which primarily utilize a Westernized view of leadership competencies, but there is little to no focus on followership within these programs (Anderson et al., 2020; Kock & Weeks, 2015; Rasmussen et al., 2017; Strong et al., 2016).

Not only must we, as international agricultural and extension educators, determine the readiness of college graduates for the workplace (Roberts et al., 2019), but we should also teach the skills needed for our students to be successful. There is a noticeable lack of research on the essential skills and behaviors required for effective followership, particularly in international settings or within global organizations. Understanding followership in the context of a global organization will help inform our practice. The purpose of the study was to explore the phenomenon of effective followership in an international organization. The objective was for middle managers to identify effective follower behaviors. This study was guided by the following research question: What follower behaviors are identified as effective by middle managers in a global organization?

2. Methodology

Because understanding followership in a global context is novel, an exploratory study was developed to add to a more extensive grounded theory approach (Patton, 2015). Mid-level managers from a global organization, who had been selected to participate in a leadership development program, were asked about their experiences leading and following in a global setting. During this program, conversations began about the phenomenon of followership, which most participants had not previously encountered. It was quickly noted that there was a need to explore followership further in this context.

A Qualtrics survey was created to study this phenomenon. The responses (N=61) were anonymous, but participants were asked to identify the country of their current work location, how long they have been in the profession, and how long they have been in a leadership/management position. Responses to location were then coded according to House's (2004) regions. An open-ended qualitative question was asked as part of the more extensive survey: "In my opinion, the most effective followers embody these behaviors."

All answers were analyzed using inductive thematic coding (Patton, 2015). The Four Dimensions Criteria (Lincoln & Guba, 1985) were used to establish the trustworthiness of the data. Participants provided 74 effective follower behaviors, with 26 behaviors listed by more than one participant. From the 121 total data chunks, the inductive analysis and thematic coding yielded seven themes.

3. Findings

The seven emergent themes are (1) higher-order thinking, (2) drive, (3) growth mindset, (4) task competence, (5) collaboration, (6) emotional intelligence, and (7) communication. The theme of higher-order thinking includes the second most frequently identified behavior of critical thinking. Followers who demonstrate effectiveness by asking the “why” in a situation are curious, inquisitive, use reasoning, and are intelligent. This theme also includes the behaviors of autonomous problem-solving and decision-making. The theme of drive incorporates followers who exhibit their effectiveness by taking initiative and are persistent, motivated, and resilient in the face of organizational change. The growth mindset theme encompasses having a growth mindset, embracing a can-do attitude, being open to learning, being receptive to new ideas, and having a desire for success. The task competence theme encompasses the specific job duties a follower would complete. Participants in this study believe that effective followers do what is asked regarding a specific task, are efficient, understand organizational strategy and adherence, and can pivot when something goes awry. The collaboration theme focuses on essential, sometimes hard-to-quantify behaviors. Participants view effective followers as having a team-oriented focus, understanding common goals, and being committed to the organization. The theme of emotional intelligence encompasses behaviors such as active listening, empathy, understanding, self-awareness, and honesty. The participants in this study identified effective followership behaviors that contribute to the theme of communication, including conveying constructive disagreement, trustworthiness, and clarity in thought, action, and speech.

4. Practical and theoretical implications

Training and development are essential for preparing followers, including students, to have a positive impact in the global market. The results of this study show that some of the competencies sought by this international organization are teachable, including higher-order thinking, collaboration, task competence, emotional intelligence, and communication. However, some are more elusive to teach, such as drive and a growth mindset. International agricultural and extension educators can position themselves at the forefront of developing curriculum and programming that leads to practical contributions to organizational success, ahead of other subdisciplines.

Based on these findings, it can be concluded that the middle managers of this global organization perceive effective follower behaviors as being both task-oriented and relationship-oriented. As specific global follower skills and behaviors have not been previously identified (Littrell & Minelgaite, 2018), this grounded theory study’s findings will add to the inadequate research on global followership.

5. References

- Anderson, J. C., Kaufman, E., Coartney, J., Mitra, S., & Cash, C. (2020). Using a tiered approach for implementing networked learning communities: A case study on developing the capacity of leaders to implement systemwide innovations within international training and development programs. *Journal of International Agricultural and Extension Education*, 27(1), 6-14. <https://doi.org/10.5191/jaee.2020.27101>
- House, R. J. (2004). *Culture, leadership, and organizations: The GLOBE study of 62 societies*. Sage.
- Kock, T., & Weeks, W. (2015). Job-related competencies are desired by those who hire international development consultants. *Journal of International Agricultural and Extension Education*, 22(1), 21-34. DOI: <https://doi.org/10.5191/jaee.2015.22102>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

-
- Littrell, R.F., & Minelgaite, I. (2018). Country's preferred leader behavior profile: Does cultural homogeneity matter? *Journal of Contemporary Management Issues*, 23(1), 1-28. <https://doi.org/10.30924/mjcmi/2018.23.1.1>
- Patton, M. Q. (2014). *Qualitative Research & Evaluation Methods* (4th ed.). Sage.
- Rasmussen, C. M., Pardello, R. M., Vreyens, J. R., Chazdon, S., Teng, S., & Liepold, M. (2017). Building social capital and leadership skills for sustainable farmer associations in Morocco. *Journal of International Agricultural and Extension Education*, 24(2), 35-49. <https://doi.org/10.5191/jiaee.2017.24203>
- Roberts, G. T., Pierre, A., Gilot, A. C., & Bunch, J. (2019). Self-perceived readiness of Haitian agricultural university students to enter the workforce: A call for curriculum reform. *Journal of International Agricultural and Extension Education*, 26(1), 73-84. <https://doi.org/10.5191/jiaee.2019.26107>
- Strong, J., Strong, R. L., Greenberg, R., Purdue, E., & Dolly, D. (2016). Understanding learners as followers: A study of a US and a Caribbean University. *International Leadership Journal*, 8(2), 88-103.

Special Session 5B

Understanding and developing Innovation Support Services (ISS): the contribution of HORIZON projects - a joint session between i2connect, ATTRACTISS and modernAKIS

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1. Purpose

The Horizon Europe project ATTRACTISS aims, among others, to empower European Innovation Support Services (ISS) through a) capacity building/training and the provision of effective guidelines, methods and tools (with emphasis on co-creation); and b) networking. Such actions are built upon, systematize and further develop the lessons learnt through notably the i2connect project which specifically focused on advisors' capacity building for interactive innovation. In parallel, the modernAKIS project aims at supporting the AKIS Coordination Bodies (CBs) and AKIS communities in the Member States in improving their AKIS. Taking into account the theoretical explorations, the experiences and the lessons learnt so far through these projects we will discuss some of the hot topics concerning ISS, i.e. a) How can ISS support bottom-up/grassroots innovative ideas develop into innovations; b) Who are the 'clients' of ISS with emphasis on hard-to-reach farming populations (small and/or remote farms, new entrants, women, etc.); c) Whether ISS are among the AKIS 'silent' actors and how to involve them; d) What (new) attitudes, skills and training (content and methodology) do advisors need to effectively support innovation; and e) which policy mechanisms can effectively support ISS provision. Furthermore, these hot topics (will) have important implications for the implementation of the current CAP and the planning of the post-2027 one.

2. Approach

A panel of representatives of the three projects and a facilitator will lead the session. Following a short introduction to the three projects, the main questions/ hot topics will be first explored by the audience. Then the panellists will have the chance to 'compare' the audience's opinions with projects' findings and open a discussion with the audience. The aim is for the Special Session to make suggestions so as to contribute to the establishment of effective ISSs and AKISs in the EU.

Session 5B

Online

Strengthening Agroecological Transitions in Rwanda through Participatory Advisory Services and Digital Integration

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Short abstract

Agroecology presents a promising pathway for transforming agri-food systems and support farmers when dealing with increasing sustainability challenges. Emphasizing site-specific practices and collaborative knowledge exchange, agroecology calls for advisory services that are both contextualised and participatory, empowering farmers in decision-making and knowledge co-creation processes. This study evaluates agricultural advisory methods in Rwanda to identify effective strategies for supporting agroecological transitions. A mixed-methods approach was employed, including focus group discussions with farmers, semi-structured interviews with advisors, and a literature review. Findings highlight the critical role of farmer participation, peer-to-peer learning, and the integration of digital tools in designing demand-driven advisory services. Group-based advisory, particularly farmer-to-farmer approaches, fosters trust and practical knowledge exchange. Digital tools such as short message services, interactive voice response, and videos support learning, though challenges such as digital literacy and content relevance remain. The study concludes that embedding training within farmer groups and ensuring participatory content development are essential for scaling agroecology. The integration of peer-based learning with digital tools may form the foundation for a farmer-centred citizen science network, contributing to a more inclusive and effective agroecological transition in Rwanda.

1. Purpose

Similar to most countries in Central and Eastern Africa, agriculture has been one of the pillars of Rwanda's economy (Clay & Zimmerer, 2020; MINAGRI, 2018). Nevertheless, the agricultural sector faces ongoing sustainability challenges, including climate change and soil degradation, necessitating a shift toward agroecological transition (Clay & King, 2019; Kim et al., 2013; Ngouhouo Poufoun & Sedi, 2023). Agroecology offers a viable pathway to support this shift by promoting diversified, site-specific practices and fostering participatory knowledge exchange (HLPE, 2019).

Given that agroecological transition requires substantial knowledge input, smallholders in Rwanda are increasingly demanding training on sustainable farming practices, highlighting the central role of agricultural advisory services (AAS) (Faure et al., 2012; Giagnocavo et al.,

2022; Ngouhou Poufoun & Sedi, 2023). AAS aims to empower farmers to better understand and solve their own problems, thereby enhancing decision-making capabilities (Hoffman et al., 2009). According to Birner et al. (2009), advisory methods must be demand-driven and context-sensitive, designed with an understanding of community, farming systems, and the specific practices being promoted.

However, in Rwanda, AAS has been heavily influenced by the Crop Intensification Program, which emphasizes land productivity through mineral fertilizers, hybrid seeds, and top-down extension models, conflicting with the core principles of agroecology (Kim, 2013). Although previous studies have explored AAS at the national level (Ndah et al., 2023), there is a lack of systemic, farmer-focused analysis on advisory methods. To address this gap, this study examines the strengths and needs of current advisory approaches and proposes design guidelines for more effective, demand-driven methods that align with agroecological values and support the agroecological transition.

2. Design

The research was carried out in collaboration with the CANALLS project (Driving agroecological transitions in Central and Eastern Africa's humid tropics through transdisciplinary Agroecology Living LabS) in Rwanda. The study adopted the extension approach of Hoffman et al. (2009) to develop the "best-fit" advisory method for agroecological transition by ensuring the alignment of advisory methods and advisory content. The model conceptualizes advisory as a system consisting of interrelated components, including client groups and their problems, advisory theory and objective, advisory methods, organizational set-up and advisory content.

As stated by Wezel et al. (2009), agroecology is a scientific research approach, a social political movement, and a set of practices. Therefore, we perceive agroecology as both an advisory objective to guide the design of advisory methods, but also as advisory content, because it proposes a set of alternative agricultural practices.

To achieve the research objective of assessing the agricultural advisory methods to support agroecological transitions, a mixed-method approach was employed, incorporating four focus group discussions (FGDs) with farmers, five formal interviews with advisors, five casual interviews with key informants, and a literature review. FGDs were carried out with farmers in Kamonyi District, the project site of Rwanda; formal interviews were conducted with advisors from the private, public, and third sector, while casual interviews were held with experts involved in agroecological/ organic or digital agriculture projects in Rwanda. FGDs and interviews were recorded, transcribed, and undergone content analysis with MAXQDA.

3. Findings

We identified and assessed the advisory methods from perspective of farmers, advisors and key informants. Findings underscore the importance of farmer participation and knowledge co-creation in designing advisory services that effectively support agroecological transitions. Empirical results highlight farmers' strong preference for group advisory, particularly farmer-to-farmer advisory, demonstrations, and group-spread Short Message Service (SMS). Farmer-to-farmer advisory refers to the advisory method where a farmer leader advises their peer farmers, allowing for contextualized knowledge sharing and making the advisory content more accepted by the peer farmers. In addition, farmer-to-farmer advisory enables farmers to learn collectively, offering them the opportunity to listen to and learn from the successful stories of their peers, thereby valuing the importance of local knowledge. In Rwanda, the farmer promoters from the Twigire Muhinzi national extension system and the field agents of the Non-governmental organization One Acre Fund form the backbone of the farmer-to-farmer advisory system. Farmer promoters and field agents are farmers

themselves and work closely with their peer farmers, making their advisory more site-specific.

This is in line with the literature review, which highlights that AAS methods that foster agroecological transition should encourage farmers' participation, enable knowledge co-creation, and value local knowledge. Therefore, the design of advisory methods should be based on these guidelines.

Meanwhile, previous research has highlighted the importance of assessing farmers' leaders' motivation to serve in their roles in ensuring the sustainability of the advisory scheme. Demonstrations enable hands-on learning, which is particularly important for empowering farmers to apply new practices, such as compost making. The prevalence of group advisory aligns with Rwanda's strong social coherence characteristics and community awareness, indicating that the adoption of such an advisory scheme respects local values, which harmonize with the principles of agroecology.

Evidence from interviews and literature indicates that mass media communication, including printed publications and Information and Communication Technology (ICT) tools, such as radio, mass SMS, videos, Interactive Voice Response (IVR), and Unstructured Supplementary Service Data (USSD) are widely used in Rwanda's advisory system. Advisors mentioned that they have been distributing flyers to inform farmers about agroforestry practices and input application methods. Farmers reported that radio and mass SMS repeat the advisory messages of farmer promoters and field agents, thereby forming an iterative learning process that reinforces the learning experience and fosters the adoption of new farming techniques. Videos offer a combination of visual and acoustic information delivery, which is particularly suitable for demonstrating complex agroecological practices. Despite the usefulness of these mass media communication tools, their anonymity often poses challenges for advisors in monitoring the audiences of these tools and evaluating their effectiveness. In contrast, two-way interactions between the sender (advisor) and the receiver (farmer), offered by IVR and USSD, overcome such anonymity problems, making them widely adopted in AAS.

Nevertheless, limited knowledge of digital tools and top-down content design pose challenges to scaling up ICT-based advisory services that drive agroecological transition. During FGDs, farmers did not mention any kind of ICT tools for advisory services, except for group-spread SMS, which was inconsistent with reports from previous projects on digital agriculture. Such inconsistency could be attributed to the limited area and the number of farmers involved in the previous projects, highlighting the need for more training on digital devices. Training on digital tools should adopt the peer learning concept by empowering a small number of participants who are more familiar with digital devices or the younger generation, and then letting them train their peers or community members in a more contextualized approach. FGDs also revealed that farmers have not been aware of the importance of socio-economic aspects in agroecology, particularly in terms of participation and local knowledge. In contrast, farmers intensively expressed more knowledge of agronomic practices. The circumstances correspond with the influence of a decentralized extension personnel structure but a top-down content design of the national agricultural extension system in Rwanda. Therefore, it is crucial to encourage farmers to participate in co-creating agroecological solutions and co-designing advisory messages, which are also fundamental principles of agroecology.

4. Practical and theoretical implications

This study identifies key strengths, limitations, and opportunities for improving agricultural advisory services in Rwanda. Findings suggest that advisory and training efforts should be embedded within farmer groups and emphasize farmer-to-farmer learning to foster a

participatory environment tailored to local needs. Digital advisory tools hold great potential for scaling agroecological knowledge, but their effectiveness relies on participatory content co-creation with farmers. The establishment of a citizen science network could be a promising approach to embracing local knowledge and fostering knowledge co-creation. Group advisory sessions could serve as occasions for farmers to share their knowledge, successful practices, or needs related to agroecology, which farmer promoters or field agents note down and upload to a citizen science platform for farmers to learn from one another. Future research could focus on assessing farmers' motivation for participating in the knowledge co-creation process by observing their interaction with advisors and other farmers. Such insights could help optimize advisory frameworks and ensure that AAS makes meaningful contributions to Rwanda's agroecological transition.

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5. References

- Birner, R., Davis, K., Pender, J., Nkonya, E., Anandajayasekeram, P., Ekboir, J., Mbabu, A., Spielman, D. J., Horna, D., Benin, S., & Cohen, M. (2009). From best practice to best fit: A framework for designing and analyzing pluralistic agricultural advisory services worldwide. *The Journal of Agricultural Education and Extension*, 15(4), 341–355. <https://doi.org/10.1080/13892240903309595>
- Clay, N., & Zimmerer, K. S. (2020). Who is resilient in Africa's Green Revolution? Sustainable intensification and Climate Smart Agriculture in Rwanda. *Land Use Policy*, 97, 104558. <https://doi.org/10.1016/j.landusepol.2020.104558>
- Clay, N., & King, B. (2019). Smallholders' uneven capacities to adapt to climate change amid Africa's 'green revolution': Case study of Rwanda's crop intensification program. *World Development*, 116, 1–14. <https://doi.org/10.1016/j.worlddev.2018.11.022>
- Faure, G., Desjeux, Y., & Gasselin, P. (2012). New challenges in agricultural advisory services from a research perspective: A literature review, synthesis and research agenda. *The Journal of Agricultural Education and Extension*, 18(5), 461–492. <https://doi.org/10.1080/1389224X.2012.707063>
- Giagnocavo, C., de Cara-García, M., González, M., Juan, M., Marín-Guirao, J. I., Mehrabi, S., Rodríguez, E., van der Blom, J., & Crisol-Martínez, E. (2022). Reconnecting farmers with nature through agroecological transitions: Interacting niches and experimentation and the role of agricultural knowledge and innovation systems. *Agriculture*, 12(2). <https://doi.org/10.3390/agriculture12020137>
- HLPE. (2019). *HLPE 14: Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition*. (HLPE Report). High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. <http://www.fao.org/3/ca5602en/ca5602en.pdf>
- Hoffman, V., Gerster-Bentaya, M., Christinck, A., & Lemma, M. (2009). *Handbook: Rural Extension Volume 1 Basic Issues and Concepts* (Vol. 1). Margraf Publishers GmbH, Scientific books.
- Kim, S. K., Tiessen, K. H. D., Beeche, A. A., Mukankuranziza, J., & Kamatari, A. (2013). Soil Fertility and Manure Management—Lessons from the knowledge, attitudes, and practices of Girinka farmers in the District of Ngoma, Rwanda. *Agroecology and Sustainable Food Systems*, 37(6), 631–658. <https://doi.org/10.1080/21683565.2012.762636>

-
- MINAGRI. (2018). *National Agriculture Policy*. MINAGRI (Ministry of Agriculture and Animal Resources).
- Ndah, HT., Herrena, B., Ottaviani, AG., & Giacomelli, E. (2023). *Systemic factors, policies, and innovation support services for agroecological transitions in Cameroon, Burundi, Rwanda, and Democratic Republic of Congo*. (CANALLS Deliverable 1.2). University of Hohenheim.
- Ngouhouo Poufoun, J., & Sedi, M. (2023). *Agroecological contexts and needs of rural communities in the Agroecological Living Labs* (CANALLS Deliverable 1.1).
- Wezel, A., Bellon, S., Doré, T., Francis, C., Vallod, D., & David, C. (2009). Agroecology as a science, a movement and a practice. A review. *Agronomy for Sustainable Development*, 29(4), 503–515. <https://doi.org/10.1051/agro/2009004>
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Advancing Sustainability-Oriented practices through South-South Collaboration in Rural Vocational Training Centres

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Short abstract

Purpose | This study explores the potential of South-South Collaboration (SSC) as a catalyst for integrating sustainability-oriented practices within Rural Vocational Training Centres (RVTCs) across the Global South, particularly in the African continent and among African representatives. Building on the work of McGrath & Russon (2023) and Ermakov (2019), the research addresses the overarching theme of collective learning, innovation processes, and capacity building, this research aims to bridge the gap in practical methodologies and tools that support sustainable, systemic, transformative, and multi-stakeholder processes in agriculture, agri-food, and rural development from and for RVTCs.

Design/Methodology/Approach | The research is grounded in a unique empirical setting involving 50 educators and managers from 15 RVTCs across 8 African countries, who engaged in an SSC initiative following an international development project initially supported by the Humboldt University of Berlin (SLE, 2023). Through qualitative in-depth surveys and an exhaustive context analysis, combined with a Qualitative Comparative Analysis (QCA) (Baptist & Befani, 2015), the study examines how collaborative learning, interactive innovation, and capacity development practices among representatives of the RVTCs contribute to the systemic integration of sustainable practices in RVTCs' work.

Findings | The study considers Majumdar's (2010) "Greening VET institutions" framework to assess how green curriculum, community adaptation, and green technology contribute to sustainable outcomes. Additionally, it considers the influence of SSC on enhancing teaching methods and managerial capacities, aligning with the educational perspectives of Deissinger & Gonon (2021) and vocational training insights from Khalid et al. (2020). Key aspects addressed include co-design and co-creation methods for learning processes (Van de Ven & Johnson, 2006), innovative education pathways promoting real systemic change, and new monitoring and evaluation tools (Rosenberg et al., 2020) to assess learning and

organizational capacities within sustainability contexts. The findings provide insights into the effectiveness of SSC in enhancing knowledge, skills, and attitudes that support the transition to a more sustainable panorama within rural education settings.

Practical and theoretical implications | The research not only contributes to academic discourse but also offers practical guidance for policymakers, international and local development agencies, and education practitioners aiming to implement transformative sustainability practices in similar socio-cultural and institutional contexts. Ultimately, this study advocates for SSC as a viable mechanism to achieve long-term sustainability goals, particularly by fostering bottom-up initiatives that resonate with the realities and needs of the Global South (Pereira, 2023; Taela, 2023).

Keywords | South-South Collaboration (SSC), Rural Vocational Training Centres (RVTCs), Collective learning, Qualitative Comparative Analysis (QCA)

References

- Baptist, C., & Befani, B. (2015). Qualitative Comparative Analysis – A Rigorous Qualitative Method for Assessing Impact. Coffey-Coffey How to.
- Deissinger, T., & Gonon, P. (2021). The development and cultural foundations of dual apprenticeships. *Journal of Vocational Education and Training*, 73(2), 197–216.
- Ermakov, D. (2019). Sustainability as a Driver for Vocational Education and Competitiveness.
- Khalid, A., Aashiq, U., Shahid, M., Syed, I., & Hassan, S. (2020). Impact of Vocational Training on Economic Empowerment of Youth in Rural Areas of Punjab.
- Majumdar, S. (2010). Greening TVET. IVETA-CPSC International Conference, Manila, Philippines.
- McGrath, S., & Russon, J.-A. (2023). TVET SI: Towards Sustainable Vocational Education and Training: Thinking beyond the formal. *The Southern African Journal of Environmental Education*.
- Pereira, F. (2023). On a Genealogy of the Concept of "South-South Cooperation". *Human Affairs*.
- Rosenberg, E., Ramsarup, P., & Lotz-Sisitka, H. (2020). *Green skills research in South Africa*. Routledge.
- SLE. (2023). Centre for Rural Development. Capacity Development Programme for Lecturers and Managers of Green Colleges 2022–2023. Humboldt University of Berlin.
- Taela, K. (2023). South-South Collaboration as a Mechanism for Sustainable Development. (Unpublished data).
- Van de Ven, A. H., & Johnson, P. E. (2006). Knowledge for Theory and Practice. *Academy of Management Review*, 31(4), 802-821.

Agroforestry Business Model Innovation Network (AF4EU)

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Short abstract

The growing global population demands not only more food but also more sustainable land use. Agroforestry systems, due to their multifunctional benefits, offer integrated solutions that promote environmental, economic, and social sustainability. To address this challenge, the AF4EU project—funded by Horizon Europe—aims to boost agroforestry adoption across Europe through a collaborative, innovation-driven network.

The project supports the exchange of good practices and scientific knowledge via digital tools, focusing on profitable practices, new business models, and agroforestry advisory services. It considers the full food chain, including consumers, ensuring a broad and inclusive impact.

AF4EU brings together 11 Regional Agroforestry Innovation Networks (RAINs) involving farmers, forest producers, researchers, extension agents, NGOs, consumers, retailers, policymakers, and business groups. These networks will analyze 33 agroforestry business models from across Europe, evaluating their economic viability, environmental value, and social impact.

Building on previous Horizon 2020 initiatives, AF4EU will develop key outputs: (i) a knowledge cloud, (ii) an alive-handbook, and (iii) Afi-Bus DSS (an agroforestry innovation business decision support tool). The project also includes a multilingual MOOC with training modules tailored to farmers and advisors, aiming to strengthen agroforestry practices and policies across Europe.

1. Purpose

The world's growing population requires solutions that simultaneously achieve greater food production through more sustainable land use practices. Agroforestry systems are ancient forms of land use that have attracted renewed interest in recent years. They are dynamic systems in which perennial woody plants are deliberately combined with agricultural crops and/or animals, under a certain form of spatial arrangement or temporal sequence (Mosquera-Losada 2009). Due to their multifunctional properties, agroforestry are part of the solution to meet the challenges of sustainability, including environmental, economic and social aspects. In response to these needs, the AF4EU project, funded by Horizon Europe, aims to promote agroforestry in Europe through the development of an extensive, interactive and innovation-driven agroforestry network. This project builds on the success of its predecessor, AFINET, and now includes more European countries through the creation

of new Regional Agroforestry Innovation Networks (RAINs). Each RAIN, made up of around 20 relevant actors, works on a specific thematic area in order to facilitate dialogue and discussion on specific thematic sectors (Table 1) aimed at using agroforestry systems to strengthen sustainability on their farms. The project aims to share local and scientific knowledge between the various partners at European level, with a particular focus on the development of rural extension services and the implementation and development of new practices and business models for profitable agroforestry.

Table 1: Specific thematic sectors initially described by the RAINs

Country	AF design (D) and Management (M) purposes	RAIN main Delivery
Spain	D: Biomass production/Forest fire (cow/horses/goat)/policies M: For feed and biodiversity, energy, soil health	Resilience, climate change mitigation, policy
Italy	D: Olive orchards and poultry/sheep and linear systems, policy M: For animal welfare, water and biodiversity, soil health	Resilience, climate change mitigation, landscape
Finland	D: Woodland/orchard and cows/sheep/chicken/bees, policy M: For feed and food (NWFP), soil health	Diversification, branding, marketing
Greece	D: Crops/goats/forest fire prevention, policies M: For feed, biodiversity, mixed farming, soil health	Resilience, climate change mitigation, certification, trading
Ireland	D: Cattle/sheep/pig/poultry and woodland/shelterbelt, policy M: For animal welfare, water, biodiversity, soil health	Resilience, water, biodiversity, branding
Belgium	D: Orchards/cereals and pig/poultry/cows, sheep, policy M: For animal welfare, cost/effective practices, soil health	Trading, resilience, marketing, branding, certification
Germany	D: Silvoarable/silvopasture (heifer, turkey, chicken, cheese)/ shelterbelts/biomass production, policy M: For animal welfare, biodiversity, energy, soil health	Landscape, policy, marketing, innovative products, climate change adaptation.
France	D: Hedgerows, biomass, policy M: Feed and biodiversity, soil health, energy	Climate change mitigation, marketing,
Portugal	D: Forest fire prevention/reducing herbicides/sheep, policies M: For feed, understory control, soil health, water	Resilience, climate change mitigation, herbicide costs
Slovakia	D: Windbreak, hedgerow, orchards (cow/sheep), home garden M: Timber, feed, biodiversity, beekeeping/soil health, policy	Resilience, climate change mitigation,
Spain	D: Olive orchards and sheep/policy/forest fire prevention M: For feed, biodiversity, soil health, policies, water, erosion	Resilience, climate change mitigation, diversification, rural develop.

2. Design

AF4EU includes 11 RAINs located in different European regions - Atlantic, Mediterranean, Continental and Boreal. To establish these networks, some regions from the previous AFINET project (Galicia–Spain, Finland, and Italy) were chosen as lighthouse regions to support and guide the development of new RAINs in Portugal, Belgium, Ireland, Slovakia, Germany, Greece, France, and Andalusia–Spain.

AF4EU networks are based on two main concepts:

1. Multi-actor approach

- ✓ Use complementary types of knowledge centred on real problems or on stakeholder opportunities.
- ✓ Focus on "real" practical problems, finding appropriate solutions from research and innovation.
- ✓ Empower key Agroforestry (AF) stakeholders and ensure that they feel comfortable enough to talk, propose and discuss their actual needs.

2. Methodology developed by AFINET

- ✓ AFINET (2017-2019) aimed to connect research with farming practice by improving knowledge exchange between scientists and professionals, focusing on the management, productivity, and profitability of agroforestry and silvopastoral systems.

The regional RAIN's met in four workshops and carried out pre-defined activities (Table 2), bringing together stakeholder groups, including farmers, livestock and forestry producers, researchers, extension agents, consumers, NGOs and political decision-makers. Through cooperation within and between these networks, regionally relevant agroforestry business models and their value chains have been analysed. Additionally, the project has identified the needs of rural extension services and the most and relevant training modules for agroforestry advisors and farmers at the European level.

Table 2: Regional RAINs workshops and activities

Meetings	Main activities of the RAINs
RAINs Co-creation Workshop #1	<p>General: RAIN creation and improvement of the awareness of RAIN actors about agroforestry carrying out participative exercises in order to highlight bottlenecks and opportunities for AF farms to provide adapted innovations to each RAIN with the collaboration of the lighthouse regions, favouring cross-fertilization knowledge. Presentation of both AFINET KC and the EU Farm Book reservoirs to develop a more targeted AF4EU Knowledge Platform (KP) through the implementation of a participatory approach that will include 4 modules: AF4EU KC, AFI-Bus DSS, AF Alive Handbook and MOOCs.</p> <p>Business Model development: 33 AF innovative farm types and their respective value chains will be proposed by the RAIN actors considering the existing 107 technical innovations described in AFINET project to be used as case use to develop innovative AF business models in each region. Identification of the main challenges and barriers linked to the 33 AF Business models considering their sustainability frameworks.</p> <p>Extension services: Identify together with the RAIN actors the main types, needs and outputs of existing extension services in each RAIN as well as their main challenges to establish priorities and targets for the extension development including needed materials and training.</p>
RAINs Co-creation Workshop #2	<p>General: Presentation of the format of the main materials to be produced to be more useful for advisors and farmers/foresters. Invitation to RAIN members will be done regarding the delivery AF4EU materials. Feedback of Mock up screens illustrating user interfaces for the AF4EU KP components will be obtained.</p> <p>Business Model development: Validation by RAIN members of the initial list of the 33 innovative AF business models based on the outputs of the all 1st RAINs and proposal of first infographics associated to both the innovative AF farm types and their respective value chains to be used as innovative business models. Initial evaluation of different innovative Business Models (i.e CANVAS/SWOT), considering financial, environment and social components to be integrated as part of the DSS as well as enablers and barriers aspects of the described value chains.</p> <p>Extension services: Validation of a Regional Extension Plan including initial format drafts of the Extension Services materials.</p>

RAINs Co-creation Workshop #3	<p>General: Validation of the first dissemination materials produced for advisors and farmers/foresters by RAIN actors.</p> <p>Business Model development: Validation of the main indicators of the sustainability (income, environment and social) of the 33 innovative AF farm types and associated value chains. Presentation of the first design of AFi-Bus DSS.</p> <p>Extension services: Validation of the main extension services protocols (Extension services training materials and training module) considering all European insights provided by the RAINs.</p>
RAINs Co-creation Workshop #4	<p>General: Feedback on interface design and interaction-related issues regarding the AF4EU KP prototype and the respective modules. Validation of the materials produced by RAIN members.</p> <p>Business Model development: Synergies development considering the 33 AF business model and the operational groups. Presentation of the Smart Specialization Strategies (RIS3). Validation of the AFi-Bus DSS all over Europe and possible linkages to the operational groups, LEADER/CLLD projects, Thematic Network and multi-actor projects.</p> <p>Extension services: Integration of AF farm types and value chains with operational groups as part of the extension services material.</p>
Regional Dissemination Events	<p>Validation of all materials in special the AF alive handbook, the Knowledge Cloud and the MOOC course. One-day hands-on training on AFi-Bus will be organized among relevant stakeholders. Evaluation of the best forms to make the generated knowledge available to other sectors and regions through National AF Associations of EURAF and EUFRAS extension network. Extension support sessions development. Country-based implementation of the AFi-Bus.</p>

3. Findings

As a result of the project, regional workshops provided valuable insights into local contexts and needs, while inter-network meetings, involving innovative brokers and partnership coordinators, facilitated knowledge exchange and contributed to the development of technical content. The information collected so far has supported the development of technical and scientific content, incorporating tools for consulting best practices and exploring potential innovative solutions, such as the knowledge cloud and manual. Following interviews with farmers involved in the AF4EU project, the gathered data was used to create a prototype, which was presented during the fourth regional meeting of the Afi-Bus DSS. For the evaluation of DSS, in the fourth regional workshop, was shown Strategic Canvas specific to the Portuguese RAIN, and was verified a general agreement on the relevance of internal and external factors (strengths, weaknesses, opportunities and threats) considered for each building block. The need to create networks and consolidate the market was also emphasised. To ensure that the MOOC is tailored to the real needs of farmers and extension agents, key topics were introduced and validated during the regional meetings. For the formation for advisory services by tailoring CECRA-based modules to regional priorities, in Portugal, the priorities identified were focused on training for agroforestry business models, and for this it was identified that funding and promotion of cooperatives is needed, as well as innovation processes and more solid training in the development of agroforestry systems. Considering the cultural and physiographic characteristics of the region, the value chains were validated according to their potential to bring innovation to business models, as well as having a greater impact on the benefits for producers and consequently for the region. The value chains most emphasised were those related to: Aromatic Plants; Meat; Honey; Dairy Goats; Agrotourism; Wood; and Mycorrhizae.

4. Practical Implications

During the first RAIN workshop, participants raised concerns about communication between farmers and the research and innovation sectors. The agroforestry farms involved in the Portuguese RAIN were presented, on the second RAIN workshop, outlining their main activities and enabling discussion among stakeholders. Three of them were selected—based on their classification within specific categories defined by the ZALF economics team—to serve as case studies for the development of business models. The value chain analysis revealed several key challenges, such as the small size of the farms, the lack of manpower and the costs in the transport of products, with repercussions on the production, collection and distribution of products. These structural limitations underscore the absence of a well-organized rural extension service in Portugal. To address this gap, the AF4EU project is working towards transforming the Portuguese RAIN into an operational group by the end of the project. This group will focus on agroforestry-related rural extension, ensuring the continuity of networking collaboration and strengthening advisory services.

5. Theoretical Implications

The online availability of access to MOOC courses was mentioned as a concern, potentially posing a barrier for some users, particularly farmers. To address this, knowledge sharing between RAINs, must ensure that technical and scientific content is tailored to the specific needs of each region, so that it is accessible and useful to the greatest number of people, whether they have previous knowledge of these matters or are just curious or new to this subject.

6. References

- Fernández-Núñez, E.; Castro, M. (2016). Management of agroforestry systems: ecological, social and economic approaches. Bragança: Instituto Politécnico. ISBN 978-972-745-169-2. <http://hdl.handle.net/10198/13444>
- Mosquera-Losada, M. R., McAdam, J. H., Romero-Franco, R., Santiago-Freijanes, J. J., Rigueiro-Rodríguez, A. (2009). Definitions and Components of Agroforestry Practices in Europe. In: Rigueiro-Rodríguez, A., McAdam, J., Mosquera-Losada, AF4EU.eu. General Description. <https://af4eu.eu> [accessed 2025 Apr 9]

Combining the living lab and farmer's field schools' approaches in a system of rice intensification: lessons learned and challenges in the Senegal River Valley (Podor)

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Short abstract

Implemented in Senegal and Ghana using a multi-stakeholder partnership approach, the Co-developing innovations for sustainable land management in West African smallholder

farming systems (COINS) project aims to promote sustainable agricultural and land-use practices, as well as governance mechanisms to improve farmers' livelihoods and food security. Through participative and inclusive implementation using the living lab approach, the COINS project would like to achieve its objectives easier and anticipate difficulties in appropriating its results. In addition, the Farmer's Field Schools (FFS) approach was combined with this participatory and co-creation method to build farmers' capacity to master the technology of the System of Rice Intensification (SRI). The experience developed in the Senegal River Valley has facilitated the implementation of research activities, strengthened the robustness of the foresight exercise on sustainable land management and enabled the training of adult farmers in SRI through FFS. As a result, SRI is much better in agronomic, economic and environmental terms except in terms of rice plant height. However, a few challenges are noted such as the governance of farmers' organizations, the need for feedback from scientists and interactions with living lab stakeholders to discuss, amend, improve research results and advocacy, etc.

1. Purpose

The issue of technology extension in agricultural settings has always been a debate between politicians, scientific researchers and farmers to modernize family farms (Zélem, 2012). The main issue has always related to considerations of approach. On the one hand, political decision-makers draw up agricultural development strategies focused on technical and technological innovation. On the other hand, scientific researchers are responsible for studying and understanding the socio-economic and environmental conditions of farmers, to make proposals to facilitate the acceptability, acceptance, penetration and then dissemination of innovative technologies in agricultural settings (Rabe et al, 2022). On the other hand, farmers' organizations, still attached to their traditional practices, find it difficult to adopt technological innovations and seem resistant to innovation. Against this backdrop, what is the best approach for appropriate modernization of family farming systems in Africa? To shed some light on the subject, this article draws on an experience developed in Senegal as part of a project called Co-developing innovations for sustainable land management in West African smallholder farming systems (COINS) which aims to promote sustainable agricultural and land-use practices, as well as governance mechanisms to improve farmers' livelihoods and food security, by contributing to an increase in natural capital through the reversal of land degradation and greater efficiency in the use of natural resources. Drawing on the experience of the COINS project, this article aims to share a research approach based on territorial foresight and the operation of the living lab, as well as a farmer training approach based on the Farmers' Field School (FFS) tool for more convincing results in terms of penetration and dissemination of an agricultural technology such as System of Rice Intensification (SRI) and in terms of scientific research. By respecting its principles, SRI technology creates harmonious conditions between soil, water, plant and light, enabling the plant to express all its potential to the full.

2. Methodology

In terms of the conception of the COINS project, it must be said that it involves a multi-stakeholder, multi-institutional and multi-partner approach between North and South. Indeed, it mobilizes German institutions, including universities and research centers, as well as African institutions such as universities, non-profit organizations, companies and research centers. In terms of research intervention, training and extension in the field, the common methodological core is the interdisciplinary approach with research teams of varied profiles and skills, as well as the participatory approach (Serpantié, 2013). This combination of approaches enables participatory processes of social change and mutual learning between

researchers and farmers by facilitating the participatory implementation of research activities, serving as a support for the creation of innovations and anticipating the appropriation of innovations by stakeholders within the framework of a living lab (Voilmy, 2016).

The living lab has served as an iterative research and extension medium insofar as it is an *"open innovation research method that aims to develop new products and services. The approach promotes a process of co-creation with end-users in real-life conditions and relies on an ecosystem of public-private-citizen partnerships"* (Dubé et al, 2014). For this reason, the first activity was to map the various stakeholders and their level of knowledge and appropriation of SRI technology, as well as to map the sustainable land management practices used by the farmers. This facilitated the interaction of stakeholders in joint activities through participatory methods, enabled the collective production of knowledge for sustainable intensification and projected the future in the context of climate change (Bakker et al, 2022).

The possible futures of Sustainable Land Management (SLM) in the System of Rice Intensification (SRI) were explored in the living lab using territorial foresight. This consists of using possible future developments as a basis for adapting today's practices and behaviors with a view to creating the conditions for a desirable future in a field such as SLM by collectively constructing qualitative scenarios, identifying levers and drawing up an action plan (Toukara et al, 2024b; Bourgeois et al, 2021; Camara et al, 2019). In addition to foresight, this living lab contributed to and facilitated the conduct of field surveys, from the collective design of data collection tools to the production of reports.

Beyond this collaborative research approach within the framework of the living lab (Bednarz N. et al, 2015), training farmers to implement SRI technology was at the heart of the intervention scheme. This training was carried out thanks to a local partnership with Senegal's Agence Nationale du Conseil Agricole et Rural (ANCAR) in the Senegal River Valley, which mobilized the FFS tool. The FFS tool is based on principles such as learning centered on around 25 adult learners, whose training duration is based on the cycle of the speculation concerned. In addition, animation sessions are facilitated by a specialized ANCAR technician and include agroecosystem analysis. Learning with the FFS tool is based on two studies: one comparative on Farming Practices (FP) and the practice of SRI, the other specific on two rice seed varieties (Sahel 177 and ISRI 7) with the only practice of SRI.

To operate these FFS principles, preliminary meetings were held with farmers' organizations to carry out a basic participatory diagnosis, to design and develop protocol. Next, FFS plots were set up. On the one hand, regular monitoring and animation, and exchange visits between farmers were recommended until maturity. On the other hand, data was collected and analyzed. Finally, an assessment workshop was organized as part of the Living Lab to capitalize on and draw lessons learned from the COINS project experience, based on a combination of participatory and inclusive methods.

3. Findings

There are several points worth making here. Firstly, the evaluation showed that the agronomic indicators were in favor of SRI, except for rice height. This was even though the farmer had recognized the performance of the SRI plot very early on and had integrated some SRI principles into the FP plot to the point of improving the latter's agronomic indicators. The number of rice tillers and rice panicles per hole, as well as yield, are much better in the SRI plot (Figure 1).

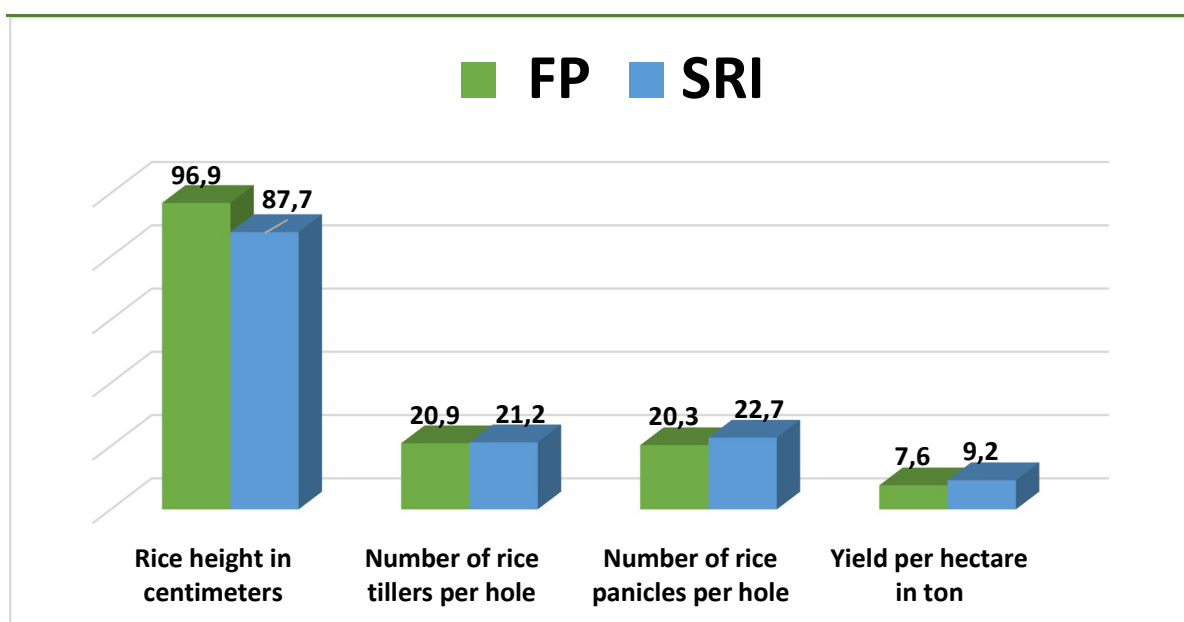


Figure 1: Agronomic comparison of FP (Farming Practices) and SRI (System of Rice Intensification)

Moreover, the specific study on two varieties of rice seeds in the SRI plot showed that Sahel 177 performs better than ISRI 7 agronomically.

Secondly, in economic and environmental terms, SRI is far better than conventional FP. It saves up to 80% on seeds, reduces water consumption by around 35%, increases yields by 35 to 100%, reduces methane (CH₄) emissions by 30 to 70% and saves 2 to 3 weeks in a production cycle (Kaboré, 2023).

Table 1: Economic assessment of FP (Farming Practices) and SRI (System of Rice Intensification)

Designation	FP	SRI	Difference
Cost soil preparation (ploughing, planting, etc.) (FCFA)	7500	7500	-
Quantity of seed (Kg)	6	2	4
Cost of seed (FCFA)	2 100	700	1 400
Cost of irrigation (FCFA)	25 000	12 500	12 500
Quantity of DAP (Kg)	10	00	10
Quantity of urea (Kg)	35	10	25
Total cost of fertilizer (FCFA)	14 750	3500	11 250
Cost of plant protection products (FCFA)	1500	00	1500
Total cost of labor (sowing, weeding, fertilizer application, hoeing, etc.) (FCFA)	-	-	-
Other expenses (FCFA)	-	-	-
Total expenses (a) (FCFA)	50 850	24 200	-26 650
Production (Kg)	760	920	+160
Production value (b) (FCFA)	114 000	138 000	+24 000
Margin (FCFA) (= b - a)	63 150	113 800	+50 650

To better understand these results, it is necessary to consider contextual elements. These include the positive impact of early reproduction of SRI principles in the FP plot, and the delayed irrigation of the SRI plot at heading. This had a negative impact on yield. Despite this

disadvantage, SRI is economically more profitable in the end, as it requires less expenditure while producing more and better. This has positive impacts on the environment, with less water and fewer chemicals (*Table 1*).

Thirdly, with foresight, 3 scenarios were collectively elaborated on SLM in the SRI in Podor department up to 2035. These are the “*Erosion of hopes in the SRI*”, “*Semi-green horizon*” and “*Golden age of SLM in the SRI*” scenarios. Furthermore, the main driving variables influencing SLM in a SRI are the accompanying measures facilitating secure access to production factors, the level of human, financial and technical resources available to technical structures, and the human capital equipped and ready to bring about change through favorable public policies and incentives, as well as the level of community awareness linked to their sensitization and the governance of farmers' organizations, which are much more influential change factors on SLM in a SRI.

Fourthly and lastly, lessons have been learned from the experience. A few challenges have been met. Securing access to the tractor on time has been a problem, for reasons of availability and financial profitability for tractor owners. The unavailability of a tractor could delay transplanting and, in turn, lead to non-compliance with the nursery age principle. Secure access to water is a sine qua non for avoiding irrigation delays, which lead to weed proliferation and consequently affect yield. Thus, practices such as ploughing, levelling the plot, transplanting and manual weeding remain hard and time-consuming for farmers due to the lack of suitable mechanization, as is often the case in so-called agroecological farming systems (Tounkara et al, 2024a). The choice of sites and the targeting of farmers enrolled in the training program are based on technical criteria, to which the farmers' organizations wanted to add the criterion of representativeness. Poorly negotiated, this can be a cause of failure for the FFS, as was the case with one farmers' organization. It follows that technical criteria must prevail to guarantee success. In addition, the farmers' organizations need to be effectively involved to ensure the necessary and regular local monitoring of the FFS's progress, and to ensure the commitment of the learners, motivated first and foremost by the acquisition of new knowledge and practices, to which we can add a system of fair and agreed sharing of the FFS's yield between all the learners from the outset. In the event of failure, the plot must not be abandoned, as this could create a breeding ground for granivorous birds in adjacent plots. It must be harvested and cleaned up.

4. Practical Implications

In practical terms, to develop SRI, we first need to act on appropriate mechanization. Ploughing, levelling the plot, transplanting and harvesting need to be mechanized in a way that does not impact negatively on the environment and exclude young, female and small farmers.

In addition to appropriate mechanization, there is a need to continue training and advising farmers, and popularizing SRI technology, considering the socio-economic and environmental realities in which farmers operate (Sanou, 2016). In this respect, farmers trained in SRI through the FFS can play the role of relay trainers for their peers, to facilitate the scaling-up envisaged in the national political agenda.

In terms of policy, the State of Senegal, as part of its food sovereignty strategy, plans to develop SRI with the National plan for adapting the agricultural sector to climate change, horizon 2050 (République du Sénégal, 2025). This policy can draw on this evidence to boost the practice of SRI in Senegal. It is also appropriate to launch an advocacy campaign based on the action plan leading to the advent of the “*Golden age of SLM in SRI*” scenario.

5. Theoretical Implications

When it comes to the living lab's research approach, it is necessary to try and apply theoretical principles to the end, to be able to properly assess the co-construction and collaborative or even reflexive research approach to developing innovations by including the end-users of these innovations from the outset (Morissette, 2013).

In this respect, the sharing of research results and feedback from scientists with living lab stakeholders is more than necessary. Not only does this enable the research results to be discussed, amended and improved, but it also allows us to consider ways of advocating for the mass dissemination of SRI technology in the Senegal River Valley, without forgetting the moral and deontological guarantee that consists in respecting the terms of the research framework based on interaction, iteration and co-construction, for innovations that are adapted and massively adopted by the end-users.

In other words, addressing social change and the introduction of an innovation into a community, especially in an agricultural context, requires moving gradually away from compartmentalized, unipolar research in which the scientific researcher is the sole master, towards decompartmentalized, multipolar research in which communities become research actors rather than mere research subjects. This represents a major challenge for the scientific community, which is called upon to critically and constructively question its methodological approaches to achieve greater impact.

6. References

- Bakker, T. et al. (2022). Les champs-écoles pour renforcer les capacités des agriculteurs et réussir la transition agroécologique. *Perspective*, (57), 1-4.
- Bednarz, N. et al. (2015). La recherche collaborative. *Carrefours de l'Education*, (39), 171-184.
- Bourgeois R. et al. (2021). Guide pour la coélaboration de scénarios : Vers la compréhension partagée et l'action commune pour la réforme et la sécurité du foncier forestier. Bogor, Indonésie : CIFOR.
- Camara, C. et al. (2019). Anticiper l'avenir des territoires agricoles en Afrique de l'Ouest : Le cas des Niayes au Sénégal. *Cahiers Agricultures*, 28. DOI : <https://doi.org/10.1051/cagri/2019012>
- Dubé, P. et al. (2014). Qu'est-ce qu'un Living Lab ? Montréal. Umvelt Service Design.
- Kaboré, E. (2023). Gestion intégrée de la riziculture pour la durabilité des systèmes rizicoles. Saint-Louis, AfricaRice, CGIAR.
- Morissette, J. (2013). Recherche-action et recherche collaborative : Quel rapport aux savoirs et à la production de savoirs ? *Nouvelles Pratiques Sociales*, 25(2), 35-49.
- Rabe, M. M. et al. (2022). Évaluation de l'effet de l'approche champ école paysan sur l'adoption des technologies améliorées de production du mil et du niébé au centre sud du Niger. *Revue Marocaine des Sciences Agronomiques et Vétérinaires*, 10(2), 234-243.
- République du Sénégal. (2025). Plan national d'adaptation du secteur de l'agriculture aux changements climatiques horizon 2050. MASAE et METE.
- Sanou, A. G. et al. (2016). Problématique de mise en œuvre du système de riziculture intensif dans les périmètres rizicoles irrigués de Karfiguéla et de la vallée du Kou au Burkina Faso. *International Journal of Biological and Chemical Sciences*, 10(6), 2693-2709.
- Serpantié, G. (2013). Genèse malgache d'un modèle agroécologique : le système de riziculture intensive (SRI). *Cahiers Agricultures*, 22(5), 393-400. DOI : <https://doi.org/10.1684/agr.2013.0659>
- Toukara, S. et al. (2024b). Promouvoir le rôle de la recherche prospective pour agir par anticipation. *Grain de sel*, (86), 26-27.

- Toukara, S. et al. (2024a). Le zaï : dépasser la pénibilité d'une pratique agroécologique chez les producteurs de mil à Ndiob (Sénégal). *Sciences and Technologies for Sustainable Agriculture*, 3(1), 53-56.
- Voilmy, D. (2016). Les living labs et la conception participative : L'exemple d'ActivAgeing. *Retraite et Société*, 3, (75), 125-136.
- Zélem, M.-C. (2012). Mondes paysans. Innovations, progrès technique et développement. L'Harmattan.

Integrating Drone Technology Into Smart Farming: Identifying Key Competences For Agricultural Experts And Drone Operators

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Short abstract

The integration of drone technology into agriculture is transforming how sustainability, productivity, and resource efficiency are addressed. Precision agriculture, enabled by unmanned aerial vehicles (UAVs), supports data-informed decision-making and optimised resource allocation. This study investigates the skills and competencies required for effective UAV deployment by agricultural professionals and drone operators. Through surveys, interviews, and focus groups with 20 experts across three countries, the study identified the emerging roles, training needs, and digital skill gaps in smart farming. Findings emphasise the importance of technical, digital, and socio-environmental skills, alongside transversal competences such as collaboration, digital literacy, and problemsolving. Domain-specific knowledge in agronomy and UAV operations—such as data interpretation, flight planning, and regulatory compliance—was found to be essential. These insights were mapped against the DigComp and ESCO frameworks to ensure consistency with EU policy standards. The study informed the development of a career eGuide and self-assessment tool, supporting targeted upskilling and vocational training. By aligning education and advisory services with technological advancements, the project contributes to workforce readiness in precision agriculture. It offers a structured framework for educators, policymakers, and stakeholders to promote the effective and sustainable integration of drone technologies in agricultural practice.

1. Purpose

1.1 Introduction

The increasing deployment of UAVs in agricultural contexts reflects a broader trend toward digitalisation and datadriven decision-making in the agri-food sector. Precision agriculture, facilitated by drone technologies, offers substantial potential for improving sustainability, productivity, and efficiency in resource use. However, the widespread integration of UAVs into standard agricultural practices is hindered by a lack of structured training pathways and

formally defined competence profiles that align technical UAV expertise with agronomic practice, expertise and needs. This skills gap is particularly pressing in light of ongoing ecological and economic challenges, including climate change, labour shortages, and the imperative to meet European Union targets related to the green and digital transitions. Without a workforce adequately trained to operate at the intersection of agriculture and emerging drone technologies, the transformative potential of UAVs may remain underutilised. This study aims to identify the key skills and competences required for effective UAV integration in agriculture. Using a multi-method approach and aligning with DigComp and ESCO frameworks, it develops validated occupational profiles and informs the creation of a career e-Guide and MOOC to support targeted upskilling across the sector.

1.2 Literature Review

Integration of drone technology into agriculture has emerged as a transformative force, addressing challenges in sustainability, productivity, and resource management. Precision agriculture, enabled by advancements in UAVs, empowers farmers with data-driven insights to optimise resource allocation and enhance crop yields [1], [2]. As agriculture becomes increasingly data-centric, the sector requires digitally skilled professionals capable of leveraging drone technologies to improve decision-making and operational efficiency [3]. However, the full potential of drone technology in agriculture remains underutilised due to persistent gaps in technical know-how, regulatory awareness, and the integration of drone operations into standard agricultural practices [4], [5]. This study explores the critical skills and competences required by agricultural experts and drone operators to successfully implement UAV-based solutions in agriculture. It presents key findings from the AgroPro project, which aims to address skill gaps in the agricultural sector by developing a comprehensive career e-Guide. The central focus is the identification of new occupational profiles for professionals using drones in agriculture. These roles show potential to improve crop yields and reduce costs related to labour, fertilisers, and other inputs. Based on an analysis of tasks and responsibilities, the study provides a clear overview of the required skills, using recognised frameworks such as European Digital Competence Framework (DigComp) and ESCO to ensure alignment with EU training standards. Two main profiles are defined—Drone-Oriented and Agriculture-Oriented—each outlining the essential knowledge, tasks, and competences. The e-Guide developed around these profiles supported the creation of a Massive Open Online Course (MOOC), aimed at delivering targeted training and promoting the use of drones in sustainable agriculture.

2. Methodology

The research adopted a multi-method qualitative approach, structured in three sequential phases to develop a targeted training framework and occupational profiling for agricultural drone professionals.



Figure 1: Methodology

2.1 Survey Design and Implementation

An initial online survey was conducted to identify the skills, knowledge gaps, and training needs of professionals involved in agriculture and drone deployment. Respondents

represented a diverse range of sectors including industry, academia, research institutions, and unemployed professionals. The survey instrument was designed in alignment with the DigComp to ensure comprehensive coverage of the digital skills necessary for UAV operations in agriculture. Questions were structured into four thematic blocks:

- Professional background,
- Drone familiarisation,
- Future agricultural tasks,
- Personal demographics.

The third block, which formed the core of the skill assessment, consisted of questions beginning with “Future agriculture professionals will need to be able to...”, and was directly mapped to the five DigComp competence areas. This allowed for an evidence-based analysis of the technological, operational, and regulatory competences necessary for UAV integration in agriculture.

2.2 Storyboard and Interviews

Following the survey, a storyboard technique was employed through individual semi-structured interviews with 20 experienced agricultural and drone professionals. These interviews aimed to identify and describe the real-life tasks, responsibilities, and contextual challenges of drone usage in the sector. The interviews were guided by the ESCO classification system, ensuring standardisation in capturing occupational information and facilitating the translation of practice-based insights into structured profiles. This phase resulted in the initial formulation of two occupational profiles: Drone-Oriented and Agriculture-Oriented professionals.

2.3 Focus Groups for Validation

To refine and validate the preliminary occupational profiles, focus groups were organised across three countries (Portugal, Greece, and Cyprus), involving practitioners from various agricultural domains. Moderated by neutral facilitators, these sessions employed open-ended, thematically guided discussions to verify the identified competencies, explore training needs, and capture additional insights related to career development, regulatory awareness, and future outlooks. The open format also facilitated the identification of soft skills, collaborative capacities, and systemic thinking, often omitted in more structured assessments.

3. Findings

The study highlights the significance of technical, digital, and socio-environmental skills, along with transversal competencies such as collaboration, digital literacy, and problem-solving. Agriculture-specific expertise—including field observation, equipment management, and data analytics—must be complemented by drone-specific capabilities such as piloting, sensor data interpretation, and adherence to safety regulations [6], [7]. These competencies were mapped to the DigComp [8] and existing ESCO occupational profiles to align with EU standards. Furthermore, the findings contributed to the development of a career e-guide and a self-assessment tool, designed to guide professionals and trainees in acquiring the necessary skills.

3.1 Survey Insights

The survey, based on a 5-point Likert scale, revealed that Precision agriculture and mapping (avg. 4.0) and Environmental monitoring and assessment (avg. 3.8) are perceived as the domains where drones can offer the greatest added value. In contrast, the lowest perceived benefit was in cost reduction (avg. 2.8), reflecting concerns about affordability and return

on investment. The most valued skills among respondents were the ability to access and retrieve drone data and the ability to self-diagnose and update competences, both essential for maintaining relevance in a rapidly evolving digital environment. Least valued were tasks involving routine software instruction or basic maintenance, suggesting a preference for higher-level cognitive and interpretative tasks.

3.2 Skill Differentiation by Background

A comparison between professionals with drone and agricultural backgrounds revealed distinct skill priorities. Agriculture-oriented professionals rated traditional farming tasks (e.g., planting, machinery operation, pest control) highly, while drone professionals emphasised analytical skills, flight operations, and technical problem-solving. Both groups showed strong scores in transversal skills like collaboration, problem-solving, and willingness to learn, underlining the cross-sectoral nature of the emerging roles.

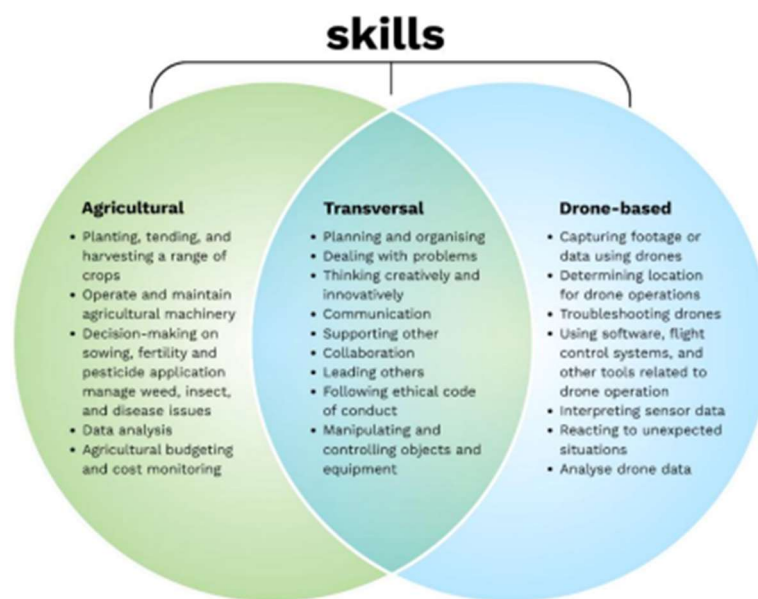


Figure 2: Skills Identified

3.3 Occupational Profiles

Development From the analysis of tasks and responsibilities, two main occupational profiles were defined, aligned with the ESCO framework:

- **Drone-Oriented Professionals:** Emphasise UAV operation, certification, flight safety, sensor calibration, data collection and analysis, software use, and regulatory compliance. Roles may include UAV pilots, drone technicians, and data analysts.
- **Agriculture-Oriented Professionals:** Focus on applying drone insights to optimise agricultural processes such as crop management, irrigation, pesticide application, and disease detection. Competencies include interpreting drone outputs, managing farm logistics, and integrating drone data with agronomic decision-making. The data also highlighted shared challenges, such as navigating regulatory landscapes, the need for formal certification, and the importance of practical training in both drone piloting and data interpretation.

3.4 Interview and Focus Group Results

Interviews and focus groups with experts further validated the profiles. Drone professionals emphasised the need for understanding sensor technologies, maintaining equipment, reacting to real-time challenges, and interpreting aerial imagery. Agricultural professionals

highlighted the relevance of drone-generated data for improving decision-making in crop treatment and planning, while also stressing the importance of traditional agronomic knowledge.

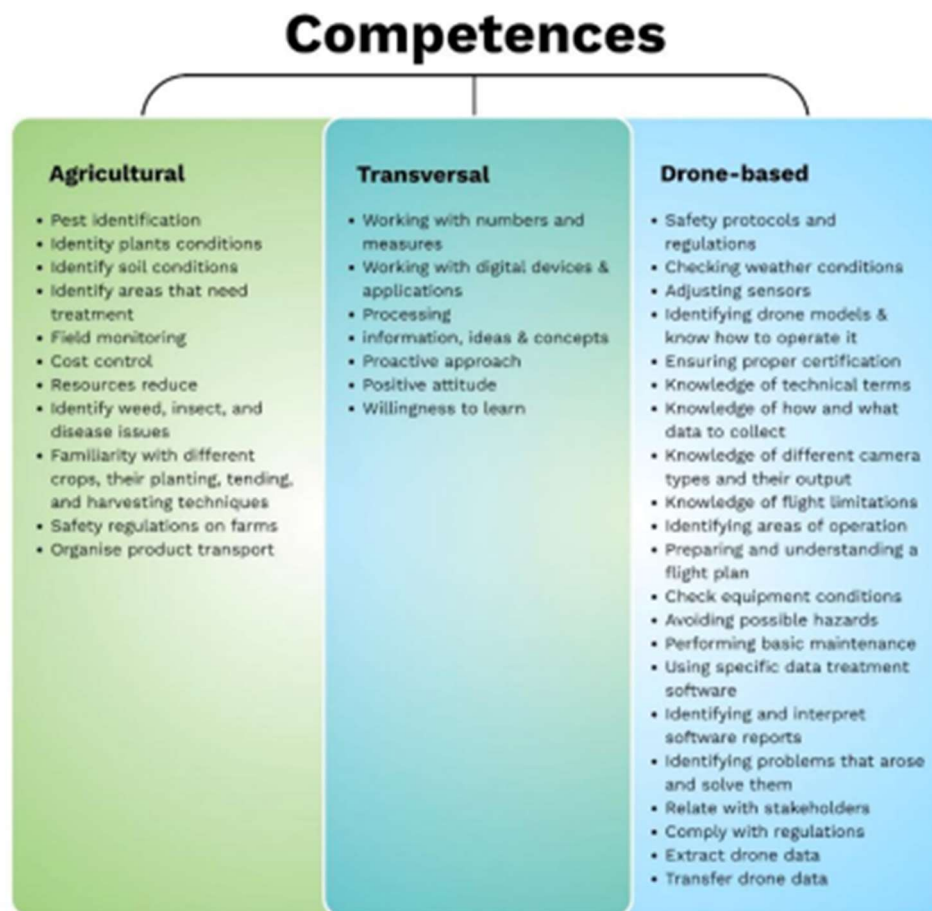


Figure 3: Competences Identified

4. Practical & Theoretical Implications

The study shows the importance of aligning vocational training, educational curricula, and advisory services with the technological advancements transforming modern agriculture. By identifying and addressing critical skill gaps in the use of UAVs, it contributes to the development of a digitally competent workforce equipped for the evolving demands of precision and smart farming. Practically, the findings support the design of modular, competence-based training programmes that are responsive to both technological developments and the operational realities of agricultural practice. The career e-Guide and associated MOOC developed through the AgroPro project serve as key instruments in this process. These tools offer structured learning pathways based on validated occupational profiles, enabling learners to acquire, assess, and certify essential digital and agricultural skills. Additionally, the study provides actionable guidance for policymakers and training providers by linking field-derived insights to established EU frameworks such as DigComp and ESCO. Theoretically, the research contributes to the discourse on digital transformation in agriculture by offering a dual-profile approach that bridges technological and agronomic domains. This model supports an interdisciplinary understanding of competence development and highlights the need for hybrid professionals capable of operating at the intersection of data, technology, and agricultural expertise. Furthermore, the study reinforces the value of participatory methods—surveys, interviews, and focus groups—in

grounding theoretical frameworks in the lived experiences of professionals. The approach is scalable and adaptable across EU contexts, and its integration of insights from initiatives such as the SmartVitiNet project strengthens its applicability. Ultimately, the study provides a replicable model for future skill development initiatives in agri-tech, promoting sustainable innovation and lifelong learning in the agricultural sector.

5. Conclusions

This study identified the core technical, digital, and transversal competences needed for integrating UAVs into smart agriculture and developed two validated occupational profiles aligned with EU frameworks. The findings informed the creation of a digital career e-Guide and MOOC, offering practical tools for upskilling professionals across the agri-tech sector. By linking field research with DigComp and ESCO standards, the project supports the development of a digitally capable workforce ready for the challenges of precision farming. The dual-profile approach demonstrates a replicable model for competence-based training in emerging technology domains. Future work will focus on pilot implementation and continued alignment with evolving EU digital and green transition strategies

6. References

- [1] M. Emimi, M. Khaleel, and A. Alkrash, "The Current Opportunities and Challenges in Drone Technology," *IJEES*, vol. 1, no. 3, pp. 74–89, Sep. 2023.
- [2] M. Yaqot and B. C. Menezes, "Unmanned Aerial Vehicle (UAV) in Precision Agriculture: Business Information Technology Towards Farming as a Service," in *2021 1st International Conference on Emerging Smart Technologies and Applications (eSmarTA)*, Sana'a, Yemen: IEEE, Aug. 2021, pp. 1–7. doi: 10.1109/eSmarTA52612.2021.9515736.
- [3] N. Khan, R. L. Ray, G. R. Sargani, M. Ihtisham, M. Khayyam, and S. Ismail, "Current Progress and Future Prospects of Agriculture Technology: Gateway to Sustainable Agriculture," *Sustainability*, vol. 13, no. 9, p. 4883, Apr. 2021, doi: 10.3390/su13094883.
- [4] M. N. Abd Kharim et al., "Agrotechnology Students' Acceptance on Agriculture Drones Spraying as Practical Tool in Class using the Knowledge, Attitude and Practice (KAP) Model," *Int. J. Adv. Res. Food Sc. Agri. Tech.*, vol. 1, no. 1, pp. 31–44, May 2024, doi: 10.37934/fsat.1.1.3144.
- [5] S. Alexandris et al., "Integrating Drone Technology into an Innovative Agrometeorological Methodology for the Precise and Real-Time Estimation of Crop Water Requirements," *Hydrology*, vol. 8, no. 3, p. 131, Sep. 2021, doi: 10.3390/hydrology8030131.
- [6] A. Hafeez et al., "Implementation of drone technology for farm monitoring & pesticide spraying: A review," *Information Processing in Agriculture*, vol. 10, no. 2, pp. 192–203, Jun. 2023, doi: 10.1016/j.inpa.2022.02.002.
- [7] K. Mahroof, A. Omar, N. P. Rana, U. Sivarajah, and V. Weerakkody, "Drone as a Service (DaaS) in promoting cleaner agricultural production and Circular Economy for ethical Sustainable Supply Chain development," *Journal of Cleaner Production*, vol. 287, p. 125522, Mar. 2021, doi: 10.1016/j.jclepro.2020.125522.
- [8] European Commission: Joint Research Centre, R. Vuorikari, S. Kluzer, and Y. Punie, *DigComp 2.2, The Digital Competence framework for citizens – With new examples of knowledge, skills and attitudes*. Publications Office of the European Union, 2022. doi: 10.2760/115376

Session 6B

METHODS & TOOLS

Learning and extension method preferences by farmers for promoting beef genetics tools in Northern Australia

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Short abstract

Genetic improvement of beef cattle is a key priority in Northern Australia for environmental, production and economic reasons. This research aims to identify the preferences of Northern Australian beef producers to participate in extension activities related to adopting genetic tools. A sequential qualitative-quantitative design was used. Fifteen purposive semi-structured interviews were conducted with Northern Australian beef industry stakeholders and 97 online surveys were completed by beef commercial and stud breeders, considering different levels of the adoption of genetic tools. A thematic analysis was conducted on the interview transcripts and the Training Needs Index (TNI) and nonparametric tests were estimated using the survey data. Lack of knowledge was found to be a barrier to the adoption of genetic tools. For genetic improvement, two key training priorities emerged for all farmers surveyed: the need for training on genomic tools (64.9%) and the importance of on-farm data collection (54.2%). Beef farmers reported they preferred on-farm extension activities where peer learning occurs. This knowledge could serve as a basis for developing extension strategies aimed at promoting the adoption of genetic tools among beef producers in Northern Australia.

1. Purpose

Genetic improvement of beef cattle is a key priority in Northern Australia for environmental, production and economic reasons (Bell & Sangster, 2023). To increase farmers' adoption of genetic tools (such as genetic and genomic estimated breeding values), it is essential to understand and address the factors that affect their management decisions and incorporate that knowledge into extension programs (Menchon et al., 2024). Across all regions of Australia, the demand for technical advice and extension services, the source of information and the relationship with extension agents or advisers (public and private) varies between types of farmers (Nettle et al., 2018). Therefore, it is essential to conduct research that is specifically relevant to beef production systems in Northern Australia that involves analysis of socio-economic, productive, and motivational factors that impact decision-making by farmers. This is particularly relevant in the process of adopting genetic tools, since decision-making regarding genetic improvement in cattle reveals that farmers are most likely to use simple strategies to make their choices easier (Martin-Collado et al., 2018). Kanakis et al. (2024) emphasised the importance of understanding farmers and fostering relationships

with them as this approach is essential for effective collaboration and applying an extension model grounded in their practices. In agriculture, co-innovation approaches involve collaborative problem-solving among various stakeholders, including organisations, farmers, government agencies, industry representatives, extensionists, researchers, and often consumers (Fielke et al., 2017; Nettle et al., 2022). In line with this, Jakku et al. (2022) along with Bell and Sangster (2023) and Nettle et al. (2022), recommend the use of co-innovation to foster closer collaboration among stakeholders and facilitate the adoption of new technologies.

This research aims to identify the preferences of Northern Australian beef producers to participate in extension activities related to adopting genetic tools. To reach this goal, the following research questions were considered: In what areas do producers have training needs? and What do producers consider to be the best delivery method for them to participate in training?

2. Design

This research followed the constructionism approach (Moon & Blackman, 2014) because it seeks to generate an in-depth understanding of the motivations and preferences of Northern Australian beef producers to participate in extension activities. This study was approved by the CQUniversity Australia Human Research Ethics Committee (approval numbers 24458 and 24882). A sequential qualitative-quantitative design was used (Kelle, 2006). Firstly, during 2023, fifteen purposive semi-structured interviews were conducted, in person or online, with beef industry stakeholders (commercial and seedstock farmers, stock agents, extension officers, researchers, and breed society members) from Northern Australia. Interviews were recorded, transcribed and coded using Otter Ai and NVivo (1.7.1 (1534) tools software. The interview data was analysed using Braun and Clarke (2006) thematic analysis methodology.

Secondly, during 2024, Northern Australia beef farmers were recruited, initiating purposive sampling followed by the snowball method. To establish a representative sample size for Northern Australia, the formula proposed by Daniel and Cross (2018) was utilised: $n = [(z^2 \cdot p \cdot q) / d^2]$, where n is the sample size, z is the desired confidence level, p is the proportion of a characteristic in the population (in this case, the number of beef farmers relative to the total number of farms in Northern Australia), q is $(1 - p)$, and d is the desired precision. Farmer proportions were sourced from the Australian Bureau of Agricultural and Resource Economics and Sciences (2023) and the Government of Western Australia (2021) resulting in p values of 0.675 and q of 0.325. With a desired precision of 90% ($d = 0.1$), the required sample size is 84 across Northern Australia (areas of Australia above the 26th parallel). Beef farmers were further classified into two sub-categories, Adopters (A) and Non-Adopters (NA), based on their use of genetic tools in their herds. Ninety-seven online surveys hosted on Qualtrics were completed by beef commercial and stud breeders from Northern Australia. Survey data were used to estimate the Training Need Index (TNI) (Patil & Kokate, 2016) to explore the preference regarding the training needs of beef farmers. Participant responses were classified into Most Needed (MN), Needed (N) and Least Needed (LN). A weight was obtained through the responses of all those surveyed.

$$TNI (\%) = \frac{\text{Total obtained score}}{\text{Maximum obtained score}} \times 100$$

To explore the distribution of the level of agreement between seedstock and commercial farmers on preferred methods for participating in training a non-normal Mann-Whitney test

was used (Field, 2018). Survey data were managed in a Microsoft Excel spreadsheet and analysed using the Statistical Package of Social Science (SPSS v 28.0.0.0.(190).

3. Findings

Interview results suggest that the lack of knowledge hinders the adoption of genetic tools. This is crucial as the lack of understanding could be associated with the absence of reasons to change attitudes towards the use of genetic tools (Ule et al., 2023). Through the interviews, beef farmers acknowledged their lack of comprehension and the need for continued learning about genetic tools. This view is shared by stakeholders, who recognise the challenges beef producers face in applying and implementing genetic concepts. Additionally, several authors have identified education as a recurring barrier to adoption in Australia, which has prompted the implementation of practices such as educational materials, awareness-raising activities, skills training, and participatory projects with farmers (Bell & Sangster, 2022, 2023; MLA, 2023).

For all farmers surveyed, it emerged that both genetic improvement and business management are the main areas of training demand (63.2% TNI each). However, differences appear when considering different levels of adoption of participants. Training in genetic improvement is the main training need among commercial or seedstock farmers who do not use genetic tools (Non Adopter), particularly for the topics of on-farm data collection and genomic tools. Two topics emerged as priorities within the area of genetic improvement for all farmers surveyed. First, there is a need for training in genomic tools (64.9%), followed by on-farm data collection (54.2%). This trend remained consistent across all farmer groups. However, differences emerged within these groups based on the level of adoption of genetic tools. For seedstock adopters, training in embryo transfer technology (52.2%) was the second most important need. In contrast, for non-adopters, training in on-farm data collection and using of quality semen (55.6% each) was the second priority. However, among commercial farmers, adopters displayed similar behaviour to non-adopting breeding cattle producers, highlighting on-farm data collection (61.5%) and knowledge about bull semen quality (61.5%) as the areas with the greatest training need. Commercial non-adopters expressed a need for training in field data collection and in reading and interpreting genetic information (51.2% both). This aligns with Ule et al. (2023) in the dairy sector, reporting that farmers need written, recorded data on an animal's performance to know exactly how good its genetic merit (breeding value) and breed characteristics are to be able to compare it with other animals. Regarding extension methods, during both the interviews and the surveys, a preference was found for activities on-farms where peer to peer learning occurred. Extension activities on research farms were the widely preferred option (84.4% and 77.5% for commercial and breeders' farmers), especially if they identify the speaker as a peer. Social media content was the least preferred option by producers. Overall, survey data suggested that there are no differences ($p > 0.05$) between commercial and seedstock farmers in preferences for extension activities.

4. Practical Implications

The findings of this research provide a practical insight into farmers' and stakeholders' recognition of the need for training to improve their understanding and adoption of genetic tools. This recognition is fundamental for the active participation of beef farmers from Northern Australia in extension activities. The topics that emerged as areas of training (genomics and on-farm data collection) could guide the design of extension programs focused on the needs of beef farmers that are held on-farm and delivered by their peers.

5. Theoretical Implications

This research reinforces the value of extension research using a participatory approach. The Training Need Index is a useful tool for collaboratively developing strategies to promote the adoption of agricultural technologies, considering the needs and preferences of farmers. These insights should guide the design of extension strategies aimed at enhancing the adoption of genetic tools among beef producers in Northern Australia.

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6. References

- Australian Bureau of Agricultural and Resource Economics and Sciences. (2023). *Farm Data Portal - Beta [Data set]*. Retrived 15 May. <https://www.agriculture.gov.au/abares/data/farm-data-portal>
- Bell, A., & Sangster, N. (2022). *Needs and gaps analysis for NB2. Final Report of Project B.GBP.0055*. <https://www.mla.com.au/research-and-development/reports/2023/needs-and-gaps-analysis-for-nb2/>
- Bell, A., & Sangster, N. (2023). Research, development and adoption for the north Australian beef cattle breeding industry: an analysis of needs and gaps [Review]. *Animal Production Science*, 63(1), 1-40. <https://doi.org/10.1071/an22065>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>
- Daniel, W. W., & Cross, C. L. (2018). *Biostatistics: a foundation for analysis in the health sciences* (Vol. 51). International Biometric Society. <https://doi.org/10.2307/2533362>
- Field, A. P. (2018). *Discovering statistics using IBM SPSS statistics (5th edition)*. SAGE.
- Fielke, S. J., Botha, N., Reid, J., Gray, D., Blackett, P., Park, N., & Williams, T. (2017). Lessons for co-innovation in agricultural innovation systems: a multiple case study analysis and a conceptual model. *The Journal of Agricultural Education and Extension*, 24(1), 9-27. <https://doi.org/10.1080/1389224x.2017.1394885>
- Government of Western Australia. (2021). *The Western Australian beef industry*. Department of Primary Industries and Regional Development. Retrieved 15 MAY from https://www.agric.wa.gov.au/export-services/western-australian-beef-industry?page=0%2C0#smartpaging_toc_p0_s0_h2
- Kanakis, K., Bickle, M., & Erbacher, J. (2024). Understanding the perceptions of producers: A tool for the extension toolbelt. *Rural Extension and Innovation Systems Journal*, 20(1).
- Kelle, U. (2006). Combining qualitative and quantitative methods in research practice: purposes and advantages. *Qualitative Research in Psychology*, 3:4, 293-311. <https://doi.org/10.1177/1478088706070839>
- Martin-Collado, D., Byrne, T. J., Diaz, C., & Amer, P. R. (2018). Complexity of animal breeding choice making [Article]. 135(6), 395-409. <https://doi.org/10.1111/jbg.12360>
- Menchon, P., Manning, J. K., Swain, D. L., & Cosby, A. (2024). Exploration of Extension Research to Promote Genetic Improvement in Cattle Production: Systematic Review. *Animals (Basel)*, 14(2). <https://doi.org/10.3390/ani14020231>
- MLA. (2023). *MLA Genetics Insights- Final Report L.GEN.2205*. M. a. L. A. Limited.
- Moon, K., & Blackman, D. (2014). A guide to understanding social science research for natural scientists. *Conserv Biol*, 28(5), 1167-1177. <https://doi.org/10.1111/cobi.12326>
- Nettle, R., Crawford, A., & Brightling, P. (2018). How private-sector farm advisors change their practices: An Australian case study [Article]. *Journal of Rural Studies*, 58, 20-27. <https://doi.org/10.1016/j.jrurstud.2017.12.027>

- Nettle, R., Major, J., Turner, L., & Harris, J. (2022). Selecting methods of agricultural extension to support diverse adoption pathways: a review and case studies [Review]. *Animal Production Science*, 64(1), Article An22329. <https://doi.org/10.1071/AN22329>
- Patil, S., & Kokate, K. (2016). Training need assessment of subject matter specialists of Krishi Vigyan Kendras. *Indian Research Journal of Extension Education*, 11(21), 18-22.
- Ule, A., Erjavec, K., & Klopčič, M. (2023). Influence of dairy farmers' knowledge on their attitudes towards breeding tools and genomic selection. *Animal*, 17(6), 100852. <https://doi.org/10.1016/j.animal.2023.100852>

How do farmers select advisory sources? A Greek study

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Short abstract

What criteria do farmers prioritize when choosing among the advisors available? In the present work, to answer this question, we first developed a theoretical scheme using concepts and insights from the field of advisory services research and seemingly extraneous areas, like business research and management science. We identified seven blocks of factors that might influence a farmer's decision when choosing advisory sources: advisors' epistemic capacity, social competencies, work practices, symbolic management practices, trust-building capacity, reputation, and impartiality. We then examined if and how these characteristics influence farmers' selection of advisory sources. To do so, we collected and analyzed quantitative data from 131 Greek farmers. Our results showed that, among the examined blocks, farmers rated advisors' epistemic capacity and impartiality as more important. However, only advisors' epistemic capacity, reputation, and social competencies are significantly associated with selecting an advisory source. These findings underscore the importance of some advisors' attributes that have received limited attention from scholars.

1. Purpose

Despite the recent policy emphasis on and the consequent rising research interest in advisory organizations and their work in promoting a resilient and sustainable agrifood future, the ways farmers select advisory sources have not yet been thoroughly examined. Selecting a service provider is an intricate and uncertain decision requiring the consideration of many different factors (Day and Barksdale, 2003).

As with any consultancy work, advisory service cannot be evaluated before its realization (Gallouj, 1997), while sometimes service receivers need to apply the advice and wait until they can evaluate its outcomes. This attribute of advisory work greatly complicates the selection of service providers (Kugytė and Šliburytė, 2005). The inability to know the outcomes of service provisioning beforehand leads farmers to base their selection decisions on different advisors' characteristics used as proxies. In this study, we developed a

theoretical scheme encompassing seven blocks referring to such characteristics of farm advisors. The first five were derived from farm advisory work research, while the remaining two came from business studies.

The first block contains characteristics defining advisors' epistemic capacity, namely perceived knowledge, their specification field, and qualifications (e.g., a bachelor's or Master's degree from a prestigious university). The second relates to the work practices used by advisors (like visiting the farm, offering advice pertaining to different fields, offering group advice). A third block comprises social competencies, which are essential for delivering advice. Beyond communication competency (Farshad and Niknami, 2024) and collaboration skills (Koundinya et al., 2018), empathy is also included in this block due to its pivotal role in gaining farmers' confidence (Rust et al., 2022). Closely linked to it – but not identical (Kuehne et al., 2019) – is the topic of trust. Trust-building capacity refers to the competence of generating positive expectations about one's benevolence and moral commitment (Khodyakov, 2007), and it is a characteristic that recently enjoyed increased attention in the relevant literature (Pappa and Koutsouris, 2025; Kuehne et al., 2019). Hence, we added it to our model as the fourth block. Moreover, we incorporated the characteristic of impartiality into our conceptual scheme as the fifth block. Despite the prominence given to the provision of impartial advice by the European Union (European Commission, 2023), it is questionable whether farmers ascribe high importance to it (Sutherland and Labarthe, 2022). In the context of the present study, impartiality refers to the execution of practices and offering of advice free from bias and without pursuing secret agendas.

A characteristic less related to the core attributes of advisory work is symbolic management. In the fields of business and management research, there is rich evidence that symbolic actions play a pivotal role in shaping the image displayed by an organization. Through such actions, organizations attempt to guide the formation of impressions by potential collaborators or customers (Zott and Huy, 2007). Actors engage in symbolic activities to attract attention around them and establish a position within their field of operation (Petkova et al., 2008). In the case of advisory work, symbolic management practices may include participation in fairs and conferences or involvement in research projects. Finally, reputation is an essentially intangible and socially constructed factor that influences the selection of a service provider (Gallouj, 1997). In rural settings, there is often a distinction between highly and less reputable advisory providers or, as Klerkx (2020) puts it, between "rockstar" and "average" advisors.

In the present study, using the above-mentioned theoretical scheme, we seek to provide insights into the criteria that farmers prioritize when choosing among the advisors available. Our work aims to address two research questions. First, how important do farmers perceive the different characteristics of advisory services? Second, how do these characteristics affect them when selecting advisory sources?

2. Methodology

To answer our research questions, we followed a quantitative research design. Data for our study were drawn from a sample of 131 farmers living in three villages in Thessaly (Greece). In the specific region, eight farm advisors operate. All of them are agronomists who provide embedded advice, i.e., they incorporate advisory support services in the pallet of services and products they offer (Klerkx and Jansen, 2010) without receiving a fee for consultancy work. This way of doing business is common for private advisory services and freelancer advisors in Greece (Charatsari et al., 2024; Koutsouris, 2014).

To collect data, we developed an instrument assessing the importance that farmers attribute to the seven blocks incorporated into our theoretical scheme. After offering a description for each one of the blocks, we asked participants to assess the importance of these

characteristics of farm advisors using a scale from 1 (not at all important) to 5 (extremely important). Then, participants were requested to review the eight advisors who operate in their region – only those for whom they can express an opinion based on (i) their previous or current collaboration, (ii) the perception they have based on the social interactions with them or their clients – by using the same seven blocks and the same rating options. In a final question, to gather data on the use of the available advisory providers, we asked participants to indicate if they collaborated with them.

To analyze the data, we used descriptive statistics and paired samples t-tests. We also performed a regression to examine which of the assessed advisors' characteristics affected farmers' selection of advisory sources.

3. Findings

Our descriptive analysis of the importance attributed by farmers to advisors' characteristics indicated that epistemic capacity and impartiality had the highest mean scores. A series of paired samples t-tests uncovered that these scores were significantly higher than those of the remaining five blocks (Table 1). Another interesting finding was that symbolic practice management received significantly lower mean scores than the other variables.

Table 1: Importance attributed by farmers to advisors' characteristics: Mean scores and differences between them

Characteristic	Mean score (S.D.)	t-test					
		I	SC	R	WP	TB	SP
Epistemic capacity	4.56 (0.69)	1.37	4.63**	5.36**	5.29**	5.81**	8.71**
Impartiality (I)	4.47 (0.65)		2.24*	2.59*	4.30**	4.19**	7.70**
Social competencies (SC)	4.29 (0.83)			0.51	1.57	1.89	4.92**
Reputation (R)	4.25 (0.82)				1.10	1.58	4.55**
Work practices (WP)	4.16 (0.68)					0.55	4.01**
Trust building (TB)	4.11 (0.64)						3.39**
Symbolic practices (SP)	3.82 (0.80)						

Note: Statistically significant differences are marked with * ($0.05 \geq p > 0.01$) and ** ($p \leq 0.01$)

For our regression, we used data concerning farmers' ratings of advisors who operate in the region. The process led to 593 ratings derived from a total of 131 farmers. The analysis ($R^2=0.29$, $F=34.63$, $p<0.001$) uncovered that reputation ($\beta=0.25$, $p<0.001$) and epistemic capacity ($\beta=0.25$, $p<0.001$) had the highest contribution to the model, followed by advisor's social competencies ($\beta=0.18$, $p=0.006$). Interestingly, trust building yielded a marginally not significant beta coefficient ($\beta=0.07$, $p=0.055$).

4. Practical Implications

Our study provides insights into the factors that impact farmers' decisions when selecting among advisory sources. From a practical standpoint, it revealed the importance of advisors' epistemic capacity, social competencies, and reputation. On the other hand, despite the emerging discussion on the need to ensure impartial advice, impartiality was not found to affect the choice of advisory sources.

5. Theoretical Implications

The present work offers a theoretical scheme incorporating advisors' characteristics that farmers evaluate when selecting farm advice providers. Although, due to space constraints,

we did not fully elaborate on the details of this scheme here, it can be helpful for future research into the attributes of advisory services. Characteristics not thoroughly investigated by relevant research, like advisors' reputation and social competencies, deserve further theorizing and investigation.

6. References

- Charatsari, C., Michailidis, A., & Lioutas, E. D. (2024). Do farm advisory organizations promote sustainability? A study in Greece. *Agricultural Systems*, 218, 104003.
- Day, E., & Barksdale, H. C. (2003). Selecting a professional service provider from the short list. *Journal of Business & Industrial Marketing*, 18(6/7), 564-579.
- European Commission. (2023). Approved 28 CAP Strategic Plans (2023-2027): Summary overview for 27 Member States. Brussels: European Union.
- Farshad, S., & Niknami, M. (2024). Validation of the professional competencies model required by experts of agricultural consulting, technical, and engineering services companies to provide private extension services. *Frontiers in Sustainable Food Systems*, 8, 1390449.
- Gallouj, C. (1997). Asymmetry of information and the service relationship: selection and evaluation of the service provider. *International Journal of Service Industry Management*, 8(1), 42-64.
- Khodyakov, D. (2007). Trust as a process: A three-dimensional approach. *Sociology*, 41(1), 115-132.
- Klerkx, L., & Jansen, J. (2010). Building knowledge systems for sustainable agriculture: Supporting private advisors to adequately address sustainable farm management in regular service contacts. *International Journal of Agricultural Sustainability*, 8(3), 148-163.
- Koundinya, V., Baird, A., Klink, J., Wolfson, L., Frankenberger, J., Bonnell, J., & Power, R. (2018). Core competencies for successful watershed management practitioners. *The Journal of Extension*, 56(1), 12.
- Koutsouris, A. (2014). Failing to implement FAS under diverse extension contexts: a comparative account of Greece and Cyprus. *Proceedings of the 11th European Farming Systems Symposium*. April 1-4, 2014. Berlin, Germany.
- Kuehne, G., Nettle, R., & Llewellyn, R. (2019). Key social processes sustaining the farmer/advisor relationship. *Rural Extension and Innovation Systems Journal*, 15(1), 20-29.
- Kugytė, R., & Šliburytė, L. (2005). A standardized model of service provider selection criteria for different service types: a consumer-oriented approach. *Engineering Economics*, 44(4), 56-63.
- Pappa, E., & Koutsouris, A. (2025). The agronomist to trust as my advisor: A Greek case study. *The Journal of Agricultural Education and Extension*, 31(1), 29-45.
- Petkova, A. P., Rindova, V. P., & Gupta, A. K. (2008). How can new ventures build reputation? An exploratory study. *Corporate Reputation Review*, 11, 320-334.
- Rust, N. A., Stankovics, P., Jarvis, R. M., Morris-Trainor, Z., de Vries, J. R., Ingram, J., ... & Reed, M. S. (2022). Have farmers had enough of experts? *Environmental Management*, 69, 31-44.
- Sutherland, L. A., & Labarthe, P. (2022). Should 'Impartial' Advice be a Priority of European Agricultural and Rural Policies? *EuroChoices*, 21(1), 15-22.
- Zott, C., & Huy, Q. N. (2007). How entrepreneurs use symbolic management to acquire resources. *Administrative Science Quarterly*, 52(1), 70-105.

Analyzing the role of agricultural extension and education in improving the agricultural startups ecosystem

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Short abstract

This research aims to analyze the role of agricultural extension and education in improving the ecosystem of agricultural startups. The data were collected by interviewing 15 agricultural experts and analyzed by the content analysis technique using coding method. The results indicate that the agricultural extension and education system can improve the agricultural startup ecosystem by several categories of indicators, consisting of culture building (9 indicators), empowerment (6 indicators), facilitation (7 indicators), institutionalization and networking (9 indicators), and monitoring (7 indicators). "Culture-building", comprising 9 terms and featuring 60 repetitions, emerged as the most salient category among all categories and garnered significantly more attention from the experts. The national agricultural extension and education department is the main actor that plays a crucial role in the development of the ecosystem of these businesses

Keywords: agricultural startup, entrepreneurial ecosystem, agricultural extension and education, content analysis

1. Purpose

Global experience shows that many nations, including the USA, India, the UK, and China, have taken good measures to solve problems and increase efficiency by launching startups and monitoring the challenges and problems of the agricultural value chain (Smolova et al., 2018; Subash et al., 2016). The success of several startups in Iran such as Snap, Tapsi, etc. in transportation has attracted new individuals in this field (Moradanjadi et al., 2019). Although this trend can increase the failure rate of businesses in these areas, leading to the frustration of entrepreneurs, it can mitigate the economic impacts and create employment in relevant business ecosystems (Sharifzadeh and Abdulhazadeh, 2021). Guiding entrepreneurs, particularly new investors entering the innovation ecosystems of underserved yet high-potential areas with significant social and economic impact, can strengthen the resilience of these ecosystems while amplifying their overall effects (Akhli et al., 2019). On the other hand, given the growing challenges in Iran across sectors such as agriculture and environment (particularly, challenges such as climate change, pollution, and energy)—coupled with the country's diverse four-season climate and the high number of graduates in these fields—the involvement of entrepreneurs and the innovation ecosystems in these areas can have a significant impact. The absence of traditional competitors in these sectors creates opportunities to drive economic growth, boost employment, and address pressing social and national challenges (Hosseininia and Aliabadi, 2020).

Promoting agricultural startups in Iran, based on the country's climatic and geographical conditions is the relative advantage and considerable capacity for the development of the value chain in this sector (Sharifzadeh and Abdollahzadeh, 2017). According to studies, startups belong to an ecosystem that consists of a collection of actors (Pigford et al., 2018). The development of startups in the agricultural sector is not an abstract phenomenon and is occurred in the context of its own ecosystem (in a specific institutional environment and in the interaction of different actors). Agricultural extension and education system as one of the relevant important actors plays a crucial role in the development of these businesses. However, the lack of a comprehensive scientific and empirical study on this role in improving the agricultural startup ecosystems is a significant research gap and is considered a challenge to carry out further studies in this field. By understanding the necessity and importance of the subject, the present study seeks to analyze the role of agricultural extension and education to improve the ecosystem of agricultural startups

2. Approach

This applied research employs a qualitative approach by interviewing agricultural experts. The participants were selected through the purposeful sampling technique. The main criteria to select the sample were background and work experience, scientific records (research, education and consulting), and familiarity with the subject of entrepreneurship and agricultural innovations. Then, the experts were invited to give their views on startups. In the beginning, 10 individuals agreed to participate in the research. This group introduced five more people and the number of respondents increased to 15 by snowball sampling method. These participants were agricultural faculty members of universities (6), agricultural experts from public agricultural organization (6), and agricultural startup activists (3). The data were analyzed by the content analysis technique using the open and axial coding method. Key concepts were extracted from the transcripts of the interviews and categorized. To enhance the trustworthiness of the study, the coding was implemented by three research team members and the results were given to the interviewees to obtain their feedbacks and revise the categories and discussions.

3. Findings

After conducting the open and axial coding, the role of extension in improving the ecosystem of agricultural startups were categorized in five principal categories as follows: (1) Culture-building (9 indicators); (2) empowerment (6 indicators); (3) facilitation (7 indicators); (4) institutionalization and networking (9 indicators), and (5) monitoring (7 indicators). The category of "Culture-building" consisted of 9 terms with 60 frequencies and had the highest frequency, receiving much more attention by experts. A list of related categories and terms is shown in Table 1.

Table 1: Categories and terms of the role of agricultural extension and education in improving the ecosystem of agricultural startups

No.	Categories	Phrases	Frequency
1	Culture-building	Holding educational events (visits, webinars, etc.)	10
2		Holding specialized seminars of agricultural startups	8
3		Training of a specialized mentor for agricultural startups	8
4		Introduce successful experiences of agricultural startups	7
5		Raising awareness of the senior managers of the Ministry of Agricultural about the effectiveness of agricultural startup activities	6
6		Holding specialized exhibitions of agricultural startups	6
7		Media actions to promote agricultural startup activities (social networks, radio and TV, etc.)	7

8		Absorbing and hiring non-native entrepreneurs to the agricultural startup ecosystem	4
9		Shape the team problem solving approach of agricultural startups along the value chain	4
Total frequency			60
10	Empowerment	Forming the flow of knowledge and experience exchange among agricultural startups	9
11		Involving large industries and companies to cooperate with agricultural startups	8
12		Introducing suitable tax incentives for starting an agricultural startup	10
13		Identifying and introducing low-interest banking facilities to agricultural startups	7
14		Integration of agricultural startup development policies in extension network programs	10
15		Designing and developing a specific strategy for the development of an agricultural startup	6
Total frequency			50
16	Facilitation	Revising laws and regulations related to launch an agricultural startup	11
17		Facilitating the administrative processes of launching an agricultural startup (license, activity permit, etc.)	9
18		Facilitating the access to distribution and sales channels	7
19		Presenting legal (property registration, intellectual property, etc.), financial and accounting counseling to agricultural startups	9
20		facilitating the access to market information for agricultural startups	6
21		Identifying and introducing extra logistics services of the Ministry of Agricultural (warehouse, land, etc.) to agricultural startups	8
22		Establish a specific organizational unit related to agricultural startup in the Agricultural Education and Extension Organization	8
Total frequency			58
23	Institutionalization and networking	Create communication networks between agricultural startups in Iran	6
24		Create communication networks between agricultural startups abroad	5
25		Identify and introduce specialized innovation centers to agricultural startups	7
26		Identify and introduce specialized accelerators to agricultural startups	8
27		Introduce specialized companies for risky investment on agricultural startup	6
28		Identify and introduce specialized shared workspaces to agricultural startups	9
29		Identify and introduce specialized growth centers to agricultural startups	5
30		Introduce the capacities of non-governmental organizations such as charitable institutions to participate in providing some sections of the financial resources of agricultural startups	4
31		Formation of the agricultural startup association	7
Total frequency			57
32	Monitoring	Identifying the problems of the value chain of agricultural products at the national and local level	7
33		Prioritizing the problems of the value chain of agricultural products according to the necessity of solving problems by the agricultural startup	10
34		Prioritizing the problems of the value chain of agricultural products based on the necessity of solving them by the agricultural startup	9
35		Establishing a database of agricultural startups along the value chain of agricultural products	10
36		Accurate recognition of the benefits of services and products of agricultural startups in solving problems of the chain before starting the activity	8
37		Modeling successful examples of international agricultural startups active in the value chain of agricultural products	7
38		Monitoring agricultural startup products and services in terms of sustainability (environmental protection, etc.)	8

4. Practical Implications

One of the key outcomes of innovation ecosystems in various countries is the emergence of startups that drive significant transformations in traditional agriculture, facilitating a faster transition to knowledge-based agriculture. The innovation ecosystems in Iran also comprise a diverse range of institutions, including science and technology parks, growth centers, innovation centers, accelerators, innovation factories, innovation funds, venture capital funds, corporate venture capital (CVC) partners, knowledge-based companies, and startups. To accelerate the formation and growth of the agricultural startup ecosystems in Iran, it is essential for the Agricultural Extension and Education System to redefine its role and propose a clear roadmap with measurable goals. This roadmap should outline actionable strategies and executive plans to foster development. In line with this, the following roadmap is proposed for defining the role of this system in advancing Iran's agricultural startup ecosystems.

- *The establishment of civil society institutions and startup ecosystems, along with the delegation of non-sovereign government responsibilities to these entities*
- *Transferring government facilities to private sector accelerators and innovation centers*
- *Creating a culture of acceptance of startups in the government and farmers*
- *Growth of startup launch and development capabilities*



Figure 1: The roles of agricultural extension and education in improving the agricultural startup ecosystem

1. Culture-building

1-1 Promoting the organizational culture of open innovation in the Ministry of Agriculture Jihad

1-2 Promoting the culture of open innovation among farmers and other agricultural users

1-3 Cooperation with organizations and institutions responsible for innovation for greater synergy

2. Empowerment

2-1 Training agricultural users, young farmers, and farmers' children to launch agricultural startups or participate in their start-ups

2-2 Conducting applied research for a better understanding of Iran' agricultural innovation ecosystems and providing optimal models to overcome the existing problems

2-3 Creating a mechanism to receive the educational requirements of startups and young elites in the agricultural sector and developing educational programs for them.

3- Institutionalization and networking

3-1 Helping to launch and empower non-governmental organizations related to the startup ecosystems of the agriculture sector

3-2 Proposing to launch agricultural innovation funds

3-3 Proposing the establishment of innovation centers, innovation laboratories and the national agricultural innovation network

3-4 Proposing the establishment of the required organizations to promoting of open innovation ecosystems in the Ministry of Agriculture Jihad

4-4 Formulating new policies and rules and the deregulation to support the development of Iran's agricultural startup ecosystems

4. Facilitation

4-1. Providing logistic services such as delegating land, building, infrastructural facilities, and specialized human resources to set up institutions required for innovation ecosystems

4-2. Proposing the use of financial institutions' capacities affiliated to the ministry to help required institutions by the innovation ecosystems

4-3. Designing and developing the necessary regulations and contracts for delegating the logistics services (land, building, etc.) to startups;

4-4. Creating a mechanism to provide research findings and available data for agricultural startups

4-5. Helping to finance innovation centers, accelerators, and agricultural startups via the identification and introduction of fund venture capital and innovative loan funds by attracting the support of sponsors

5. Monitoring

5-1. Establish a monitoring center for Iran's agricultural startup ecosystems using the capacities of NGOs and the private sector

5. Theoretical Implications

The results of this study can compensate the lack of a comprehensive scientific and experimental study of analyzing the role of agricultural extension and education system to improve the start-up ecosystems, focus on the agriculture context, and provide the ground for further studies in this field.

6. References

- Akhli, M., Didekhani, H., Sharifzadeh, M. Sh., and Hosseini, S. M. R. (2018). Conceptual model for recognizing the opportunity of new entrepreneurs of academic agricultural technology. *Agricultural Education Management Research Journal*, 10(45), 139-157.
- Moradanjadi, H., Sharif, Zadeh, M. Sh., Vahedi, M., and Mehdizadeh, H. (2019). Develop and use a framework to evaluate the ecosystem of fava-based start-up businesses in Ilam province. *Entrepreneurship Development*, 12(3), 401-420.
- Sharifzadeh, M. Sh. and Abdollahzade, G. (2021). Agricultural innovation ecosystem in Golestan province. *Journal of Agricultural and Education Extension Sciences*, 16(1), 1-22.
- Sharifzadeh, M. Sh. and Abdulzadeh, G. (2017). Comparative evaluation of the sustainability of entrepreneurial agricultural businesses and conventional agricultural production systems in Golestan province. *Journal of Agricultural and Education Extension Sciences*, 13(2), 1-20.

-
- Hosseininia, Gh. & Aliabadi, V. (2019). Analysis of the gap between the current and desirable dimensions of the entrepreneurial ecosystem in agricultural knowledge-based companies in Hamadan and Kermanshah provinces. *Cooperative and Agriculture Quarterly*, 8(29), 57-78.
- Smolova, H., Kubova, P., and Urbancova, H. (2018). Success factors for start-ups related to agriculture, food and nutrition and their relevance to education. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 66(3), 791-801.
- Subash, S. P., Srinivas, K., Samuel, M. P., and Kalpana Sastry, R. (2016). Evolution of agribusiness incubation ecosystem in NARES (National Agriculture Research and Education System) for promoting Agri entrepreneurship. *Indian Journal of Agricultural Economics*, 71(3), 237-251.
- Pigford, A. A. E., Hickey, G. M., and Klerkx, L (2018). Beyond agricultural innovation systems? Exploring an agricultural innovation ecosystems approach for niche design and development in sustainability transitions. *Agricultural Systems*, 164, 116-121.
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Didactical Strategies for developing interactive innovations in rural Europe: Lessons from the I2CONNECT Project

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Short abstract

Didactical strategies are essential for creating meaningful training experiences. This paper concerns didactical strategies designed and applied to serve different types of interactive training courses carried out by the I2CONNECT project to enhance the competences of advisors and other AKIS actors in supporting interactive innovation. It delves into learning theories and advisory practice, urging a continued focus on holistic and adaptive didactical strategies that engage all levels of advisory system. It indicates that didactical strategies play a crucial role in promoting change in the context of AKIS, by creating learning environments that inspire change and enable the implementation of collaborative, interactive approaches in response to complex problems. Fostering trust, collaboration, and reflective practice in training activities can contribute to resilient rural advisory services, capable of addressing the challenges that the modern agriculture and forestry face.

1. Purpose

Interactive innovation is a growing trend in EU policymaking, becoming an integral element of flagship strategies such as the European Innovation Partnership and Horizon Europe, aiming at creating innovative solutions to boost sustainability in the agri-food sector. Interactive innovation involves dynamic processes of multi-actor initiatives that mobilize and interlink the building blocks of Agricultural Knowledge and Innovation Systems (AKIS), including farmers, advisors, researchers, agribusiness, NGOs, etc., to address held in common complex problems. It emphasizes close cooperation between the engaged actors who share not only their knowledge and skills to develop sustainable solutions but also the power and responsibility to influence the innovation process, and, accordingly, develop co-

ownership on its outcome (Knierim et al., 2020). This, in turn, implies that in interactive innovation processes the actors are engaged in collaborative learning, since they work together to produce something that did not exist before the collaboration, and which would not exist without the collaboration process (Peters & Armstrong, 1998). In practice, for advisors and other AKIS actors delivering advisory/ innovation support services the implementation of such processes entails the acquisition of competencies that correspond to new functions and activities (such as capacity building, networking, intermediation and facilitation) as well as new roles (such as innovation brokers/intermediaries) (Knierim et al., 2018; Faure et al., 2019). Consequently, the emergence of interactive innovation highlights the need to accelerate the transition of the roles of advisors from experts to facilitators of collaborative processes and, overall, the transformation of advisory services from linear models of knowledge transfer to models that promote cooperation and collaborative learning. In serving this goal the I2CONNECT Horizon project designed and implemented a range of training activities on interactive innovation and the development of the related competencies, targeting different segments of the advisory system. To this end, the development of appropriate didactical strategies was necessary. Didactical strategies, being carefully designed for educators to shape how learners engage with knowledge and attain desired learning outcomes, are fundamental for building impactful educational experiences (Rump, 2024). Crafting effective didactical strategies entails a deep understanding of the subject matter but also of the learners and their needs. In turn, they allow educators to set clear learning objectives, which guide the learning process and ensure that each activity and method contributes to the learning outcome(s). They also allow educators to create an engaging learning environment, considering factors such as learners' prior knowledge, preferable learning styles and motivations. Didactical strategies include the selection of methods and tools as well as the design of assessment and feedback procedures. The teaching methods must be in line with the learning objectives and learners' characteristics. Each method should help learners to engage with the material in ways that resonate with their specific needs and contexts. In parallel, assessment and feedback procedures are crucial for ensuring continuous improvement, allowing learners to realize their strengths and weaknesses and 'educators/facilitators' to improve their strategies. This article is based on the collective work of the I2CONNECT Creative Content Group (CCG), which focused on the development of didactical strategies to support the training activities of the project. It summarizes the theoretical foundations and practical approaches used to foster interactive innovation in rural advisory services and support rural advisors in shifting from the traditional role of expert to the role of facilitator of collaborative processes.

2. Design

This article is based on the work and reports of CCG, notably its' Deliverable 3.1 (Rump, 2024). The CCG comprised partners who were involved in the training activities and had regular online and face-to-face meetings throughout the project (2019-2024). The group employed a practical action research approach (Creswell, 2015) pertaining the development and implementation of didactical strategies to support interactive training in the framework of the I2CONNECT project. This included discussion and group reflection on the content, the didactical strategies and the outcome of the training courses. I2CONNECT had a clear vision to transform advisory work and systems by equipping advisors and key AKIS actors so as to support interactive innovation. Therefore, the starting point of developing didactical strategies was the desired competencies of the target groups. Based on the competency profile of innovation advisors (Debruyne & Lybaert, 2020) the key skills and knowledge areas required to effectively support interactive innovation concern: a) Advisors' basic disposition and attitude, meaning that advisors are capable to understand their role and responsibilities

(GersterBentaya et al. 2009). Essential competencies in this category include self-awareness, sensitivity, willingness to share power, communication skills, reliability and professional attitude and ethics; b) Content knowledge and competence, including understanding the social context and AKIS; c) Methodological competence, including an understanding of innovation process as well as competencies in facilitation, conflict resolution and systems thinking; d) Organizational competence; and e) Reflection (including self-reflection and reflection with peers), learning and personal development competencies. This profile formed the basis of the desired learning outcomes, guiding the CCG to delve into learning theories and develop the didactical strategies applied in the project's training courses. Such courses were carried out across Europe, including 6 Train-the Trainer (TTT) courses for new interactive innovation trainers, 49 national training and coaching courses for rural advisors in 22 countries, 4 excellence classes for managers of advisory and innovation support services and 3 summer schools for postgraduate students in European universities.

3. Findings

3.1 The theoretical foundations of the applied didactical strategies

Various concepts, models, learning theories and approaches underlie the applied didactical theories (Rump, 2024). In the first place the distinction between content (i.e. what is discussed, which includes technical and thematic aspects of the subject matters) and process (i.e. the 'how', which includes the methods of participants' engagement, relationships (of trust) building and group dynamics) was made. This distinction is particularly important for interactive innovation facilitators, who need to ensure fair opportunities of meaningful participation for all relevant actors/ stakeholders. Social and collaborative learning, two concepts grounded in constructivist theory, emphasizing the social aspect of learning as a process of knowledge co-construction, led the design of learning strategies. This is crucial for designing learning environments allowing for, on the one hand, demonstration and observation and, on the other, teamwork and problem-solving tasks, fostering social and collaborative skills, such as observation, reflection and communication. In addition, an appropriate learning environment is essential for harnessing group dynamics to encourage dialogue and peers' feedback as well as for scaffolding learning, which enables learners to achieve a higher level of understanding under the influence of more knowledgeable peers or facilitators. Therefore, the creation of collaborative spaces for meaningful interaction between learners and networking facilitation were among the strategies applied in the training programmes. Adult education theories, including andragogy, experiential learning, and transformative learning, were also important for drawing on learners' prior experiences through adopting experiential, participatory and problem-based modes of learning, critical thinking and reflection practices. Relevant practices that applied in the training courses included peer-to-peer reflection sessions, the use of learning journals (summer schools) and the integration of reflection into evaluation processes, e.g. by asking learners to reflect on the impact of the training on their thinking and behavior and the challenges they faced. To this, the reflective stance of the educator/facilitator should be also added. Furthermore, symbolic body actions were employed to help learners embody and express crucial abstract concepts, e.g. co-leadership and co-responsibility, leading to significant realizations or unlock untapped potential in learners. Examples of symbolic body actions used in the training sessions are physical activities that included the crossing of a symbolic boundary, and collective exercises with learners moving through a space together, performing activities without speaking but observing what happened within the group dynamics and themselves. Moreover, the building of safe spaces and trust is fundamental in interactive processes, since it enables effective and meaningful communication and knowledge sharing. Building safe

spaces and trust in the training sessions involved the encouragement of open communication among participants and consistent support from peers and trainers which in turn, allowed learners to experiment and challenge themselves without fear of judgment while also reinforcing reliability and accountability, in the sense that trainers and trainees fulfill with consistency their commitments, thus building the confidence needed for collaboration. Additionally, concepts, models and mechanisms related to interactive innovation and thus essential for implementing interactive training were taken into account, such as:

- Co-creation, a collaboration process that transforms the advisory process into a shared journey, in which diverse actors develop tailored solutions;
- Co-opetition, a strategy for maximizing collective impact through strategic partnerships of actors who are typically competitors, especially in resource-scarce environments;
- Serendipity, referring to unexpected discoveries that arise from open dialogue and unplanned interactions with diverse actors;
- Cross-pollination for innovative thinking, referring to the synthesis of ideas from different fields aiming to inspire the disruption of established practices;
- Self-organization, referring to the spontaneous formation of organizational patterns and structures by groups and communities, attained through facilitating connections among learners and creating space for emergent learning pathways.

Advisors involved in interactive innovation processes need strong communication and facilitation skills as well as being adept at creative problem-solving and innovation networks navigation, to initiate and support such processes.

3.2. The training courses: key elements and adaptation of the didactical strategies

The objective of the TTT courses was to equip trainers with the necessary skills and knowledge to deliver effective training sessions to advisors. The employed strategies included role-playing exercises simulating real-world training scenarios, peer coaching sessions enhancing learners' facilitation skills, and reflective practices helping them to assess their own progress. Moreover, the TTT trainers' team comprised highly experienced in such training courses trainers or participants thus facilitating the integration of experience and contributing to their continuous improvement. The advisors' training and coaching courses were a key element of i2connect, as rural advisors were the main target group in view of effectively promoting interactive innovation. The courses were structured upon advisors' needs regarding the acquisition of further knowledge on innovation processes and of facilitation skills for working mainly with farmers' innovation networks. To these ends, case studies reflecting real-world situations and problem-based learning, which allow the implementation of new concepts to directly address real-world challenges, were particularly effective strategies. In the summer school courses the guiding principle was the use of interactive and collaborative training to support learners in their own learning about interactive innovation. The main challenges to this end were that the learners a) had no or limited practical experience in advisory/innovation support work and b) had already developed an expert rather than a facilitator mindset since they had been raised in a teacher-centric educational environment. To deal with these difficulties the trainers emphasized a learner-centric, participatory approach, based on the learners' examples and activities. The summer schools addressed fundamental concepts using a variety of interactive exercises and methodological tools to sensitize learners about the roles undertaken and the competencies needed in delivering innovation support services (see also: Zarokosta & Koutsouris, 2024). In the case of excellence classes, the target groups were human resources managers, project and team managers as well as general managers with the main learning objective being to help them gain a clear understanding of what

interactive innovation is and entails for their organizations. The classes were mainly based on case studies and peer-to-peer learning, which helped learners to develop shared visions about the creation of enabling environments for interactive innovation in different occasions. However, these peer-to-peer exchanges between managers with different backgrounds and levels of experience created challenging conditions for the trainers, due to the need to continuously adapt the training. Undoubtedly, the need to adapt the selected didactical strategies to the specific context and participants was essential for all training courses, even though their core principles (employment of learner-centered approaches, collaborative learning and problem-based learning) remained consistent across all formats. Thus, for example, in TTTs the emphasis was on role-playing and reflecting practices, while in advisors' training it was on problem-based learning, allowing trainees to apply new concepts and methods to every day challenges. Maintaining a balance between theory and practice in each training course was another critical element of the didactical strategies, highlighting the need to link the theoretical principles of interactive, collaborative training with practical examples and activities. Furthermore, flexibility in delivery (e.g. choosing between online, in-person and blended training) was necessary to ensure learning opportunities for all participants, regardless of their circumstances. Eventually, the thoughtful application of the selected didactical strategies across various training contexts was a critical success factor of the various I2CONNECT training sessions.

4. Practical Implications

The I2CONNECT training sessions employed a holistic didactical approach, affecting learners at a cognitive, emotional, and physical level. This approach is crucial for mobilizing learners' full potential and enabling them to contribute to systemic change through self-reflection and collective inquiry. Nevertheless, for this change to be sustainable, it is necessary to be rooted to learners' experiences and interactions while encouraging them to develop the competencies needed to navigate the complex, interconnected systems of the agri-food sector. These courses offer an example for future training courses/ programs, showcasing the importance of designing didactical strategies that foster systemic awareness, self-awareness and reflection, symbolic body actions, peer learning and collaboration, while highlighting the need for their implementation with clarity, reliability and flexibility.

5. Theoretical Implications

The interconnected nature of modern agricultural challenges necessitates a shift from isolated decision-making to integrated, collaborative approaches. To support this transition, training and education programs for rural advisors must evolve. Thus the need to further explore and adapt various learning theories, systemic concepts, models and tools to become able to support holistic and adaptive learning strategies that engage all levels of advisory systems. Acknowledgements The research presented in this paper was funded by the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 863039 (I2CONNECT). The authors wish to express their gratitude to all contributors to both the Deliverable 3.1 and the CCG.

6. References

- Creswell, J.W. (2015). Educational research. Planning Conducting and Evaluating Quantitative and Qualitative Research. Pearson Education Inc.
- Debruyne, L., & Lybaert, S. (2020). Repository of required competencies of an innovation advisor. Available online at: <https://i2connect-h2020.eu/wp-content/uploads/2021/09/Deliverable-1-4-1.pdf>

- Faure, G., Knierim, A., Koutsouris, A., Ndah, T., Audouin, S., Zarokosta, E., Wielinga, E., Triomphe, B., Mathé, S., Temple, L., & Heanue, K. (2019). How to strengthen innovation support services in agriculture with regards to multi-stakeholder approaches. *Journal of Innovation Economics & Management* 28: 145-169.
- Gerster-Bentaya, M., Hoffmann, V., Christinck, A., & Lemma, M. (2009). *Rural Extension Handbook, Volume III: Training Concepts and Tools*. <https://doi.org/10.16309/j.cnki.issn.1007-1776.2003.03.004>
- Knierim, Andrea, Ndah, H. T., & Gerster-Bentaya, M. (2018). Co-designed conceptual framework for the inventory and characterisation of Innovation Support Services and Innovation Support Providers. Stuttgart, Germany
- Knierim, A., Gerster-Bentaya, M., Mekonnen Birke, F., Bae, S. & Kelly, T. (2020). Innovation advisors for interactive innovation process: Conceptual grounds and common understandings. Available online Extended Abstract for the 27th ESEE conference at: https://i2connect-h2020.eu/wpcontent/uploads/2021/09/i2connect_Final_Deliverable1.1_correctedversion.pdf
- Peters, J. M., & Armstrong, J. L. (1998). Collaborative learning: People laboring together to construct knowledge. *New Directions for Adult and Continuing Education*, 1998(79), 75–85.
- Rump, N. (2024). Recommendations about didactical strategies. Available online at: <https://meteodocs.llkc.lv/index.php/s/nSbSFwpkPrEJeGF#pdfviewer>
- Zarokosta, E. & Koutsouris, A. (2024) Building Advisors and researchers' capacity to support agricultural knowledge and innovation systems in Europe: The case of the I2CONNECT summer school. *Proceedings 2024*, 94(1), 33.

Analysing the diversity of farmers' pesticide use through professional dialogue networks analysis

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Short abstract

Understanding the mechanisms underlying farmers' trajectories of change is essential to inform agricultural extension and advisory services, as well as to adapt policies that facilitate agroecological transitions. This study aims to understand the influence of information flows between farmers on pesticide use trajectories, through an analysis of professional dialogue networks. We conducted a case study of three groups of farmers involved in a French pesticide reduction program, using Social Network Analysis methods and theories. Farmers' pesticide use trajectories were characterized through the evolution of their Treatment Frequency Indicator (TFI). Based on interviews, we mapped farmers' professional dialogue networks and analyzed their crop protection practices and information exchanges. We show that farmers maintain relationships with peers and diverse peer groups, exchanging information that frame their pest management practices. Some groups mobilize pesticide-centered repertoires of information, while others develop tools and norms aligned with low-

pesticide systems. In two studied cases, the policy-induced peer groups failed to become dialogue spaces where repertoires and practices evolve towards this target. These results challenge idealized views of peer groups and highlight the value of mapping farmers' professional dialogue networks. This study also demonstrates the relevance of integrating Farming System Research and Social Network Analysis frameworks and theories for practical implications.

1. Purpose

Understanding the mechanisms underlying farmers' trajectories of change is essential to generate knowledge that informs agricultural extension and advisory services, as well as for adapting policies that facilitate agroecological transitions. Since the late 2000s in France, reducing pesticide use in agriculture has been a key objective of public policy. The first Ecophyto plan, launched in 2008, aimed to halve pesticide use nationwide by 2018, a deadline now extended to 2025. To achieve this goal, the plan has promoted innovative approaches for identifying and disseminating alternative practices to pesticide use, and has established a national scheme, the DEPHY-farm network, to support farmers who volunteered to work on pesticide reduction through peer exchange and systemic advisory services.

However, a gap exists between this policy objective and the observed dynamics of pesticide use in the fields. Since the beginning of the plan, pesticide use has not decreased at the national level (Hossard et al., 2017), nor in some farms within the DEPHY-farm network. Nandillon et al. (2024) demonstrate that over a nine-year period, the Treatment Frequency Index (TFI) decreased on two-thirds of the farms involved in this network, while it increased on the remaining third.

While technical and economic factors are often studied to explain these divergent paths, less attention has been paid to how peer-to-peer relationships, involving professional norms and knowledge exchange, influence farmers' pest management practices. In this study, we aimed to understand the influence of information flows between farmers on their pesticide use trajectories, based on an analysis of professional dialogue networks.

2. Design

We conducted a case study analysis of three groups of farmers within the DEPHY-farm program in France.

We first characterized farmers' pesticide use trajectories through the time-course of their Treatment Frequency Index (TFI) from their entry into the group, using data collected by advisors in the DEPHY-farm database.

Within each group (composed of 10 to 12 farmers), we interviewed 8, 7 and 6 farmers respectively, who showed contrasted TFI trajectories. These interviews aimed to collect information on four themes: i) the farmer's crop protection practices and the rationale behind them, ii) recent changes in practices, their origins and the resources mobilized to put them into practice, iii) the farmer's professional relationships and information exchanged on crop protection, iv) their experience within the DEPHY-farm program (motivations for joining the group, point of view on group activities and exchanges, positioning with respect to other members, role of the group in their trajectory of change).

Based on farmers' declared relationships with other farmers—both within and beyond the DEPHY group—, social network diagrams were generated for each case study using the 'igraph' package in R. These visualisations allowed us to analyse the structural configuration of each network, the individual positions within them, and particularly the distribution of TFI reduction and non-reduction trajectories within the network, drawing on Social Network theories (Compagnone & Hellec, 2015; Crowe, 2007).

To further explore the links between network features and pesticide reduction trajectories, we compared farmer's crop protection practices, and the information they exchange and use regarding crop protection. We used the concept of "shared repertoires of resources for action" (Wenger, 2011) to identify the reference group of each farmer, meaning the group to which they foremost refer to evaluate what should be done in a situation and how, and the professional norms in those groups.

3. Findings

We show that most farmers maintain relationships with peers and peer groups (both formal and informal), included outside their own DEPHY group. They thus exchange information (knowledge, norms, diagnostic tools and references) that frame their ways of thinking about and implementing crop protection. Some groups build and mobilize mainly pesticide-centered repertoires, while other develop new tools and new norms better suited to low-pesticide agriculture.

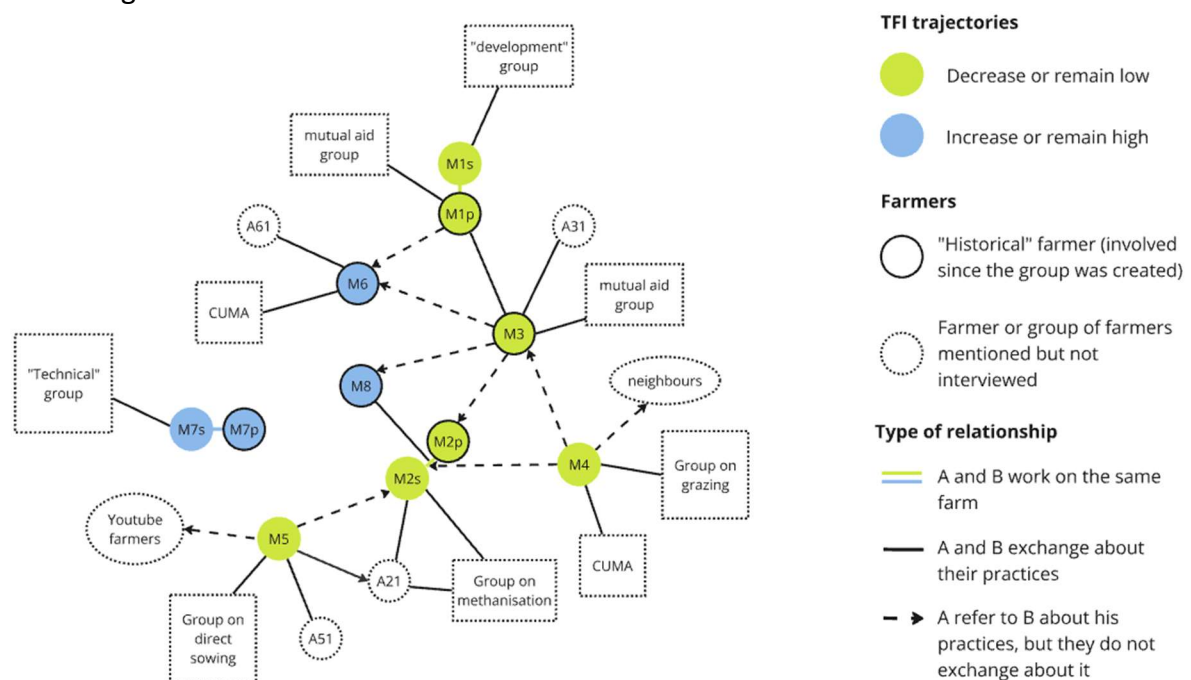


Figure 1: Graphical representation of the network of farmers' relationships with peers and their TFI evolution in the first case study

In the first case study, we observe a dense network structure connected to other peer groups (Figure 1), hosting both dynamics of change in crop protection practices and internal debates on relevant practices. Interviews reveal a strong norm in the Dephy group favouring reduced fungicide and insecticide use. For instance, yield is no longer the only shared criterion for evaluating their success in wheat cultivation; reduced fertilizer and fungicide use have also become key criterion. This involves in practice a different choice in varieties and increased plot observation to monitor local disease pressure, reflecting an evolution in the group's shared repertoire of resources for action in lign with pesticide reduction. Farmers M7, who are disconnected from other members of the Dephy group, do not align with these standards. Instead, they engage with another peer group whose approach focuses on improving treatment efficiency —reducing product doses while maintaining their effectiveness, notably by optimising treatment timing and spraying conditions. Regarding herbicide use, the Dephy group is divided: some farmers (M1, M3, M4) rely on ploughing and fodder crops to manage weeds, whereas others (M6, M8, M7, M5), practicing

no-till systems with predominantly autumn-sown crops, are more reliant on herbicides. Farmers occupying central and influential positions within the network (M6 and M8) actively promote no-till farming practices, which are valorized in the network, and confer them an expert status within the Dephy group, but do not contribute to reducing the herbicide TFI. Farmers M2 are the only ones who have successfully reduced their herbicide TFI under no-till conditions, by introducing alfalfa in crop rotation —a change supported through connections to another peer group involved in a shared biomethane project. This change was not driven by dynamics occurring in the Dephy group. Within the Dephy group, peer exchange about non-chemical weed management mainly focus on the use of mechanical weeding tools in maize. The use of the spring-time harrow is a practice that is still under debate and has not been stabilized within the group. It is only implemented by M2, M3, and M8, in the core of the network. Recently, M7 —previously more distant from Dephy group discussions—shared photos with the group documenting a hoeing trial on their maize. These could be signs of i) a change in M7's position within the network, and ii) an ongoing evolution in the group's shared repertoire of resources for weed management.

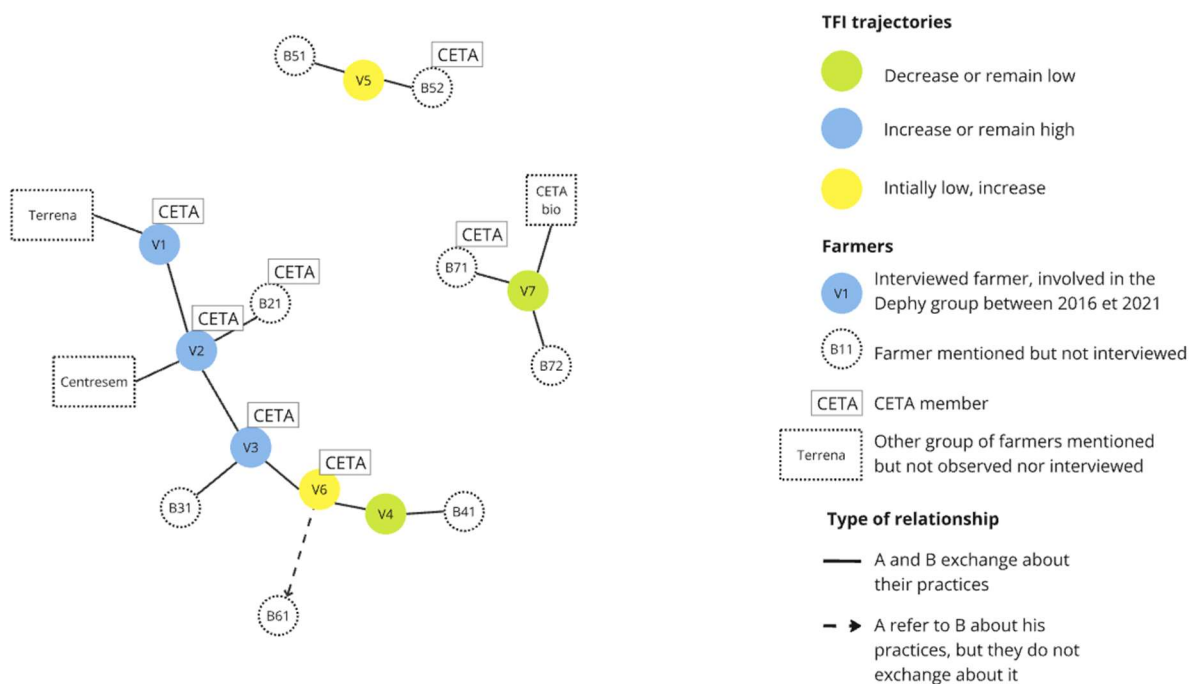


Figure 2: Graphical representation of the network of farmers' relationships with peers and their TFI evolution in the second case study

In the second case study, the network is fragmented and poorly connected to other groups, with a chain of relationships and two individuals having their own dialogue network but not connected to other members of the Dephy group (Figure 2). There are no cluster or densely connected subgroup. The network displays a diversity of TFI trajectories, including farmers with initially low TFI who increased their usage over time. However, these trajectories are not distributed randomly within the network. Farmers whose TFI stagnates or increases tend to be in the main chain of relationships, while those who reduced their TFI (V4 and V7) are located on the margins and outside this chain.

Several poles appear based on the information exchanged between farmers and the practices they implement: a conventional pole (V1, V2, V3, V6) in the northern part of the chain; an integrated protection pole (V4, B41) in the southern part, an organic farming pole in the east (V7). There is no information flow between these poles, and crop protection

practices are not discussed across them, as farmers have few connections between them. Each pole develops its own repertoire of resources for action.

Farmers in the conventional pole (V1, V2, V3, V6) participate in the same Agricultural Technical Study Group (known in French as CETA – *Centres d'Études Techniques Agricoles*), which is identified as their reference group. The resources they mobilize in their discussions mainly concern the conditions for the effectiveness of pesticides, as well as current pesticide regulations. In contrast, V4 and B41 mobilize a very different repertoire, exchanging about crop sequence, sowing density, sowing date adjustments and stubble ploughing before sowing to manage pest and weeds. V6, positioned between these two poles, and showing an increasing TFI, implements practices advocated by the CETA group, which we interpret as exerting a normative pressure to continue pesticide use.

In this case, the Dephy group does not constitute a social space for developing a shared repertoire of resources that could support pesticide reduction for these farmers. It lacks the characteristics of a community of practice, a place where farmers collectively develop responses to the challenges they face. Knowledge and standards guiding their actions are shaped elsewhere, in other groups. In one part of the network (CETA pole), reducing pesticide use is not a major concern, and the norm even leans towards increased usage. Only farmers involved in other exchange groups with shared repertoires of resources fostering pesticide sobriety reduce their TFI.

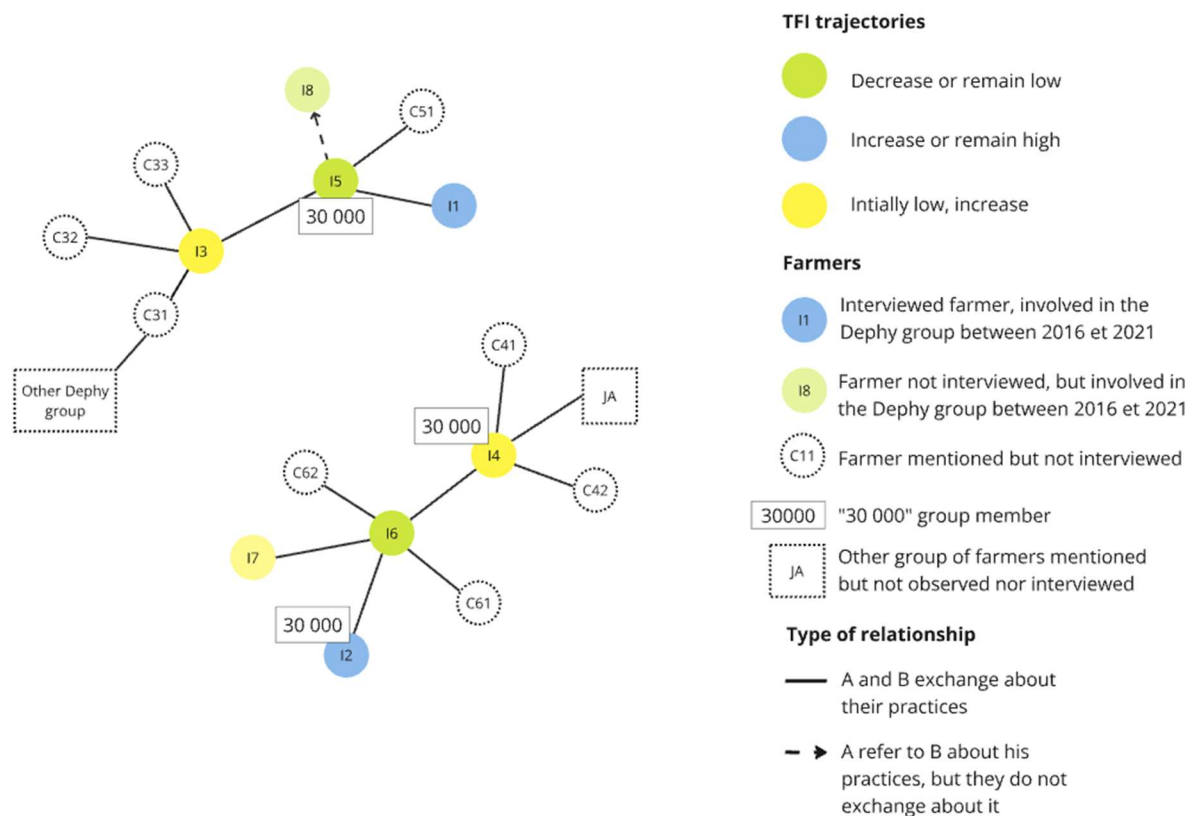


Figure 3: Graphical representation of the network of farmers' relationships with peers and their TFI evolution in the third case study

In the third case study, the group's funding ceased two years before farmers were interviewed. At the time of the survey, the network's structure is fragmented in two helices. The former Dephy group members still exchanging about weed and pest management (I1, I5, I3 on one side; I4, I6, I2 on the other) are farmers who are geographically close to each other. TFI trajectories vary widely among farmers, and appear randomly distributed within the network. In each helix, farmers with contrasting TFI trajectories are linked together.

Farmers who are linked to each other have very different practices and ways to assess them. Interviews indicate that in this network, differences in standards and practices are accepted between peers, indicating low normative pressure. It is seen as normal that not all farmers reduce their pesticide use. For instance, F5 frequently mention agronomic (soil type), structural (farm size, equipment) and organizational (labor availability) constraints to explain why other Dephy group members have not adopted the same practices or achieved the reduction objective.

Conversely, some farmers formulate similar reasoning, implement similar practices, use the same indicators to assess them, but do not communicate with each other today. They exchange information and develop their practices through interactions with other farmers or groups outside the Dephy group.

Here again, the Dephy group doesn't appear to be a reference group for the farmers involved in the program.

4. Practical Implications

We show that enrolling farmers in a peer group is not sufficient for them to form a genuine group and to act as a community of practice. Although many studies emphasize the crucial role of peer groups in fostering change (e.g. Lamine, 2011; Mawois et al., 2019; Slimi et al., 2021), our results highlight cases where public policy-induced farmers groups, aiming to put pesticide reduction into practice, failed to become cohesive community where repertoires and practices evolve towards this target. Instead, farmers involved in the Dephy program were referring to other groups, sometimes less aligned with pesticide reduction goals, for support and guidance in crop protection practices. These findings challenge the idealized vision of peer groups and invite us to broaden our understanding of collective dynamics by focusing on the professional dialogue networks that farmers themselves shape to find support and carry out their practices.

We further demonstrate that the structure of these networks strongly conditions the capacity to enrich repertoires of resources for action. In the first case study, a bonding and bridging structure, such as described by Compagnone & Hellec (2015) and Crowe (2007), manifests the features of 'ambidexterity' (Cofré-Bravo et al., 2019), combining internal resources mobilization and external resources introduction. In contrast, the second and third case study show fragmented and loosely cohesive structures which limit cooperation, the sharing of resources, and collective transformation of norms toward pesticide reduction. In case 2, we observe subgroups formed within the Dephy group, each consolidating its own standards without exchange across them, thus widening the gap between the farmers developing a pesticide-centered repertoire and those developing new tools and new norms better adapted to low-pesticide systems. In case 3, although farmers with diverse practices remained connected, normative pressure was weak, and while some farmers implemented innovative practices, it didn't transform the norm within the group. We aligns with the "bridging" network structure (Crowe, 2007), more favorable to the implementation of change on the basis of resources external to the group.

Multiple group membership—a position designated as 'structural fold' by Vedres & Stark (2010) —can be an asset for farmers, when it facilitates access to diverse resources and enables practice change (e.g., M2 in Case 1). However, it could also create tensions when farmers are caught between conflicting norms or approaches (e.g., V6 in Case 2). The influence of structural folds on group dynamics (introduction of new ideas, shared repertoire evolution) and further on the local socio-professional dynamics (transforming practices and norms outside the depthy group through peer dialogue) can therefore be more or less consistent with public policy expectations.

Finally, we argue that Social Network Analysis methods could offer advisors a valuable tool to map and better understand the dialogue spaces in which farmers engage, ultimately helping to foster more effective support for agroecological transitions.

5. Theoretical Implications

From an academic perspective, this study underscores the value of integrating two systemic disciplinary fields: farming system research (FSR) and social network analysis (SNA).

For agronomists interested in systems, examining farming practices in their social dimension provides valuable insights into change pathways and the underlying logic of farmers' actions. SNA indeed takes a step aside from the individual perspective and "risk aversion" analysis that prevail in studies examining barriers to agroecological transition (e.g. Menapace et al., 2013). It demonstrates how changing one's practice also involves negotiating with one's peer group to evolve agricultural norms within the collective, or sometimes necessitate engaging with another community of practice to find appropriate support.

For SNA practitioners, beyond analysing network structures and individual positions in the network, gaining a deeper understanding of what information farmers seek and mobilize within their relational network and link it to their practices is an original and interesting methodological strategy. This approach enables the identification of each farmer's reference group — the group to which they refer to evaluate what should be done in a situation and how — and the related norms.

6. References

- Cofré-Bravo, G., Klerkx, L., & Engler, A. (2019). Combinations of bonding, bridging, and linking social capital for farm innovation: How farmers configure different support networks. *Journal of Rural Studies*, 69, 53–64. <https://doi.org/10.1016/j.jrurstud.2019.04.004>
- Compagnone, C., & Hellec, F. (2015). Farmers' Professional Dialogue Networks and Dynamics of Change: The Case of ICP and No-Tillage Adoption in Burgundy (France): Farmers' Professional Dialogue Networks. *Rural Sociology*, 80(2), 248–273. <https://doi.org/10.1111/ruso.12058>
- Crowe, J. A. (2007). In search of a happy medium: How the structure of interorganizational networks influence community economic development strategies. *Social Networks*, 29(4), 469–488. <https://doi.org/10.1016/j.socnet.2007.02.002>
- Hossard, L., Guichard, L., Pelosi, C., & Makowski, D. (2017). Lack of evidence for a decrease in synthetic pesticide use on the main arable crops in France. *Science of The Total Environment*, 575, 152–161. <https://doi.org/10.1016/j.scitotenv.2016.10.008>
- Lamine, C. (2011). Transition pathways towards a robust ecologization of agriculture and the need for system redesign. Cases from organic farming and IPM. *Journal of Rural Studies*, 27(2), 209–219. <https://doi.org/10.1016/j.jrurstud.2011.02.001>
- Mawois, M., Vidal, A., Revoyron, E., Casagrande, M., Jeuffroy, M.-H., & Le Bail, M. (2019). Transition to legume-based farming systems requires stable outlets, learning, and peer-networking. *Agronomy for Sustainable Development*, 39(1), 14. <https://doi.org/10.1007/s13593-019-0559-1>
- Menapace, L., Colson, G., & Raffaelli, R. (2013). Risk Aversion, Subjective Beliefs, and Farmer Risk Management Strategies. *American Journal of Agricultural Economics*, 95(2), 384–389. <https://doi.org/10.1093/ajae/aas107>
- Nandillon, R., Guinet, M., & Munier-Jolain, N. (2024). Crop management strategy redesign enables a reduction in reliance on pesticides: A diachronic approach based on a diversity of French commercial farms. *Agriculture, Ecosystems & Environment*, 366, 108949. <https://doi.org/10.1016/j.agee.2024.108949>

- Slimi, C., Prost, M., Cerf, M., & Prost, L. (2021). Exchanges among farmers' collectives in support of sustainable agriculture: From review to reconceptualization. *Journal of Rural Studies*, 83, 268–278. <https://doi.org/10.1016/j.jrurstud.2021.01.019>
- Vedres, B., & Stark, D. (2010). Structural Folds: Generative Disruption in Overlapping Groups. *American Journal of Sociology*, 115(4), 1150–1190. <https://doi.org/10.1086/649497>
- Wenger, E. (2011). Communities of practice: A brief introduction. *National Science Foundation (U.S.)*.

Toward refined conceptualizations and methodological approaches to understand shifts in knowledge production and guide interventions for agroecology transitions

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Short abstract

In current EU policies, living labs, decentralized research infrastructures, and agricultural knowledge and innovation systems (AKIS) are seen as central to co-creation for advancing agroecological transition. However, the addition and combination of these open innovation arrangements and AKIS in participatory (action) research in an agroecology transition context represent new levels of complexity, for which concepts and methods are only just emerging. This perspective paper draws on insights from a November 2024 symposium comprising policymakers and researchers from ten countries entitled '*Exploring methods for researching shifts in knowledge production for agroecology transition*' that aimed to critically advance the conceptual and methodological groundings that may guide interventions for agroecology transition. Based on the symposium's outcomes, we identify four key tensions: the oversimplification of Gliessman's transition-transformation levels as linear rather than overlapping and fluid categories, the risk of dilution of the High Level Panel of Experts (HLPE) agroecology principles through cooptation, the problematic nature of Agricultural Knowledge and Innovation Systems (AKIS) as supposedly neutral innovation frameworks, and the structural constraints limiting farmers' agency within living lab approaches. These findings suggest that current institutional approaches to agroecological transition may inadvertently reinforce conventional agricultural paradigms, particularly when innovation is confined to incremental, substitutional changes. We suggest attention to refined conceptualizations and methodological approaches that can better account for the complex interplay between knowledge systems, institutional structures, and farmers' innovation capacity in driving agroecological transition.

1. Purpose

Recent EU policy initiatives focus on agroecology as the basis for more resilient farming systems that might also contribute to addressing climate, biodiversity, environmental, economic, and social challenges (European Green Deal, Farm to Fork, Biodiversity strategy).

The initiatives entail restructuring centralized research models and shifts in knowledge production. Living labs (LLs), decentralized research infrastructures (RIs), and agricultural knowledge and innovation systems (AKIS) are seen as central to (knowledge) co-creation for advancing agroecological transitions (EC, 2019). The addition and combination of these open innovation arrangements and AKIS in participatory (action) research in an agroecology transition context represent new levels of complexity for which concepts and methods are only just emerging. Thus, there is a knowledge gap regarding which concepts and methods are being used, their shortcomings, and how to effectively integrate them into practice and measure their impact on agroecology transition outcomes. This perspective paper draws on insights from a 2024 symposium entitled *'Exploring methods for researching shifts in knowledge production for agroecology transition'* that aimed to critically advance the conceptual and methodological groundings that may guide interventions for agroecology transition.

2. Approach

The symposium convened 36 researchers from ten countries and two representatives from the European Commission (DG Agri) to discuss which methods, theories, and analytical approaches may help critically advance understandings of shifts in knowledge production; the role of AKIS for agroecology transition in Europe's diverse social, economic, institutional, and biophysical conditions; and how to obtain experiences and insights that may advance research guidance for agroecology transition. Eighteen presentations explored perspectives related to the symposium's theme across three sub-topics: (1) Research paradigms, related to AKIS, LLs, and RIs, and shifts in knowledge production associated with agroecology transition, (2) addressing barriers and levers to agroecology transition across Europe's diversity, and (3) linkages between AKIS actors and the role of AKIS in accelerating agroecology transition. These presentations served as the basis for broader group discussions from which key takeaways were distilled.

3. Findings

Based on the symposium's outcomes, we identify four key tensions: (1) the oversimplification of Gliessman's (2016) transition-transformation levels as linear rather than overlapping and fluid categories, (2) the risk of dilution or cooptation of the High Level Panel of Experts (HLPE) agroecology principles, (3) the problematic nature of AKIS as supposedly neutral innovation frameworks, and (4) the structural constraints limiting farmers' agency within LL approaches.

4. Theoretical Implications

We suggest refining conceptualizations and methodological approaches to better account for the complex interplay between knowledge systems, institutional structures, and farmers' innovation capacity in driving agroecology transitions.

4.1 The oversimplification of Gliessman's transition-transformation framework

Gliessman's (2016) agroecology transition-transformation framework provides a ubiquitous structuring framework across disciplines in agroecology research. Yet, tensions exist between the framework's oversimplification and linear presentation and the complexity of dynamic transition processes, and the diverse circumstances of transitions observed in practice (McKay et al., 2025). Gliessman has acknowledged this shortcoming (i.e., it is not a new criticism), yet the tensions persist. Thus, potential refinements to capture non-linearity, multiple entry points, and interconnections between levels might better reflect the complexity of real-world transitions.

Another dimension of this tension is how the framework might better accommodate nested scales with change occurring simultaneously across multiple spatial dimensions (e.g., from farms to foodshed to food system dynamics). Averbuch et al. (2024) suggest that additional levels of structuration might allow for a better understanding of the interplay of actors across scales, for example, distinguishing between meso and macro levels can reveal barriers and enablers from national and supranational (e.g., EU-level) interactions.

Moeller et al. (2023) highlight tensions between focusing on technical practices at lower levels and addressing social, economic, and political dimensions across all levels. They also argue that transitions unfold in multiple dimensions at once with parallel processes at work simultaneously, thus suggesting that Gliessman's framework should reflect the possibility for multiple entry points and transition progressions. Soleto et al. (2024) suggest that understanding where farms fall on a transition continuum is important because different barriers are present at different points along the continuum. Furthermore, engagement strategies might differ depending on what stage of transition an actor is at, with cognitive and conceptual outcomes being more effective for early-stage transitions and actionability and strategic agency enhancement being more effective for later-stage transitions (Leitheiser et al., 2024). These tensions offer opportunities for improving the framework and its utility as a conceptual tool.

4.2 The risk of dilution or cooptation of the HLPE agroecology principles

The 13 HLPE Agroecology principles—often combined with Gliessmann's transition-transformation levels (Wezel et al., 2020)—are also a ubiquitous structuring framework. However, these principles mean “many things to many people”, reflecting a tension between establishing core values while allowing for context-specific interpretations and applications. This flexibility enables adaptation to diverse farming systems and cultural contexts yet also provides opportunities for dilution and cooptation of the principles (Moeller et al., 2023). Historically, the dilution-cooptation tension has been present in agroecology as a movement (LVC, 2015), and our findings suggest that as agroecology enters mainstream policy (Anderson & Maughan, 2021) the tension increases. Further, this tension exists in other alternative agricultural and sustainability frameworks (i.e., greenwashing). Thus, the tension is not unique and follows fears of how radical alternatives are systematically diluted when they gain institutional recognition. As one way to combat this, Moeller et al. (2023) suggest using “red flags” to identify when adaptation of a principle becomes cooptation or dilution. These red flags aim to ensure that the core values of agroecology are not compromised, thus diminishing the risk of dilution. Other research in sustainable urban transformations has shown that reflexive governance and multi-actor collaborations can help institutionalize radical approaches without losing their transformative potential (de Geus et al., 2024), thus providing potential opportunities for agroecology to navigate this tension through reflexive governance mechanisms.

4.3 AKIS as supposedly neutral innovation frameworks

Our results suggest a tension between AKIS as neutral knowledge infrastructures (EIP-AGRI, 2022) and functioning as a politically and culturally embedded process (Knierim et al., 2015). AKIS actors operate within political, economic, cultural, and ecological contexts that shape knowledge priorities and flows (ibid). The interaction between different agricultural worldviews creates a dynamic space where perspectives compete for legitimacy, resources, and influence (Anderson & Sumberg, 2017). One way this tension manifests is in the evolving role of farm advisors, who navigate between working with farmers and engaging with regulatory services (Blix Germundsson & Bååth, 2024), and in shifts from public to private advisory services (Vlahos & Koutsouris, 2024). This tension also appears in discussions of

broader networks including education, research, input suppliers, farmer organizations, and policymakers (Sutherland et al., 2023). This expanded view creates a tension between simplified models of knowledge transfer and what is happening on the ground and highlights a tension between bottom-up and top-down knowledge flows, which underscores the need for a multi-level AKIS model to understand local and regional dynamics of AKIS and has given rise to concepts like microAKIS that elevate farmer-centered knowledge systems (Vlahos & Koutsouris, 2024; Zerbian et al., 2024). At the same time, Knierim (2024) questions the utility and legitimacy of the microAKIS concept, further illustrating the tension in AKIS conceptualizations. These tensions invite the reconceptualization of AKIS as explicitly political and adaptive, acknowledging that knowledge is contested, evolving, and contextual (Anderson & Sumberg, 2017). This tension between knowledge structures and embedded political realities creates space for more nuanced understandings of knowledge dynamics in agroecology transitions.

4.4 Structural constraints limiting farmers' agency within LL approaches

LLs exist at the intersection of participatory ideals and structural realities that dictate the political, economic, and social contexts within which they operate and that shape their implementations and outcomes (McPhee et al., 2021). Therefore, LLs might be constrained by deeper systemic issues related to power, economics, knowledge hierarchies (or knowledge production more broadly), and other institutional frameworks. A tension that might arise due to these systemic issues is power dynamics between farmers and other LL participants. One potential challenge is the continued existence of knowledge hierarchies despite participatory intentions or difficulties linking traditional and scientific knowledge (Cruz et al, 2024). Another challenge could be navigating shifting roles, e.g., of researchers who often become facilitators (McPhee, 2024). As agriculture becomes more digitized, the question of data ownership also arises (Lahnamäki-Kivelä & Karikallio, 2024).

Structural realities also create tensions between farmers' formal participation and actual agency, where structural constraints mean farmers often have less agency than assumed (Thorsøe et al., 2024). This suggests a need to expand the focus of LLs to address these structural dynamics and constraints (ibid), and to consider how to scale successful local initiatives to regional, national, or EU levels to achieve widespread change (Dalgaard et al, 2024), as LLs' transformative potential is scalar dependent (Thorsøe et al., 2024).

Finally, LLs (and co-creation by proxy) in the present policy environment tend to be perceived as a panacea solution that will solve all our problems. This creates a tension between idealized visions of LLs as comprehensive solutions to all food system challenges and the practical challenges they face, requiring movement beyond utopian conceptions (Lagneaux et al, 2024). Identifying these practical challenges enables their management and reveals leverage points for overcoming barriers (Kozar et al, 2024).

5. Practical Implications

Our explorations of conceptual-mythological tensions related to shifts in knowledge production to achieve agroecology transitions suggest that these tensions have direct implications for policy interventions, which can be misguided if they fail to account for these complexities. Clarity at conceptual and methodological levels is essential for real-world implementation. For instance, as MCPhee (2024) has pointed out, an early challenge to implementing LLs in Canada was that actors lacked knowledge for implementation, even though they supported the idea. Recognizing the explanatory limitations of agroecology transition concepts can lead to more precise political and scientific discourse, which reduces potential misconceptions in innovation and transition processes (Knierim, 2024). Thus, by addressing these tensions explicitly, we can develop more effective approaches to support

agroecology transitions that account for complexity, power dynamics, place specificity, and multiple change pathways.

6. References

- Anderson, C.R., & Maughan, C. (2021). "The Innovation Imperative": The Struggle Over Agroecology in the International Food Policy Arena. *Front. Sustain. Food Syst.*, 5. doi: 10.3389/fsufs.2021.619185
- Anderson, J.A., & Sumberg, J. (2017). Knowledge Politics in Development-Oriented Agronomy. In J. Sumberg (Ed.), *Agronomy for Development: The Politics of Knowledge in Agricultural Research* (1st ed.). Routledge.
- Averbuch, B., et al. (2024, Nov 20-21). Addressing the heterogeneity of perceptions of living labs in relation to agroecology transition across Europe. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition*. Brussels, Belgium.
- Blix Germundsson, L. & Bååth, J. (2024, Nov 20-21). An AKIS perspective on authorities' regulation of agriculture: Insights from a better-regulations project. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition*. Brussels, Belgium.
- Cruz, J.C., Bertuglia, A., Sabán, C., & Saradi, S. (2024, Nov 20-21). Knowledge, communication, and change: three AKIS stages to foster the agroecology transition. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition*. Brussels, Belgium.
- Dalgaard, T., Accatino, F., Pfeifer, C., Sterly, S., Pabst, H., et al. (2024, Nov 20-21). Potentials and barriers for more Mixed Farming and Agroforestry Systems—shifts needed in knowledge production for agroecology transition in Europe. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition*. Brussels, Belgium.
- de Geus, T., Wittmayer, J.M. & Silvestri, G. A balancing act: radicality and capture in institutionalising reflexive governance for urban sustainability transitions. *Urban Transform* 6(2) (2024). <https://doi.org/10.1186/s42854-023-00061-z>
- EIP-AGRI. (2022). *Agricultural Knowledge and Innovation Systems (AKIS): Boosting innovation and knowledge flows across Europe*. https://eu-cap-network.ec.europa.eu/publications/eip-agri-brochure-agricultural-knowledge-and-innovation-systems-boosting-innovation_en
- EC (European Commission). (2019). European R&I partnership on agroecology living labs and research infrastructures. *Agriculture, forestry and rural areas*. https://research-and-innovation.ec.europa.eu/research-area/agriculture-forestry-and-rural-areas/ecological-approaches-and-organic-farming/partnership-agroecology_en
- Gliessman, S. (2016). Transforming food systems with agroecology. *Agroecol. Sustain. Food Syst.*, 40(3), 187–189. <https://doi.org/10.1080/21683565.2015.1130765>
- Knierim, A. (2024). Why use the microAKIS concept? *J Agri Edu Ext*, 1–12. <https://doi.org/10.1080/1389224X.2024.2402307>
- Knierim, A., Boenning, K., Caggiano, M., Cristóvão, A., Dirimanova, V., Koehnen, T., Labarthe, P. & Prager, K. (2015). The AKIS concept and its relevance in selected EU member states. *Outlook Agr*, 44(1), 29-36.
- Kozar, R., Stone, T.F., Klemm, T., Dean, G., Csonka, V., et al. (2024, Nov 20-21). Doing co-creation for transformative change. What are the implications for an agroecological living lab approach? A systematic review. *European Partnership AGROECOLOGY Symposium:*

- Exploring methods for researching shifts in knowledge production for agroecology transition.* Brussels, Belgium.
- Lagneaux, S., Tosar, V., Fockedey, A., Mathot, M., & Stilmant, D. (2024, Nov 20-21). Data sharing on Living labs enhancing agriculture's transition. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition.* Brussels, Belgium.
- Lahnamäki-Kivelä, S., & Karikallio, H. (2024, Nov 20-21). Three projects to improve transdisciplinarity and the co-construction of knowledge into the agro-ecological transition. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition.* Brussels, Belgium.
- Leitheiser, S., Rossing, W., van Dam, D., Egmond, J., Hauggard-Nielsen, H., Kazakova, Y., Soto, R.L., Dumont, B., Barlagne, C., Schaen, L., Duval, J., Klötzli, J., et al. (2024, Nov 20-21). How can actionable knowledge co-production contribute to agroecological transformation? A middle-range evaluation model to support transformative learning in mission-oriented science-society collaborations. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition.* Brussels, Belgium.
- LVC (La Vía Campesina). (2015, Mar 4). *Declaration of the International Forum for Agroecology.* <https://viacampesina.org/en/2015/03/declaration-of-the-international-forum-for-agroecology-mali-2015/> (accessed May 14, 2025).
- McPhee, C. (2024, Nov 20-21). Researching Participant Experiences: Lessons from Agriculture and Agri-Food Canada's Network of Agroecosystem Living Labs. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition.* Brussels, Belgium.
- McPhee, C., Bancarz, M., Mambrini-Doudet, M., Chrétien, F., Huyghe, C., & Gracia-Garza, J. (2021). The Defining Characteristics of Agroecosystem Living Labs. *Sustainability*, 13(4), 1718. <https://doi.org/10.3390/su13041718>
- McKay, B.M., Nehring, R., & Catacora-Vargas, G. (2025). The political economy of agroecological transitions: key analytical dimensions. *J Peasant Stud*, 52(3), 461-484 DOI: 10.1080/03066150.2024.2399138
- Moeller, N.I., Geck, M., Anderson, C., Barahona, C., Broudic, C., Cluset, R., Henriques, G., Leippert, F., Mills, D., Minhaj, A., Muetting-van Loon, A., de Raveschoot, S.P., & Frison, E. (2023). Measuring agroecology: Introducing a methodological framework and a community of practice approach. *Elementa-Sci Anthropol*, 11(1) <https://doi.org/10.1525/elementa.2023.00042>
- Soletto, P.F., Gutiérrez-Briceño, I., Márquez-Barrenechea, A., Pérez-Ramírez, I., Yacamán Ochoa, C., Lucantoni, D., Vizuete, B., Hevia, V., González, J.A., Schwarz, G., & García-Llorente, M. (2024, Nov 20-21). Identifying and addressing farmers' perceived barriers for the agroecological transition in the Madrid region. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition.* Brussels, Belgium.
- Sutherland, L.A., Adamsone-Fiskovica, A., Elzen, B., Koutsouris, A., Laurent, C., Stræte E.P., & Labarthe, P. (2023). Advancing AKIS with assemblage thinking. *J Rural Stud*, 97(2023), 57-69. DOI: 10.1016/j.jrurstud.2022.11.005
- Thorsøe, M.H., Stone, T.F., & Berg, T.R. (2024, Nov 20-21). Limits to Living Labs: Conditions for adopting sustainable soil management by strategic decision-support. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition.* Brussels, Belgium.

-
- Vlahos, G., & Koutsouris, A. (2024, Nov 20-21). The role of farm advisors in agroecological AKIS. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition*. Brussels, Belgium.
- Wezel, A., Herren, B.G., Kerr, R.B. et al. (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. *Agron Sustain Dev*, 40(40). <https://doi.org/10.1007/s13593-020-00646-z>
- Zerbian, T., & López-Garcia, D. (2024, Nov 20-21). Exploring multilevel and territorial dynamics of AKIS through a mixed-methods approach based on social network analysis. *European Partnership AGROECOLOGY Symposium: Exploring methods for researching shifts in knowledge production for agroecology transition*. Brussels, Belgium.
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Supporting farmers as a structuring activity for an organization: The case of multi-stakeholder cooperatives in France

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Short abstract

Multi-stakeholder cooperatives are original and innovative forms of cooperative that aim to bring together different categories of actors in support of a common project of collective interest, often localized. In France, they are developing under the SCIC status (Société Coopérative d'Intérêt Collectif). We are part of a group of researchers of the SCIC-AGRI research project, in partnership with five agri-food SCICs. We'd like to explore the concrete forms of support developed by SCICs, paying particular attention to how they differ from traditional models. Based on an in-depth qualitative survey, we present here a case study focusing on support projects for setting up in agriculture in two of the five SCICs studied, in order to explore the different facets of the support they offer. This research contributes to a reflection on the renewal of entrepreneurial support practices centered on collective learning, the co-construction of knowledge and the recognition of invisible work in the peer support process. This study is showing that peer accompaniment goes beyond the simple transmission of experience. It is a lever for the co-construction of knowledge, mutual legitimization and professional socialization that integrates plural functions (technical, emotional, cooperative).

1. Research objective

Multi-stakeholder cooperatives are original and innovative forms of cooperative that aim to bring together different categories of actors in support of a common project of collective interest, often localized. They seek to meet social utility needs by exploring new forms of governance and offering services tailored to specific needs. In France, they are developing under the SCIC status (Société Coopérative d'Intérêt Collectif), created in 2001. In the agricultural and agri-food sectors, they are proposing innovations targeting territorial transformations in three key areas: collective ownership and support for planning farm; reterritorialization of food distribution; and diversification of agricultural activities (Suarez et al., 2022).

We are part of a group of researchers working on a research project called SCIC-AGRI, in partnership with five agri-food SCICs, which is taking an in-depth look at how they operate, both internally and in their relations with local actors and the agricultural sector, in order to understand their role in transitions. In this paper, we seek to better understand why and how these SCICs are redefining work and agri-food entrepreneurship. We propose to open the black box of these organizations by analyzing the activities proposed by SCICs. Both their contours and their dynamics remain difficult to characterize, given their organizational complexity and the rapid transformations they are undergoing. Among these activities, support occupies an important, if not primordial, place, whether it's for people trying out agricultural activities, municipalities intending to set up an agricultural project on their territory, farms wishing to form a collective, local grocery stores, etc.

Entrepreneurship literature has highlighted the diversity of existing forms of support, from top-down advice to peer-to-peer exchange practices (Paul, 2004; Jaouen *et al.*, 2006; Chabaud, *et al.*, 2010; Fabbri and Charue-Duboc, 2013). This diversity can be seen as a means of fostering collective learning in the service of entrepreneurial projects and ensuring greater resilience in the face of risk. Support for SCICs is most often based on a model founded on popular education and a learner-centered conception of training, where "*the adult trainee is the subject of his or her story and the primary actor in his or her training in a positive interdependence with others (peers in his or her group and trainers)*" (Parodi, 2018, p. 103).

The diversity of their stakeholders and multi-partnership accentuate the difficulties involved in deploying support, and confront SCICs with the challenge of testing a constantly evolving collective mechanism. This study examines how agri-food SCICs are redefining forms of entrepreneurial support, through collective, territorialized and cooperative practices. We focus here on support activities and the people who deploy them, seen as agents of change (Cerf *et al.*, 2011).

In this paper, we'd like to explore the concrete forms of support developed by SCICs, paying particular attention to how they differ from traditional models. How is support implemented, and what does it produce for actors and organizations? Based on an in-depth qualitative survey of two SCIC partners in our research project, we have attempted to provide some answers to these questions. By highlighting practices based on the co-construction of knowledge, co-accompaniment by peers and the pooling of resources, they are participating in the transformation of agricultural entrepreneurial dynamics, work collectives, and the agroecological transition (Coquil *et al.*, 2018). In so doing, we propose to contribute to the renewal of theoretical frameworks for entrepreneurial peer accompaniment and to a better understanding of the role of these organizations in agricultural transitions.

2. Research methodology

As part of the SCIC-AGRI project, we have conducted over a hundred interviews and organized several interventions with the five SCIC partners over the past three years. These semi-structured interviews, lasting between 45 minutes and 2 hours 45 minutes, were conducted with the different types of SCIC members. They were designed on the basis of an interview guide common to all the SCICs surveyed and focused on major themes: work, governance, the business model, the territory, public actions and environmental sustainability. These interviews were supplemented by on-site observations during events organized by the SCICs (General Assemblies, working groups, anniversaries of the structure, annual festive gatherings, etc.) as well as access to the structures internal documentation. Finally, we had regular exchanges with SCIC managers as part of the program's co-piloting meetings. This rich material gives us an overall view of entrepreneurial practices and work

organization. We present here a case study focusing on support projects for setting up in agriculture in two of the five SCICs studied, in order to explore the different facets of the support they offer.

Table 1: Presentation of the two cases: Le 100e Singe and Les Fermes Partagées (FEP)

Name of SCIC	Overall aim	SCIC project studied here	Creation date	Activities	Type of member
Le 100e Singe	Third place and agricultural test space	Enable people undergoing retraining to test their farming project for 3 years, with a view to setting up in business.	2018	Support, legal and social hosting of the business, provision of work resources (land, equipment, workspace, fablab, etc.), support by peasant-tutors and networking.	Affiliated structures (cooperative and association created by the Scic); partner farms, local authorities, employees, project leaders, partners, citizens and users of the site.
Les Fermes Partagées (FEP)	Grouping of collective farms	Encouraging the development of collective farms	2020	Pooling of resources and risk sharing, appropriate legal structures, development of the cooperative network, long-term support	Farms, salaried entrepreneurs, employees; strategic partners; technical partners; supporters; local authorities

3. Support systems for the co-construction of knowledge and cooperative life

In the case of FEP, the SCIC offers long-term support for collective and cooperative farm projects in the Auvergne-Rhône-Alpes region. It provides support for the development of the overall strategy (management tools, assistance in monitoring activities, accounting, taxation, administration, IT) as well as help in organizing the collective. To this end, it mobilizes collective intelligence tools and methods, and third-party mediators, to address specific human and relational issues. It provides pre-creation start-up support, including impact studies on the use of cooperative statutes or feasibility studies for collective projects (economic forecasts, business plans, organizational and relational foundations, etc.). It also provides support for established farms, at particular times, such as when a crisis or difficulty is encountered by a collective, or even when an activity or project comes to a halt. FEP's support is designed to meet the needs of farmers' collectives. It does not provide all the support skills required (in particular, it is not competent in technical matters), but acts as an intermediary, directing and guiding associate farms towards the appropriate actors.

Supporting several collective farms enables the SCIC to facilitate links and exchanges of experience between member farms and between farms and agricultural support structures. This helps to create a network of mutual aid and sharing of common problems, notably through co-accompaniment, carried out jointly by a salaried facilitator and a peasant. The peasant's point of view enriches the employee's accompaniment, complementing it with real-life experiences; it can also provide more technical advice that the employee is not in a position to offer. Farm visits complete the support and anchor it in an *in-situ* immersion approach. The farms thus become learning farms, giving a new dimension and role to the associated farms, fully in line with FEP's political project, its capitalization and horizontal deployment. The system is built up gradually, according to the interest and availability of peasants wishing to get involved in the support. It is also a complementary way of remunerating FEP peasants, within the framework of a multi-activity scheme. In a reciprocal way, this scheme also enables peasants to gain a better understanding of the support profession, its problems and difficulties. Certain situations of tension within the SCIC have

been resolved thanks to a better mutual understanding of each other's professions.

As for Le 100e Singe, it offers people the chance to test an agroecological plant production activity on pre-selected and equipped test sites. Its main site, which is also a third-place, has a few hectares available as test sites, but it favors archipelago development in the suburbs around Toulouse by identifying actors who would be interested in making land available as test areas. These include local authorities with communal land, peasant farms wishing to contribute to the renewal of farming generations, or who are testing the association or collaboration on their farm, and other SSE structures (such as Jardins de Cocagne). Two principles have been established for hosting test sites. Firstly, the site must be equipped (equipment, access to water, etc.) so that the person testing the activity doesn't have to make any material investment; and secondly, there must be at least one person present on site to respond to the testers' requests on a day-to-day basis. These people are known as "hosts".

Support takes many forms. Firstly, there is formal support for administrative, social and accounting aspects, provided by SCIC employees. This is followed by entrepreneurial support, which has historically been provided by a SCIC employee and focuses more on project management than technical support. To reinforce agronomic technical support, Le 100e Singe now offers co-supervision with a peasant tutor who can contribute his or her technical expertise to support the farmers' activity (economic model) and encourage peer-to-peer transfer. The salaried accompanier provides additional support for project management, also on a peer-to-peer basis. Lastly, group training sessions are organized on topics relevant to the test persons. This is an opportunity to call on actors in the agricultural field, and also enables test persons to exchange ideas with each other, given that they are not physically on the same premises. In addition, there is a great deal of malleability between the roles of support person and supported person, insofar as a person can take on several roles in the course of his or her career. This is the case, for example, of a person who has been successively in a business test, then a salaried employee, and who has now set up as a farmer and paid peasant tutor. This malleability of postures is seen as an asset, as it reinforces learning and is one of the possibilities offered by the cooperative: a multitude and diversity of possible forms at the service of the same mission. Constantly striving for improvement over the last few years, but also dependent on changes in the human resources available, the SCIC is testing to find the forms of support best suited to its project and the needs of its beneficiaries.

Following the example of the alternative model of entrepreneurial support based on collective learning and collaboration between peers proposed by Fabri and Charue-Duboc (2013), we note that the SCICs studied are developing varied forms of support that turn traditional entrepreneurial support on its head, from the expert to the novice, and from the technician to the project owner. Indeed, there is no single prescriber here, but rather shifting collectives made up of a variety of players providing technical, strategic, legal, etc. support, who sometimes take on the role of supported, sometimes that of accompanying. In this way, the support team does not have all the skills, and the co-accompaniment provided by the farmer/employee pair enables the SCIC to offer a range of complementary experiences. Considered a genuine skill, the time spent by the farmers on accompaniment is also financially rewarded. Although this valuation raises a number of questions concerning the methods of remuneration and the robustness of the business model of the employing SCIC, it enables the accompanying farmers to diversify their sources of income. What's more, the support provided is linked to the SCIC's overall project, and emphasizes the importance of

horizontal governance and the animation of cooperative life, thus reinforcing the acquisition of management, animation and collective decision-making skills. Last but not least, the provision of resources (land, equipment and infrastructure) to the people supported helps to secure their projects by sharing risks and offering a collective framework to combat isolation.

Fabri and Charue-Duboc (2013) propose to distinguish between individual learning through a combination of action and reflection, and collective learning through co-construction with peers. They note that this co-construction by peers is part of a collective relationship where the roles of accompanier and companion can be exchanged, thus going beyond the interpersonal relationship. This dual situation is found both in the case of people who are accompanied and then become accompaniers, and in moments of exchange when a person can be both accompanier and accompanied. If we can observe this result in our case studies, it seems interesting to us to qualify the different forms and contributions of accompaniment for people wishing to set up on the one hand, and for the SCIC as a whole on the other. Indeed, as a structure associating different categories of associates, the SCIC must be able to organize its activity beyond the perspective of a learning collective.

Table 2 highlights the different forms and contributions of support for the people supported, on the one hand, and for the SCIC itself, on the other.

Table 2: Forms and contributions of support in the SCICs studied

Forms of support	Benefits for supported persons	Contributions to the SCIC
Co-construction of knowledge made possible by the malleability of postures	Creating a network for mutual support and sharing Recognition of experiential knowledge	Strengthening the collective, contributing to the resilience of the joint project
Co-supervision by an employee and a peasant tutor	Exchanges of experience that strengthen interpersonal bonds Peer peasants can be paid	Building trust through a better understanding of each other's businesses Strengthening commitment to SCIC
Promoting cooperative life	Increased skills in management, leadership and collective decision-making	Greater involvement in the structure's governance bodies, strengthening participatory democracy
Pooling resources on farms	Reducing or limiting initial investments	Improved quality of support services Securing project holders within a collective framework

4. Practical implications of the results

This research contributes to a reflection on the renewal of entrepreneurial support practices centered on collective learning, the co-construction of knowledge and the recognition of invisible work in the peer support process. It also shows that support in this kind of structure is not just about the business itself, but also about learning and implementing inclusive projects open to cooperation (shared governance, collective leadership, actor networking). In addition, we have found that pooling resources during the business start-up or test phase strengthens the resilience of agricultural project holders. Finally, our study may provide food for thought on the support that public

authorities could provide for training in alternative support systems such as co-accompaniment.

5. Theoretical implications and research prospects

The wide variety of forms of support offered by SCICs invites us to take a fresh look at support, by placing the supported-supporting relationship at the heart of SCIC operations. While this relationship is highly diverse in nature, what appears to be specific is that the boundary between the companion and the supported is tenuous. This malleability can be seen as a means of fostering collective learning at the service of the project. It is further reinforced by the career paths of people who were initially supported to test their farming activity. Some were able to branch out into salaried support activities within the SCIC. Others have set up as peasants, but remain members of the SCIC and can offer a support activity. The fact that she is based on multi-partnership seems to favor these career paths within the SCIC, as corroborated by what we also observed in another SCIC studied with several hundred member-persons.

This study enriches the work of Fabri and Charue-Duboc (2013) on alternative accompaniment models, by showing that peer accompaniment goes beyond the simple transmission of experience. It is a lever for the co-construction of knowledge, mutual legitimization and professional socialization that integrates plural functions (technical, emotional, cooperative). Moreover, the SCIC is not limited to peer support; it organizes a genuine strategic activity enabling peasants to invest in cooperative life and establish a work collective. This raises theoretical questions: how does shared governance influence forms of support? What tensions arise between the formalization of the process and the spontaneity of peer support dynamics? How can the time devoted to peer support be measured and taken into account when it is not always formalized?

Lastly, although not yet explored in this paper, accompaniment can sometimes lead to the perception of a lack of legitimacy in its posture for both employees and farmers. This raises the question of training for peer coaches: what programs and mechanisms could encourage and facilitate the development of this type of coaching, and give peer coaches a sense of security?

6. References

- Cerf, M., Guillot, M. N., & Olry, P. (2011). Acting as a change agent in supporting sustainable agriculture: how to cope with new professional situations? *Journal of Agricultural Education and Extension*, 17(1), 7-19.
- Chabaud, D., Messeghem, K., & Sammut, S. (2010). Vers de nouvelles formes d'accompagnement, *Revue de l'Entrepreneuriat*, 2010/2, 9, 1-5.
- Coquil, X., Cerf, M., Auricoste, C., Joannon, A., Barcellini, F., Cayre, P., ... & Prost, L. (2018). Questioning the work of farmers, advisors, teachers and researchers in agro-ecological transition. A review. *Agronomy for Sustainable Development*, 38, 1-12.
- Fabbri, J. & Charue-Duboc, F. (2013). An entrepreneurial coaching model based on apprenticeships within an entrepreneurial collective: the case of La Ruche. *Management international*, 17(3), 86-99.
- Jaouen, A., Loup, S., & Sammut, S. (2006). L'accompagnement par les pairs, confiance partagée et résilience, *Revue de l'entrepreneuriat*, 5(1), 59-72.

-
- Parodi, M. (2018). From the legacy of Henri Desroche to the know-how of Cooperative Colleges. *RECMA*, 348, 98-111.
- Paul, M. (2004). *L'accompagnement : une posture professionnelle spécifique*. L'harmattan.
- Suarez, N., Triboulet, P., Arnaud, C., & Terrisse, P. C. (2022). Scic responses to emerging agricultural issues: panorama and dynamics. *RECMA*, 363, 64-82.
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Levers and limits for agricultural collectives under Geographical Indication to take action in transitions. Six case studies from the French cheese sector within the ADAOPT project

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Short abstract

This paper examines how six French Geographical Indication (GI) cheese sectors navigated climate change adaptation during the ADAOPT project. Using participatory tools such as farmer training, serious games, technical inputs, participatory design and peer-to-peer learning, the project aimed to foster collective strategies for sustainable transitions. First, a trajectory analysis of the six GIs within the project was conducted to systematically and temporally understand their evolution. Second, a cross-analysis of six professional practice assessment sessions was carried out with GI facilitators to gain deeper insights into the challenges they faced. Despite diverse methodologies, significant challenges arose, including top-down governance, sectoral fragmentation and over-solicitation of actors and facilitators.

To overcome these barriers, the project identifies several solutions. Systemic approaches that frame transitions within a broader strategy rather than isolated technical fixes foster engagement and long-term planning. Territorial multi-stakeholder partnerships enhance innovation capacity. The use of serious games and participatory foresight tools, facilitates dialogue, strategic thinking, and commitment among diverse actors. Adaptive governance models that introduce more inclusive and decentralized decision-making structures improve responsiveness and implementation.

The paper offers practical insights into enhancing collective action within GI systems, contributing to broader theoretical discussions on AKIS, participatory processes, and adaptive governance for sustainable agri-food transitions.

Keywords | Multi-actor processes, capacity development, serious games, participatory approach, Geographical Indication, adaptive governance.

1. Purpose

This paper explores the dynamics of six French cheese GI sector as they navigate transition challenges during the ADAOPT project: Picodon PDO, Valençay (PDO) Camembert de

Normandie PDO, Laguiole PDO, Mont d'Or (PDO) and Tomme de Savoie (PGI). It details the approaches employed, the tools mobilized—including participatory design, farmer training, serious games, technical inputs, and peer-to-peer learning—and the results achieved. Furthermore, it analyses the limits encountered and highlights key solutions to enhance collective mobilisation and action and insights for Agricultural Knowledge Innovation Systems (AKIS)

Geographical Indication (GI) systems combine local governance, heritage, and place-based production rules. One of their strengths is that they combine different actors from the food chain who have worked together for many years, developed collective learning and combined their efforts. Compared to the mainstream food chains, they have a unique opportunity to work collectively for meaningful adaptation (Dernat et al., 2022a). However, these characteristics also limit action, especially when governance structures are less flexible, actor coordination is complex, and resources are scarce (Belmin, Casabianca, 2018). In this context, collective learning and innovation are crucial for sustainable agricultural transitions (Lema et al, 2021; Scotti et al., 2023). It is particularly important in GI sectors where historical governance structures could create inertia (Dernat et al., 2022b).

2. Design

In the project, each territory defined its own process, based on its institutional culture, resources, and strategic priorities. In Camembert de Normandie, the work began with a technical group and evolved toward strategic scenarios debated in the general assembly, whereas in Valençay the reflexion was confined in a small working group composed of different sectorial actors. In Laguiole, a collective of 20 producers formed a GIEE (Economic and Environmental Interest Grouping) and worked on technical issues. Mont d'Or prioritized issues like forage autonomy or water access, to work on technical and local solutions. Picodon and Tomme de Savoie adopted an approach aimed at global understanding, considering climate change as one issue among others.

The tools used were deliberately diverse: Serious games like *La Grange* (Dernat et al. 2023) and *Lauracle* were used to open up systemic dialogue in territories (Picodon, Mont d'Or, Tomme de Savoie). On-farm training and expert-led workshops allowed for grounded discussions on agronomy, pasture resilience, and water management (Camembert de Normandie, Laguiole, Mont d'Or). Simulations helped actors weigh the economic implications of proposed technical changes (Valençay). Surveys and scenario-based inquiries were extended to a wide range of stakeholders, including consumers, to gauge expectations and acceptability of certain adaptation levers (Picodon, Camembert de Normandie, Tomme de Savoie). All activities aimed to foster collective visioning and to equip local actors with both the confidence and knowledge to initiate change.

To understand collective dynamics, the analysis methodology consisted of two complementary approaches. First, a trajectory analysis (inspired by Polge et Pagès, 2022) of the six GIs within the project was conducted to systematically and temporally understand their evolution. Second, a cross-analysis of five co-development sessions (Payette & Champagne, 1997) carried out with GI facilitators at the end of the project to gain deeper insights into the challenges they faced.

3. Findings

We present here the main findings from cross-analysis of the data from the two collection methods.

3.1 Main difficulties encountered

The project demonstrates the complexity of mobilizing GI actors despite diverse participatory methodologies like in other publications (Berthet et al., 2018; Slimi et al., 2021).

Governance challenges arise due to traditional top-down structures that often delegate decision-making to non-representative working groups, which limits collective buy-in. For instance, three GIs set up local working groups to anchor reflection in territory-specific challenges, but their representativeness and decisional power remained limited. Although these groups led to valuable insights and proposals, it was not easy to communicate them to the decision-making bodies which are responsible for the strategic decisions and even less to the broader group of producers and processors who would be the ones who would implement change.

Sectoral fragmentation is another obstacle. Most transition levers focus on the production level for two main reasons i) farm level is the level which climate change is impacting the most and ii) political and economic constraints hinder broader sector-wide engagement. Adaptation options (like reduced herd size or lower milk production in summer) can be limited by the power imbalance with processors and by previous strategic decisions of the GI (like increased volumes).

Over-solicitation of actors also plays a role, as multiple parallel initiatives create a sense of overload, reducing the effectiveness of collective action. In many GIs, actors reported saturation due to overlapping agendas from various projects, which blurred the message and reduced engagement, despite strong initial mobilization. In particular, the process of reopening specifications is often long and demanding in terms of mobilising groups and can lead to stakeholder fatigue.

Additionally, GI facilitators face a heavy workload and a wide range of responsibilities, making it difficult for them to dedicate sufficient time and energy to fostering collective mobilization. Small GIs lacked the internal resources to maintain long-term engagement, especially when confronted with multiple demands from overlapping projects or institutional calls. In another GI, a lack of consistent territorial animation led to loss of momentum between working group sessions, despite a high level of participant motivation and technical interest.

3.2 Identified solutions

To overcome these barriers, the project identified several solutions.

Systemic approaches that frame transitions within a broader sectoral strategy rather than isolated technical fixes foster engagement and long-term planning. In some cases, the work within the Adaopt project has been conducted in parallel to discussions for the revision of the PDO specifications which are in essence systemic and long-term. It is the case for example in the Camembert de Normandie where there was also a dialog with the 3 other PDOs of the region.

The use of serious games and participatory foresight tools, such as La Grange (Dernat et al., 2023), facilitates dialogue, strategic thinking, and commitment among diverse actors. This tool was used in Picodon and Tomme de Savoie to stimulate systemic reflection beyond immediate technical fixes, notably around cheese consumption, water resources, and availability of workforce.

Territorial multi-stakeholder partnerships that engage extension services, cooperatives, and research institutions enhance innovation capacity. The Laguiole case is emblematic, where a GIEE was formed to coordinate field trials, training, and diagnostics on sustainable practices, combining local cooperative leadership with expert input and farmer-driven governance.

Adaptive governance models that introduce more inclusive and decentralized decision-making structures improve responsiveness and implementation. Some territories, like Laguiole and Picodon, experimented with clearer mandates for their working groups, which facilitated continuity, clarity, and ownership of the transition strategy. The involvement of field actors in the reflexion and decision process is also very valuable. When the process began with a concrete problem—such as water shortages in Picodon or degraded pastures in Laguiole—producers felt directly concerned and became involved. Smaller working groups with clear mandates and autonomy, like the four-person “water group” in Picodon, showed a remarkable capacity for sustained collaboration.

4. Practical Implications

The ADAoPT project provides a series of insights for those seeking to support sustainable transitions within GI sectors and improve AKIS.

Designing adaptive support systems for collective action

The study highlights the need for flexible and context-specific facilitation strategies to mobilize Geographical Indication (GI) actors. It shows that the effectiveness of collective action depends not only on participatory tools but also on governance legitimacy, local anchoring, and realistic timeframes. For instance, structuring working groups with clear mandates (e.g., Laguiole or Picodon) and ensuring articulation with decision-making bodies (e.g., Camembert de Normandie) were critical to progress towards action.

Leveraging systemic and multi-scale approaches

Many actions were effective at a local level—particularly when focused on concrete technical issues—but these need to be linked with more strategic reflections to ensure coherence and long-term orientation. The results suggest that framing climate adaptation as part of a broader, systemic transformation—encompassing biodiversity, farm succession, and value chain coordination—enhances engagement. Serious games and integrated foresight tools help stakeholders to step back, rethink value chains, and co-develop long-term trajectories.

Enhancing knowledge circulation

Local press coverage, newsletters, and stakeholder meetings helped reinforce the visibility and legitimacy of the work, especially when accompanied by practical outputs such as technical factsheets. Knowledge circulation can be enhanced by including local advisors, technicians and vets in the work so that they also will act as relay in their daily work where they are in contact with many farmers.

Providing long term human support

Collective action requires time, clarity, and continuity. Facilitators must be equipped and supported over several years, not months. The most effective collectives in the project were those with clearly identified facilitators, supported by external partners and, where possible, young professionals or trainees to assist in implementation.

5. Theoretical Implications

Reinforcing participatory innovation frameworks in territorially-embedded food systems

The study reinforces the idea that participatory approaches must be deeply embedded in territorial dynamics and actor configurations. It confirms and extends work on the limits of

classical top-down governance in collective innovation (Slimi et al., 2021), showing that decision legitimacy is essential for participatory methods to lead to systemic change.

Operationalizing adaptive governance in agri-food transitions

The project also suggests that reflexive governance—where institutional actors remain open to feedback from the field, and where technical groups can shape strategy—is key to maintaining legitimacy. Moreover, the work shows that transitions require not only innovations in practices or tools, but also in roles and responsibilities.

6. References

- Belmin, R., Casabianca, F. (2018). The key role of Geographical Indications in the governance of 'terroir niches'. Insights from three Corsican case studies. 13. *European IFSA Symposium. Farming systems: facing uncertainties and enhancing opportunities*, IFSA, International Farming Systems Association, Autriche., Chania, Greece. hal-02734501
- Berthet, E. T., Hickey, G. M., & Klerkx, L. (2018). Opening design and innovation processes in agriculture: Insights from design and management sciences and future directions. *Agricultural systems*, 165, 111-115. <https://doi.org/10.1016/j.agsy.2018.06.004>
- Dernat, S., Rigolot, C., Vollet, D., Cayre, P., & Dumont, B. (2022a). Knowledge sharing in practice: a game-based methodology to increase farmers' engagement in a common vision for a cheese PDO union. *The Journal of Agricultural Education and Extension*, 28(2), 141-162.
- Dernat, S., Etienne, R., Hostiou, N., Pailleux, J. Y., & Rigolot, C. (2022b). Ex-post consequences of participatory foresight processes in agriculture. How to help dairy farmers to face outcomes of collective decisions planning?. *Frontiers in Sustainable Food Systems*, 6, 776959. <https://doi.org/10.3389/fsufs.2022.776959>
- Dernat, S., Dumont, B., & Vollet, D. (2023). La Grange®: A generic game to reveal trade-offs and synergies among stakeholders in livestock farming areas. *Agricultural Systems*, 209, 103685. <https://doi.org/10.1016/j.agsy.2023.103685>
- Lema, Z., de Bruyn, L. A. L., Marshall, G. R., Roschinsky, R., & Duncan, A. J. (2021). Multilevel innovation platforms for development of smallholder livestock systems: How effective are they?. *Agricultural Systems*, 189, 103047. <https://doi.org/10.1016/j.agsy.2020.103047>
- Payette, A., & Champagne, C. (1997). *Le groupe de codéveloppement professionnel*. PUQ.
- Polge, E., & Pagès, H. (2022). Relational drivers of the agroecological transition: An analysis of farmer trajectories in the Limagne plain, France. *Agricultural Systems*, 200, 103430. <https://doi.org/10.1016/j.agsy.2022.103430>
- Scotti, I., Ievoli, C., Bindi, L., Bispini, S., & Belliggiano, A. (2023). Facing Climate Vulnerability in Mountain Areas: The Role of Rural Actors' Agency and Situated Knowledge Production. *Sustainability*, 15(22), 15877. <https://doi.org/10.3390/su152215877>
- Slimi, C., Prost, M., Cerf, M., & Prost, L. (2021). Exchanges among farmers' collectives in support of sustainable agriculture: From review to reconceptualization. *Journal of Rural Studies*, 83, 268-278. <https://doi.org/10.1016/j.jrurstud.2021.01.019>

A framework for assessing and enabling national agroecology extension systems: approach and results from its application in five West African Countries

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Short abstract

Purpose | To explore conditions for the emergence and sustainability of national agroecology extension systems (NAES), and share the experience of the application of an approach combining multi-criteria assessment and participatory foresight allowing for co-elaboration of transformation pathways of NAES, and cross-country comparability and learning.

Approach | A participatory and iterative process was used to develop the framework for assessing and enabling national agroecology extension systems (FRENAES), an integrated tool relying on collective intelligence of actors and stakeholders of the extension system. On one hand, FRENAES uses semi-quantitative assessment relying on actors-based scores and dialogue to evaluate of state of the national agroecology extension system. On the other hand, it includes participatory foresight to identify and explore transformative actions and tensions related to the systemic change for the emergence and sustainability of national agroecology extension system. The approach was applied in five west African countries: Côte d'Ivoire, Ghana, Guinea Bissau, Nigeria, Senegal.

Findings | The FRENAES has two subcomponents, the first one centered on the assessment through diagnosis and analysis of the system and, the second one on the enabling, consisting in the co-elaboration of solutions and transformation pathways. Overall, its application revealed that the national agroecology extension and advisory systems (NAEAS) are still in their infancy. They are fragile and constrained by the lock-in of the current socio-technical regime, despite growing awareness and interest in agroecology among stakeholders, particularly producers. Agricultural advisory services and other innovation support services

are not yet able to play their part in supporting agroecological transitions. On the enabling side, participatory foresight has shown that the emergence and sustainability of NAEAS go beyond the simple reconfiguration of existing conventional agriculture-based extension and advisory systems. The unlocking and transformation of the socio-technical regime to make it more compatible with an advisory system centered on agroecology is essential. Food transitions and markets, policies and institutions, social movement, paradigm shift and capacity building in extension and advisory services, have emerged as the main levers for this change. Furthermore, the development of NAES require changes in power game between actors of the agrifood system.

Practical and theoretical implications | FRENAES represented a user-friendly participatory and cost-effective solution to identify the alignment and co-elaborate transformation pathways in a participatory and comprehensive way. Therefore, it appears that the latter has the potential to be applied to prioritize capacity development of the AES, guide decision-making process and draw transformation pathways. The existing knowledge gap hindering capacity and the identification of strategic levers to foster the emergence and sustainability of agroecology extension systems can be overcome using a framework integrating diagnosis, analysis and participatory foresight based on experts' and actors' appreciation.

Keywords | Pluralistic extension and advisory systems, sustainable agrifood systems, integrated approach, transformative change, West Africa

Developing a socially distributed knowledge production model for agricultural research and innovation projects

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Short abstract

Integrating knowledge production and skills-building procedures in agricultural research and innovation projects is a good practice and a policy recommendation. In this study, adopting the distinction between "Mode 1" and "Mode 2" knowledge production, we sketch the contour lines of a new model for assisting innovators who participate in research projects to co-create knowledge and skills in innovating. The model developed (Twin Transition Schools) is used as a background for delineating the key features of a new philosophy in agricultural research and innovation projects, which gives prominence to serve societal needs, promotes the collaborative production of contextual knowledge, and facilitates the cultivation of innovation-related skills in real settings. To embrace this philosophy, researchers may need to reconceptualize the meaning of research and innovation, shifting from a *from-lab-to-society* perspective to an approach in which research is mainly executed within social environments, and innovation is practice-driven. Fostering horizontal hierarchies and deploying facilitation competencies are critical factors for ensuring the success of Mode 2

research. Despite the practical difficulties, applying a Mode 2 lens in agricultural research and innovation projects can strengthen innovators' skills, providing, in parallel, spaces for societally validating innovation.

1. Purpose

The relationship between knowledge and innovation is well documented in the literature (Castaneda and Cuellar, 2020). Policies and funding schemes stress the importance of adding a knowledge production component in research and innovation projects. For instance, Horizon Europe, the emblematic scientific initiative of the European Union, emphasizes the need for research projects to support the creation and spreading of knowledge. The Consultative Group on International Agricultural Research also emphasizes the need to promote research-generated knowledge as a mechanism to facilitate and make full use of innovation.

To respond to this requirement, designers of relevant projects often take the convenient path of drawing the desirable innovation trajectory, identifying potential steps in the innovation process, determining the skills that innovators should develop in each step, setting forth knowledge delivery mechanisms to address skills gaps, and monitoring the process. Although this approach is proven efficient for helping innovators acquire skills *for* innovating (skills needed to use the innovation at hand), it might insufficiently assist them in constructing skills *in* innovating (competencies enabling them to embed innovation in their work and social practices and applying it into different contexts). To achieve the latter, there is a need to shift from "one-way" knowledge diffusion strategies to a philosophy promoting a more interactive and multi-actor production of knowledge and collaborative development of skills in authentic settings (Fieldsend et al., 2022).

Such a need is also stressed in Responsible Research and Innovation frameworks, where the emphasis shifts from the development and diffusion of scientific knowledge to the co-production of innovation-related knowledge through the involvement of different actors who operate inside and beyond conventional academic cycles (Owen et al., 2021). Involving innovators – and other societal actors as well – in the process of constructing new knowledge can lead to a new form of science: what some call "citizen science" (Hecker et al., 2018) or what Gibbons (2000) defines as "Mode 2 science," i.e., a form of context-specific research, where society speaks back to science, and, together they co-create socially reliable knowledge.

In the present study, building upon the ideas developed by Gibbons et al. (1994) on the "Mode 1" and "Mode 2" paradigms of knowledge production, we outline a new philosophy for generating contextual and application-oriented agricultural knowledge and skills in the framework of agricultural research and innovation projects. We also highlight the roles that researchers must undertake to support such a new pattern of innovation research.

2. Approach

Using the challenging field of innovating toward twin transitions (simultaneous transitions to a digitalized and more sustainable future) as a background and drawing on the experience of an ongoing research project, we briefly introduce a model (Twin Transition Schools - TTS) for producing socially distributed knowledge and cultivating skills in innovating. Then, we summarize the philosophical and operational principles of such a "Mode 2 research project" and discuss the practical difficulties accompanying its implementation.

3. Findings

The TTS model is grounded on participatory knowledge production, collaborative innovation, and user-centered research approaches. It combines scientific and field-level

knowledge, promoting social and experiential learning that emerges within networks of heterogeneous actors who co-innovate towards sustainability, exploring and exploiting different digital technologies. TTS aim to enhance skills building within problem-based contexts by exploiting transition experiences and merging the different interpretative schemes that dissimilar actors endorse and use. They are formed of farmers, farm advisors, AgTech start-ups, researchers, and academics who engage in twin transition processes. By experimenting with novel digital technologies while following sustainability transition pathways (e.g., converting from conventional farming to agroecology or regenerative agriculture), these actors explore and exploit varying types of innovation (including organizational and business model innovation). Through this procedure, they cooperatively extract meaning from the innovation, translate the transition experience into knowledge, and develop skills in innovating. Hence, knowledge is distributed across the social actors who co-innovate, whereas skills are socially constructed and validated in pragmatic situations. To successfully apply such a model, researchers working on innovation projects should prioritize contextual over expert knowledge, focus on integrative competencies, and create spaces where knowledge production and skills building are controlled and governed by learners. In other words, there is a need to shift from the conventional Mode 1 paradigm - where research governs the innovation process, and skills are developed mainly to support innovation products implementation - to Mode 2, which emphasizes the development of multiple skills (some of which were not pre-defined) during the research and innovation validation process in real settings (Table 1).

Table 1: Differences between Mode 1 and Mode 2 agricultural research and innovation projects

	Mode 1	Mode 2
Main purposes of research and innovation	Serving academic interests	Serving societal interests
Type of research	Purely “scientific” and disciplinary	Application-oriented, context-specific, and trans-disciplinary
Central research philosophy	Research discoveries emerge in controlled settings (e.g., laboratories)	Research is (mainly) executed in authentic settings (e.g., farms)
Ways to validate research findings	Measurements, assessment of cause-effect relationships, predictions	Application in real settings and validation from key actors
Roles of researchers	Organizing the research project, preparing the research instruments, collecting and analyzing data, summarizing the main conclusions	Organizing the research project, selecting the socio-technical context within which the research will take place, preparing the research instruments, collecting and analyzing data by actively participating in the research, validating the results with the actors involved, summarizing the main conclusions
Production of knowledge	Research conclusions are translated into practical knowledge that fills a research gap	Knowledge is produced within the socio-technical context in which it emerges

Such a shift requires a change in the very understanding of the meaning of research on the part of researchers and academics. In the Mode 2 philosophy, a significant part of research happens outside the controlled settings of laboratories and experimental facilities, while innovation is practice-driven and accountable to society. It also necessitates the development of more horizontal hierarchies than those possibly followed in Mode 1 scientific practices, since in TTS, the significance and prioritization of problems awaiting innovative solutions, the practices followed to co-develop and evaluate possible solutions, and the skills to be developed are not determined beforehand.

Researchers may find it challenging to engage in this new way of working. However, this is not the only difficulty associated with developing and implementing a Mode 2 research project. Properly orchestrating the knowledge production process while facilitating co-innovation, balancing the various interests, and motivating learners are all demanding tasks. In addition, expecting that all actors will easily adapt to this innovation and knowledge production model is rather overoptimistic. Efficient guidance and facilitation are keys to ensuring the success of the initiative. Finally, the high level of flexibility and the lack of strictly designed innovation paths generate possible uncertainties, which may negatively impact researchers' eagerness to engage in such projects.

4. Practical Implications

Despite the long journey that agricultural innovation research has taken from linear to multi-actor and systemic paths, a reliance on disciplinary approaches continues to exist in innovation practice. Based on a different philosophy, our model was designed to assist innovators in generating new, socially distributed, and contextually rich knowledge. Practitioners working in several knowledge-demanding agricultural innovation fields can adapt TTS to their projects.

5. Theoretical Implications

From a theoretical standpoint, the present study contributes to the agricultural knowledge and innovation literature by outlining some pivotal features of the "Mode 2" knowledge generation process and opening a discussion on the practice of designing user-centered and societally impactful research projects. This approach provides opportunities to facilitate the development of context-specific and application-focused knowledge and skills during co-innovation. By adding a Mode 2 knowledge production component in currently used theoretical frameworks like Responsible Research and Innovation or citizen science, researchers can enhance actors' skills in innovating and, in parallel, increase positive societal change.

6. References

- Castaneda, D. I., & Cuellar, S. (2020). Knowledge sharing and innovation: A systematic review. *Knowledge and Process Management*, 27(3), 159-173.
- Fieldsend, A. F., Varga, E., Biró, S., Von Münchhausen, S., & Häring, A. M. (2022). Multi-actor co-innovation partnerships in agriculture, forestry and related sectors in Europe: Contrasting approaches to implementation. *Agricultural Systems*, 202, 103472.
- Gibbons, M. (2000). Mode 2 society and the emergence of context-sensitive science. *Science and public policy*, 27(3), 159-163.
- Gibbons, M., Limoges, C., Scott, P., Schwartzman, S., & Nowotny, H. (1994). *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: Sage.

-
- Hecker, S., Bonney, R., Haklay, M., Hölker, F., Hofer, H., Goebel, C., ... & Bonn, A. (2018). Innovation in citizen science—perspectives on science-policy advances. *Citizen Science: Theory and Practice*, 3(1), 4-4.
- Owen, R., Von Schomberg, R., & Macnaghten, P. (2021). An unfinished journey? Reflections on a decade of responsible research and innovation. *Journal of Responsible Innovation*, 8(2), 217-233.

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Special Session 6B

Let's play! Special session with a serious game for strengthening the governance of agrifood innovation systems

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Short abstract

This paper presents a foresight-based policy serious game prototype developed by the Food and Agriculture Organization (FAO) to strengthen multilateral governance of Agrifood Innovation Systems (AIS). Designed to be piloted, refined and applied within FAO's Innovation Policy Labs (IPLs) methodology, the game aims to enhance key functional capacities among AIS stakeholders, and allow to stress-test various policy options in a safe simulated environment, by engaging them in scenario-based, collaborative problem-solving exercises. The game structure incorporates scenario building, a co-creation process to jointly formulate and stress-test innovative policy solutions, visioning, skilled facilitation, and a reflective debriefing session.

For the ESEE special session, the design will include an interactive part where the audience will be engaged to try the game in one or two groups, depending on the number of the participants. The entry point for the game will be a scenario presenting a challenge to be addressed in a multistakeholder setting and lead to an innovative and win-win solution (action plan) for the problem.

1. Purpose

As more and more often innovation processes emphasize participatory and system-based approaches, policy serious games are increasingly recognized as effective tools for adult learning, capacity development, and decision-making support, particularly in complex governance contexts. Policy serious games offer a structured, experiential format for strengthening functional capacities—such as navigating complexity and uncertainty, negotiation, facilitation, consensus building, and conflict resolution—essential for collaborative policy development and adaptive governance. As such, they are deemed particularly relevant for enhancing multistakeholder governance of agrifood innovation systems (AIS).

This paper presents a foresight-based policy serious game prototype developed by the Food and Agriculture Organization (FAO) to strengthen multilateral governance of Agrifood Innovation Systems (AIS). Designed to be piloted, refined and applied within FAO's Innovation Policy Labs (IPLs) methodology, the game aims to enhance key functional capacities among AIS stakeholders, and allow to stress-test various policy options in a safe simulated environment, by engaging them in scenario-based, collaborative problem-solving exercises. The game structure incorporates scenario building, a co-creation process to jointly formulate and stress-test innovative policy solutions, visioning, skilled facilitation, and a reflective debriefing session.

The special session's participants will have the opportunity to engage in the game, provide critical feedback, and reflect on its pedagogical value and applicability across diverse extension and education contexts.

This session ultimately aims to contribute to the academic discourse on capacity development methodologies and participatory learning tools, and to assess the potential of policy serious games in transforming how we build the capacities required for inclusive and effective agrifood innovation system governance.

2. Methodology

FAO's methodology is the result of a long-standing experience in foresight and facilitation of multistakeholder co-creation processes, as well as various collaborations with policy serious games experts and practitioners (including FAO's policy serious game for FAO's Regional Office for Europe and Central Asia, FAO&UNDP Nexus: food systems serious game in times of crisis and Sintef research institute). Prototype versions of the game have been already applied in different settings through the Samoa circle role play.

The game's objective is to engage different AIS stakeholders in decision-making and help them:

- strengthen their functional capacities for multilateral policy formulation and governance in agrifood innovation systems, such as navigating complexity and uncertainty, facilitation, negotiation, conflict resolution and consensus building;
- stress-test various policy options in a safe simulated environment.

The main rules of the game are:

- Role play involving relevant AIS stakeholders (such as policymakers, extension agents, researchers, farmers, community members, private sector and civil society actors);
- Future scenario building based on identified relevant drivers of change, weak signals, trends and wild cards;
- Concrete task (co-creation of an innovative solution for a common problem);
- Goal: development of a win-win action plan informed by the scenarios built, independently of the innovative solution chosen;
- Two rounds: a "regular" one, and the second one where the stakeholders are urged to modify their action plan to respond to a crisis;
- Skilled facilitation;
- Debriefing and feedback session to discuss the experience and reflect on the existing and needed capacities and outcomes of the process.

The methodology integrates the UN 2.0 capabilities: innovation (the co-created solution must be innovative), foresight (players build foresight scenarios that inform the solutions to future-proof them), data (stakeholders' expertise is used to ensure that solutions are evidence-based), digital (final version of the serious game will integrate AI to support data component and scenarios building), and behavioural science (promoting behavioural change and mindset shifts, helping to build trust among actors and encourage more equitable participation).

The second "crisis" round of the game is considered instrumental to enhance capacities to apply participatory approaches also to emergency situations, where the rapidity of response is usually valued more than a multistakeholder perspective and social acceptance, that are, however, key to ensure sustainability of the proposed solutions.

The foresight-based policy serious game methodology (under finalization) will feature three cases related to different innovation contexts to make the game experience more concrete: nature-based and social innovations, AI/quantum technologies, and biotechnology related innovations. However, the methodology will be adaptable to various contexts and needs. It will be also available in an in-presence, online and blended versions.

For the ESEE special session, the design will include an interactive part where the audience will be engaged to try the game in one or two groups, depending on the number of the participants. The entry point for the game will be a scenario presenting a challenge to be addressed in a multistakeholder setting and lead to an innovative and win-win solution (action plan) for the problem.

The last part of the session will allow the audience to provide feedback and share their experience on similar approaches in view of improving the game methodology.

Time (total 100')	Presentation
10'	Short presentation of the FAO's foresight-based policy serious game for inclusive and effective governance of agrifood innovation systems
5'	Q&A
5'	Instructions for the serious game participants
20'	Serious game round 1
10'	Debriefing and reflection on the 1st round
20'	Serious game round 2: a crisis strikes
10'	Debriefing and reflection on the 2nd round
15'	Q&A, feedback on the game and a discussion
5'	Conclusions and next steps

3. Findings

Policy serious games are a proven tool to support adult learning, capacity development and decision-making. Our experience shows that FAO's methodology allows for:

- Improvement of functional capacities, which are key for stakeholders' empowerment and co-creation of innovative win-win solutions;
- Co-creation of more impactful and innovative solutions as the game helps stress-test different options in a safe simulated environment and elaborate risk mitigation plans before implementing innovations in real life.
- UN 2.0 capabilities add a great value to the methodology: on one hand, they make the game more engaging and impactful, on another, their integration in the game prepares players to apply the UN 2.0 capabilities in real-life settings.
- One of the key strengths of the methodology is its flexibility and adaptability, allowing for an effective capacity development activity suitable to various contexts, capacity levels, needs and scenarios.
- Trust and relations developed among the players can translate into real-life collaborations among involved stakeholders.

In conclusion, the findings demonstrate that, by simulating complex decision-making environments, serious policy games, particularly when augmented by AI, support adult learning through experiential engagement, improving stakeholders' readiness to engage in multistakeholder AIS governance processes. They are a very effective way to promote needed mindset shift and functional capacities and co-create and stress-test transformative

solutions before their application in real-life setting. Ultimately, policy serious games prove a very effective tool to enhance multistakeholder AIS governance.

4. Practical Implications

The use of policy serious games in governance process of agrifood innovation systems (AIS) carries wide-ranging practical implications for capacity development, participatory policy processes, and institutional learning.

Firstly, serious games provide a safe, simulated environment in which diverse stakeholders can practice and strengthen key functional capacities for navigating the complex, multistakeholder settings typical of AIS governance and future uncertainties. Unlike traditional training methods, policy serious games allow participants to experience the consequences of their decisions in real time, thereby improving decision-making under uncertainty, changing situations and fostering systems thinking.

In practical terms, the structured game format facilitates the testing of different policy options in a low-risk setting, enabling stakeholders to explore trade-offs, unintended consequences on different stakeholder groups and environment, and alignment with long-term goals. This makes serious games particularly valuable during the early stages of policy formulation or reform, where space for experimentation is often limited. Additionally, by including realistic governance scenarios—including resource constraints, competing interests, and institutional bottlenecks and a “difficult stakeholder”—policy serious games help identify potential implementation challenges and allow users to develop proactive risk mitigation strategies. Hence, use of policy serious games leads to more transformative solutions in real-life situations.

Importantly, policy serious games can also be tailored to local contexts, increasing their relevance and potential for uptake. Their participatory and interactive nature not only enhances engagement but also promotes behavioural change and mindset shifts, helping to build trust among actors and encourage more equitable participation. The trust and relations developed among players can translate into real-life collaborations. When embedded within initiatives like FAO’s Innovation Policy Labs (IPLs), policy serious games can support the co-creation of context-specific, win-win solutions and foster a shared understanding of innovation system dynamics. As such, they serve not only as a learning tool, but also as a platform for dialogue, negotiation, and collective action—making them a valuable addition to the capacity development toolkit of professionals working to strengthen innovation governance in complex and dynamic environments.

Given the usefulness of the policy serious games in adult and professional learning, it is deemed that more emphasis should be placed on capacities of educators (universities, training centers) to develop and implement policy serious games-based activities.

5. Theoretical Implications

From a systems theory perspective, policy serious games operationalize the AIS framework by simulating the interconnected roles of actors, institutions, and knowledge flows within dynamic policy environments. Drawing on adult learning theories, policy serious games can demonstrate that learning is most effective when embedded in context-rich, participatory, and emotionally engaging settings.

Furthermore, policy serious games create a reflective space in which participants can examine the different dimensions and consequences of policy decisions, rehearse alternative courses of action, and experience diverse knowledge production mechanisms. In this sense, such games function not only as capacity development tools but also as instruments of critical inquiry, making visible the often-invisible assumptions and ideologies that underpin policy decisions.

In addition, the integration of artificial intelligence (AI) and the UN 2.0 capabilities into policy serious games' design can enhance the realism and complexity of gameplay, enabling researchers to explore how stakeholders behave under different rules, constraints, and incentive structures.

In conclusion, the recent rise of the policy serious games, especially AI-enhanced and UN 2.0-aligned, as a valuable capacity development approach, signs the beginning of a new paradigm in adult learning.

6. References

Alexandrova-Stefanova, N., Nosarzewski, K., Mroczek Z.K., Audouin, S., Djamien, P., Kolos, N. & Wan, J. 2024. Shaping sustainable agrifood futures: pre-emerging and emerging technologies and innovations for impact - An extended global foresight report with regional and stakeholders' insights. Rome, FAO and Paris, CIRAD. <https://doi.org/10.4060/cd2743en> - <https://agritrop.cirad.fr/610673> Revised November 2024

FAO&UNDP - Nexus: food systems serious game in times of crisis

TOPIC 3 – AI and digitalisation of advisory services and education

Convenors: Ataharul Chowdhury; Pierre Labarthe

Session 1C

DEMO AND TEST OF LLM & AI FOR LLL AND EXTENSION

Proof of Concept: Leveraging Large Language Models for Qualitative Analysis of Participant Feedback

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Extended abstract

1. Purpose

Documenting programmatic successes in Extension education and impacts on participants is important. Program evaluation necessitates the use of informal and formal methods and strategies which continuously evolve (Nichols et al., 2015). Making sense of qualitative data is as creative as it is analytical (Esterberg, 2001), providing a more holistic perspective of the individual experience. For educational programming, Extension or otherwise, qualitative data can help identify areas for improvement and ensure that the interventions and programs meet stated objectives and the needs of the people they are designed to serve. However, qualitative data analysis has its costs: time, resources, and expertise, among others (Jones et al., 2019).

Artificial intelligence (AI) is transforming the research landscape and expanding opportunities in data analysis. This proof-of-concept study (Crocker, et al., 2025) explores the innovative application of Large Language Models (LLMs) for qualitative analysis of feedback from an Extension program, addressing the challenge of efficiently analyzing qualitative data.

2. Design

We compare traditional human qualitative analysis with qualitative analysis conducted by AI. The Texas Tech University Institutional Review Board approved this study (IRB # 2023-949). We utilized a convenience sample of evaluation data from program participants ($N = 118$) in 14 *A Matter of Balance*, a community-based fall risk reduction educational series for older adults, implemented between January and September 2023. We evaluated responses to, “What other changes have you made as a result of this class?”

For the human analysis, three research team members participated, using an inductive process and following standard procedures as outlined by Esterberg (2001) and Creswell & Poth (2018). We used both an inductive and deductive process for the analysis conducted by AI, developing a protocol (Dai et al., 2023; De Paoli, 2023; Xiao et al., 2023) and following

tips for efficient prompt engineering based on White et al. (2023). Using stepwise, guided prompting, ChatGPT coded participant responses for content, organized into major themes, subsequently reorganized into major themes based on the human researchers' codes.

3. Findings

The qualitative analysis process in this study involved extensive human effort, with three researchers dedicating several weeks and multiple face-to-face meetings. In contrast, the ChatGPT analysis required about ten minutes for protocol preparation and less than five minutes of interaction to yield results. We provide ChatGPT's initial coding and representative comments for each in Table 1.

Table 1: ChatGPT's Codes with Representative Comments

Code	Representative Comments
Exercise and Physical Activity	<ul style="list-style-type: none"> • "I do the exercise program each morning." • "Exercised daily." • "Exercise more!"
Environmental Safety and Home Modifications	<ul style="list-style-type: none"> • "Removed throw rugs." • "Changed bath mat." • "Moving rugs and furniture."
Increased Awareness and Caution	<ul style="list-style-type: none"> • "More aware of my surroundings." • "Be more careful." • "Stair awareness."
Footwear and Clothing Choices	<ul style="list-style-type: none"> • "Plan to buy shoes that are safe." • "Retired my bathroom rugs." • "Changed bath mat. Area rugs. Exercise."
Positive Attitude and Health Awareness	<ul style="list-style-type: none"> • "Drink more water." • "Increased priority for exercise." • "Much better attitude about aging and determined to keep it up."

ChatGPT's involvement added a novel dimension to the analysis, efficiently processing and categorizing large volumes of text while providing a unique perspective on the dataset. We subsequently provided ChatGPT the human researchers' codes and asked it to reanalyze the data and provide representative comments for each. We compare representative comments from the human researchers and ChatGPT in Table 2.

Table 2: Directed Coding Using Human Researchers' Codes with Representative Comments

Human Representative Comments	Code	ChatGPT Representative Comments
<ul style="list-style-type: none"> • "More aware of my surroundings." • "More cautious about things I do that might be dangerous and how to apply things learned." • To pay more attention of my surroundings." 	Awareness	<ul style="list-style-type: none"> • "More aware of my surroundings." • "Be more careful." • "Stair awareness."
<ul style="list-style-type: none"> • "Began exercising during TV commercials." • "I no longer hurry or walk fast." • "Not carrying too many things at one time." 	Behavior	<ul style="list-style-type: none"> • "I do the exercise program each morning." • "Exercised daily." • "Exercise more!"
<ul style="list-style-type: none"> • "Removed throw rugs and using light at night." • "I removed some throw rugs. I replaced - moved some electric cords." • "Moving rugs and furniture." 	Environment	<ul style="list-style-type: none"> • "Removed throw rugs." • "Changed bath mat." • "Moving rugs and furniture."
<ul style="list-style-type: none"> • "None." • "NA." • "No changes." 	No comment	<ul style="list-style-type: none"> • "NA." • "None." • "I wouldn't change anything. Everything was great!"
<ul style="list-style-type: none"> • "Much better attitude about aging and determined to keep it up. Thanks." • "I wouldn't change anything. Everything was great!" • "The class was very helpful. I know to stop and take it easy if I feel dizzy." 	Satisfaction	<ul style="list-style-type: none"> • "The class was very helpful." • Thanks." • "Much better attitude about aging and determined to keep it up."

The comparison of human and AI analysis revealed thematic agreements and semantic differences. ChatGPT successfully narrowed down codes and matched 60% of the human researchers' focused codes. ChatGPT also identified a theme that the human researchers did not consider – "Positive Attitude and Health Awareness" – providing a novel dimension to the analysis. However, there were discrepancies in identifying representative comments and overestimating comment frequencies. We only found minimal agreement between the human researchers and AI ($\kappa = .392, p < .001$) versus moderate agreement among the human researchers ($\kappa = .555, p < .001$).

4. Practical and theoretical implications

The study juxtaposes traditional human-led qualitative analysis with AI-driven techniques, revealing the complementary strengths of human insights and AI efficiency. It underscores the potential of LLMs to enhance qualitative analysis while recognizing the need for human oversight to ensure depth and context accuracy. By combining the depth and contextual sensitivity of human analysis with the efficiency and novel perspectives of AI, we validated the educational program's effectiveness and demonstrated the potential of integrating AI tools like ChatGPT in qualitative research. AI can significantly streamline the process of analyzing qualitative feedback in Extension programming. However, given the nature of the

data, combining AI's computational power with human intuition and understanding may be necessary, augmenting, not automating, the process (Jiang et al., 2021). This hybrid approach will ensure that the derived insights are accurate and meaningful.

While our focus was an analysis of survey data from a fall risk reduction program for older adults, this method and those who will improve upon it can help support a broader range of educational programs grappling with similar challenges. Additionally, utilizing AI for programmatic analysis offers program organizers and educators informed guidance for making data-driven decisions that can lead to a more enriching educational experience for participants.

Keywords

program evaluation, qualitative data analysis, AI (Artificial Intelligence), ChatGPT, large language models (LLM)

5. References

- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry & research design: Choosing among five approaches* (Fourth edition). SAGE.
- Crocker, A.B., Schmidt, M., Tejeda, J.D., & Rodriguez-Mori, H. (2025). Proof of concept: Leveraging large language models for qualitative analysis of participant feedback. *The Journal of Extension*, 63(1). <http://doi.org/10.34068/joe.63.01.16>
- Dai, S.-C., Xiong, A., & Ku, L.-W. (2023). *LLM-in-the-loop: Leveraging large language model for thematic analysis* (arXiv:2310.15100). arXiv. <http://arxiv.org/abs/2310.15100>
- De Paoli, S. (2023). *Can large language models perform an inductive thematic analysis of semi-structured interviews?* <https://doi.org/10.48550/arXiv.2305.13014>
- Esterberg, K. G. (2001). *Qualitative methods in social research* (1st ed.). McGraw-Hill Humanities/Social Sciences/Languages.
- Jiang, J. A., Wade, K., Fiesler, C., & Brubaker, J. R. (2021). Supporting serendipity: Opportunities and challenges for human-AI collaboration in qualitative analysis. *Proceedings of the ACM on Human-Computer Interaction*, 5(CSCW1), 1–23. <https://doi.org/10.1145/3449168>
- Jones, K. R., Gwynn, E. P., & Teeter, A. (2019). Quantitative or qualitative: Selecting the right methodological approach for credible evidence. *Journal of Human Sciences and Extension*. <https://doi.org/10.54718/KUET2761>
- Nichols, A., Blake, S. M., Chazdon, S., & Radhakrishna, R. (2015). From farm results demonstrations to multistate impact designs: Cooperative Extension navigates its way through evaluation pathways. *Journal of Human Sciences and Extension*. <https://doi.org/10.54718/DNHS3672>
- White, J., Fu, Q., Hays, S., Sandborn, M., Olea, C., Gilbert, H., Elnashar, A., Spencer-Smith, J., & Schmidt, D. C. (2023). *A prompt pattern catalog to enhance prompt engineering with ChatGPT* (arXiv:2302.11382). arXiv. <http://arxiv.org/abs/2302.11382>
- Xiao, Z., Yuan, X., Liao, Q. V., Abdelghani, R., & Oudeyer, P.-Y. (2023). Supporting qualitative analysis with large language models: Combining codebook with GPT-3 for deductive coding. *28th International Conference on Intelligent User Interfaces*, 75–78. <https://doi.org/10.1145/3581754.3584136>

The Emergence of AgML's CY-Bench: An AI Platform to Enhance Engagement, Empowerment, and Partnerships

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Short abstract

4th generation institutions strive for broader ecosystem goals by focusing more on innovation, socio-economic impacts, and engagement with stakeholders beyond research, teaching, and extension lenses. An increase in knowledge AI modelling results is essential to population growth, workforce development, and advancing science's influence on societal impacts. AgML is a multinational transdisciplinary research team seeking to develop best practices for rigorous machine learning use in agricultural modelling. CY-Bench, created by AgML, is a comprehensive dataset for subnational crop yield forecasting. CY-Bench data have been vetted by a community peer-review process and can be used for process-based model calibration, or machine learning model training in a variety of conditions around the world. Community-engaged research is a systems approach to maximize stakeholder empowerment, collaboration, and partnerships with the goal of improving research impacts. AgML is doing cutting-edge AI work with the people who understand the application, able to transfer the knowledge, and who can measure the technologies' impact. Extension and advisory services can influence peer-to-peer and researcher-to-farmer AI knowledge gaps by providing clarity from evidence-based AI solutions. Stakeholders and researchers can help create an extension and advisory ecosystem that fosters AI-based innovation while ensuring that solutions are scalable, sustainable, and widely accessible.

Keywords | agricultural modeling, machine learning, community-engaged research, crop yield forecasting, evidence-based AI solutions

1. Purpose

Agriculture is well-positioned to profit from the rapid acceleration and dissemination of Artificial Intelligence (AI) according to Tzachor et al. (2022). AI is an Industry 5.0 innovation that is transforming education, research, and our outreach practices to external stakeholders in ways that support the evolution to a 4th generation institution. Fourth generation institutions are global universities that are fully integrated in their local innovation ecosystem with the aim of tackling significant societal issues and accelerating economic growth. AI can specifically help advance community-engaged teaching and research. The need to increase AI and Data Science knowledge is essential to population growth, workforce development, and advancing science's influence on societal impacts. Extension and advisory services can influence peer-to-peer and researcher-to-farmer AI knowledge gaps by providing clarity from evidence-based AI solutions on relevant issues. Maximizing stakeholder impacts includes the indices of stakeholder engagement, empowerment, and partnerships. Community-engaged research (CER) and extension increases scholarship's relevancy, translation, and sustainability by increasing capacity,

enhancing trust, and better translating knowledge to action. An emergent paradigm to combine research, education, and innovation with a robust societal impact and regional development focus is referred to as a 4th generation university. This will foster a future where AI not only drives agricultural productivity but also supports broader societal goals, such as environmental sustainability, food security, and improved livelihoods for all stakeholders in the agricultural sector. Comprehending knowledge transfer social dimensions is critical for extension and advisory services prior to recommend technological applied solutions (Lee et al., 2024).

2. Design

Machine learning (ML) is a subset of AI focused on algorithms and statistical models that improve the performance of computers on specific tasks through experience and data (Belhadi et al., 2025; Thomasson et al., 2025). AgML, a multinational transdisciplinary research team of the Agricultural Model Intercomparison and Improvement Project (AgMIP), is led by Wageningen University and Research and seeks to identify key research gaps and opportunities at the intersection of agricultural modelling and machine learning research, support enhanced collaboration and engagement between experts in these disciplines, and conduct and publish protocol-based studies to establish best practices for robust machine learning use in agricultural modelling (Paudel et al., 2024). AgML developed CY-Bench (Crop Yield Benchmark), a comprehensive dataset for subnational crop yield forecasting, with coverage of major crop growing countries of the world (Paudel et al., 2025). CER includes the domains; integrative, reflective, contextualized, strength-based, reciprocal, and lifelong (Mtawa et al., 2016). Integrative is the use formal, and nonformal learning CER projects as stakeholders practice as stakeholders and as community members resulting in advance interpersonal and academic growth. Reflective offers structured critical reflection learning experiences that foster a greater impact of the experience that develops the contextualization of the experience toward future experiences CER immerses stakeholders into the complexities and unpredictability of societal problem solving referred to as contextualized learning experiences. A strength-based domain houses the human, social, and intellectual capital that exists to engage partnerships that result in impact amplification. The reciprocal lens centers on the added value benefit to community stakeholders to answer societal issues from stakeholders' intellectual and physical capital to understand the issue and develop solutions. The lifelong domain refers to the perpetual culture of learning that stakeholders develop and the extent the CER can construct influential, relevant, and distinctive experiences. CER provides a multi-dimensional approach to maximize stakeholder empowerment, collaboration, and partnerships (Renwick et al., 2020).

3. Findings

Due to the abstract spacing limits, selected CY-Bench findings are presented here. The dataset combines sub-national yield statistics with relevant predictors, such as growing-season weather indicators, remote sensing indicators, evapotranspiration, soil moisture indicators, and static soil properties. CY-Bench goals include: (a) establish a standardized framework for developing and evaluating data-driven models across diverse farming systems in more than 25 countries across six continents; (b) enable robust and reproducible model comparisons that address real-world operational challenges; and (c) provide an openly accessible dataset to the earth system science and machine learning communities, facilitating research on time series forecasting, domain adaptation, and online learning. CY-Bench is a digital education tool that supports land sustainability, and the continuous development of advanced data driven models for crop yield forecasting to enhance decision-making on food security. CY-Bench data have been vetted by a community peer-review

process and can be used for process-based model calibration, or machine learning model training in a variety of conditions across the whole globe. Among the design choices in creating CY-Bench was also that the evaluation metrics should closely represent the needs of stakeholders and allow a more granular breakdown of model performance, for example, the model's ability to capture yield variability in years with climate extremes. CY-Bench utilizes publicly accessible data from many institutions to model forecasts. For example, the U.S. crop yield statistics are provided from the National Agricultural Statistics Service (NASS), soil data is supplied from the World Inventory of Soil Emission Potentials (WISE), Global Land Data Assimilation System's (GLDAS) dataset provides soil moisture, and AgERA5 provides temperature, radiation, and precipitation data. Indicators of crop biomass and health include vegetation indices, such as the normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI), biophysical metrics such as the fraction of absorbed photosynthetically active radiation (fPAR) and leaf area index (LAI). The indicator of vegetative greenness is provided by NASA's Land Processes Distributed Active Archive Center (LPDACC). Crop type maps for maize and wheat are provided by from the Group on Earth Observations Global Agriculture Monitoring (GEOGLAM). CY-Bench was constructed to train and assess models for in-season maize and wheat yield forecasting in regions or country groups, including larger and smaller crop producing countries worldwide. Apart from generating accurate projections for stakeholder adoption, models should be reliable in applied contexts. Stakeholder needs should be represented in the model's evaluation metrics and provide a granular analysis of the model's capability.

4. Practical Implications

Advances are needed to establish mechanisms to transfer AI-generated insights to industry, government, and academic stakeholders. We bring together AgML transdisciplinary members who are doing cutting-edge AI work with the people who understand the application and able to transfer the knowledge to stakeholders and those who can measure the technologies' impact. Extension and advisory services can influence peer-to-peer and researcher-to-farmer AI knowledge gaps by providing clarity from evidence-based AI solutions on relevant issues. Maximizing stakeholder impacts includes the indices of stakeholder engagement, empowerment, and partnerships. Utilizing CER helps us purposeful engagement stakeholder efforts that advance data literacy, internal student and faculty collaborations, workforce development, and additional external stakeholder collaborations such as industry, government, and community leaders. AI data modeling can forecast markets based on price, climate, pests, and supply chain. Robots are being used to prepare and package corn, milo, rice, soybeans, and wheat commodities. We promote the involvement of industry leaders not only for CES but for curricula development in our institutions. We are utilizing the additional stakeholders to enhance our CES efforts by providing feedback and information for videos and case studies to develop stakeholders. Our tripartite outcomes will synergistically elevate extension, research, and education and strengthen extension and advisory services' engagement in communities. ML data analysis and data sharing would be improved using a CER approach (Emmons et al., 2023). The next phases of AgML includes improving machine learning translational science and stakeholder engagement to advance extension and advisory services, stakeholder buy-in, and institutional trust.

5. Theoretical Implications

The phenomenon of improving science and that science improving stakeholder practices is a foundation of 4th generation institutions. Preparing the next generation of scholars and practitioners that can successfully engage the public is crucial to ensuring research directly

addresses community issues, enhances trust, and increases knowledge transfer from institutions to stakeholders, and therefore, accelerates potential impact. We are specifically interested in developing graduate and undergraduate stakeholders in using AI-powered systems to engage local communities in developing plans or solutions for pressing societal and environmental concerns. Stakeholders can assist with curricula development, videos, field experiences development and execution, data collection, AI data analysis, case study and scenario development, project reporting, and scholarly outputs. This transformational mentoring enhances student matriculation to industry or graduate programs. Community-engaged development of AI evidence-based solutions offers extension and advisory services capacity improvements, speeding-up the transfer of knowledge to farmers, and improves farmer's trust from their participation in the co-creation of knowledge and innovations. Extension and advisory efforts should be tailored to the unique needs and contexts of different farming communities, ensuring that farmers are not only equipped with the technical skills but also the practical understanding of how AI can address their specific challenges. Together, stakeholders and researchers can help create an extension and advisory ecosystem that fosters AI-based innovation while ensuring that solutions are scalable, sustainable, and widely accessible. We are applying AI research findings in curricula to address community problems, to forecast future challenges, and to generate new knowledge for student's societal impacts. AI and the digitisation of extension and advisory services involves a transdisciplinary team's intellectual capital to maximize impact through data acquisition, model development, knowledge transfer to stakeholders and data synthesis to policymakers. These practices, interdisciplinary by nature, involve the ability to assess and respond to the core ethical, legal, policy, social, economic, and political implications of AI.

6. References

- Belhadi, A., Kamble, S. S., Mani, V., Benkhathi, I., & Ezahra Touriki, F. (2025). An ensemble machine learning approach for forecasting credit risk of agricultural SMEs' investments in agriculture 4.0 through supply chain finance. *Annals of Operations Research*, 345, 779–807. DOI: 10.1007/s10479-021-04366-9
- Emmons, K. M., Mendez, S., Lee, R. M., Erani, D., Mascioli, L., Abreu, M., Adams, S., Daly, J., & Bierer, B. E. (2023). Data sharing in the context of community-engaged research partnerships. *Social Science & Medicine*, 325, 115895. DOI: 10.1016/j.socscimed.2023.115895
- Lee, C. L., Strong, R., Briers, G., Murphrey, T., Rajan, N., & Rampold, S. (2024). Factors predicting innovation decisions: The effects of performance expectancy, social influence, and facilitating conditions on U.S. Extension's promotion of precision agriculture technologies. *NJAS: Impact in Agricultural and Life Sciences*, 96(1). DOI: 10.1080/27685241.2024.2420111
- Mtawa, N. N., Fongwa, S. N., & Wangenge-Ouma, G. (2016). The scholarship of university-community engagement: Interrogating Boyer's model. *International Journal of Educational Development*, 49, 126–133. DOI: 10.1016/j.ijedudev.2016.01.007
- Paudel, D., Kallenberg, M., Ofori-Ampofo, S., Baja, H., van Bree, R., Potze, A., Poudel, P., Saleh, A., Anderson, W., von Bloh, M., Castellano, A., Ennaji, O., Hamed, R., Laudien, R., Lee, D., Luna, I., Meroni, M., Mutuku, J. M., Mkuhlani, S., Richetti, J., Ruane, A. C., Sahajpal, R., Shai, G., Sitokonstantinou, V., de Souza Nória Júnior, R., Srivastava, A. K., Strong, R., Sweet, L., Vojnovic, P., and Athanasiadis, I. N. (2025). CY-Bench: A comprehensive benchmark dataset for sub-national crop yield forecasting. *Earth Systems Science Data*, [preprint]. DOI: 10.5194/essd-2025-83

- Paudel, D., Baja, H., van Bree, R., Kallenberg, M., Ofori-Ampofo, S., Potze, A., Poudel, P., Saleh, A., Anderson, W., von Bloh, M., Castellano, A., Ennaji, O., Hamed, R., Laudien, R., Lee, D., Luna, I., Masiliūnas, D., Meroni, M., Mutuku, J. M., Mkuhlani, S., Richetti, J., Ruane, A. C., Sahajpal, R., Shuai, G., Sitokonstantinou, V., de Souza Noia Junior, R., Srivastava, A. K., Strong, R.... Athanasiadis, I. N. (2024). *CY-Bench: A comprehensive benchmark dataset for subnational crop yield forecasting* (1.2) [Data set]. AgML. DOI: 10.5281/zenodo.13838912
- Renwick, K., Selkrig, M., Manathunga, C., & Keamy, R. 'Kim.' (2020). Community engagement is ... : revisiting Boyer's model of scholarship. *Higher Education Research & Development*, 39(6), 1232–1246. DOI: 10.1080/07294360.2020.1712680
- Thomasson, A., Ampatzidis, Y., Bhandari, M., Ferreyra, A., Gentimis, T., McReynolds, E., Murray, S., Peterson, M., Rodriguez Lopez, C., Strong, R., Tedeschi, L., Vitale, J., & Ye, X. (2025). AI in agriculture: Opportunities, challenges, and recommendations. Council for Agricultural Science and Technology (CAST), March, 1-12. DOI: 10.62300/IAAG042514
- Tzachor, A., Devare, M., King, B., Avin, S., & ÓhÉigeartaigh, S. S. (2022). Responsible artificial intelligence in agriculture requires systemic understanding of risks and externalities. *Nature Machine Intelligence*, 4, 104–109. DOI: 10.1038/s42256-022-00440-4

ExtensionBot's AI Impacts on Extension and Advisory Services

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Short abstract

Chatbots use Artificial Intelligence (AI) and a human computer interaction (HCI) model to automate responses to human queries. One such chatbot is ExtensionBot which transfers prompt conversational answers to submitted issues or inquiries using extension information. ExtensionBot offers opportunities to enhance extension and advisory services by offering an AI platform to actors, educating actors on AI, increased AI engagement, advancing collaboration, and by providing a repository to curate content. ExtensionBot harnesses AI enhancements to provide actors more rapid digital evidence-based solutions. We examined the institutions that have provided curricula to ExtensionBot, and the number of those institutions' respective educational resources located within the chatbot. Results demonstrate our queries for prickly pear cactus (PPC) growing recommendations and managing wheat pests, but ExtensionBot provides information to other contexts such as soil testing, livestock, crop management, lawn and garden recommendations, etc. AKIS systems approach is well-positioned to harness the attributes of ExtensionBot to meet the immediate needs of food and agricultural actors. Extension and advisory efforts should be tailored to the unique needs and contexts of different farming communities, ensuring that farmers are not only equipped with the technical skills but also the practical understanding of how AI can address their specific challenges.

Keywords: Chatbot, AKIS, Industry 5.0, Generative Artificial Intelligence, Human Computer Interaction

1. Purpose

Chatbots are a tool for individual consultation that stimulates learning and interpersonal communication through interactive strategies and user-friendly interfaces (Hwang & Chang, 2021). The most prominent and current research of extension utilizing large language models (LLMs) is ExtensionBot (Kpodo et al., 2024). ExtensionBot was created to advance the work of agricultural extension by more quickly equipping farmers with accurate research-based, correct, and situation-specific solutions (Thomasson et al., 2025). ExtensionBot was developed to supply research-based information in seconds (Extension Foundation, 2024). Examining digital extension curricula's impact on actors should be a priority of extension and advisory services as we move toward Industry 5.0 innovations in our 5G paradigms (Strong et al., 2023).

2. Design

AKIS was utilized to reimagine community-engagement in extension and advisory services to impact stakeholders through an AI lens. Fieldsend (2020) identified AKIS as a conglomerate of providers distributing information among themselves and innovations and advisement to actors. The optimization of AKIS relies on institutions, extension, and advisory services transferring agricultural knowledge to farmers (Kountios et al., 2024). AI tools such as Retrieval-Augmented Generation (RAG), ExtensionBot, autonomous robots, unmanned ground vehicles (UGVs), unmanned aerial vehicles (UAVs), machine learning, deep learning, digital twins, and IoTs offer relevant, translational, and innovative data-driven solutions to enhance agricultural extension and advisory services. ExtensionBot is a product of a large language model (LLM) that assesses differing levels of granularity, complex queries across multiple data providers and curriculum, automated reasoning and inference, discovers connections between resources due to the issue and implication, and provides improved comprehension and utilization of data. ExtensionBot's architecture is derived from a Retrieved-Augmented Generation (RAG) method to supply citable references and avoid non-vetted non-evidence-based information.

3. Findings

Based on the abstract limits, our synopsis of ExtensionBot's capabilities is provided. Farmers can ask ExtensionBot questions related to soil testing, crop management, and lawn and garden recommendations. Examples of questions that will include "What are the best practices for managing pests during wheat growth?", "What variety of maize is recommended for my region?", "What are the recommended cotton marketing practices?", or "When is the best time to harvest groundnuts?". Each ExtensionBot response gives the farmer detailed recommendations respective to the submitted question. If accepted, the presentation would demonstrate ExtensionBot's platform, sections within the system, live search queries, the time it takes to receive a response, and the generated response for the respective inquiry. We examined the institutions providing curricula to ExtensionBot and the number of their respective educational resources located in the LLM's RAG approach. The University of Florida provides over 40% of the extension information curated in ExtensionBot (see Table 1).

Table 1: Contributing Institutions and the Number of Educational Resources to ExtensionBot (N = 38,562)

Institution	<i>f</i>	%
University of Florida Blogs	10,354	26.85
University of Florida Publications	6,402	16.60
Oregon State University	5,203	13.49
Pennsylvania State University	4,740	12.29
University of Tennessee	2,602	6.74
Louisiana State University	1,917	4.97
University of California – Integrated Pest Management	1,675	4.34
Oklahoma State University	1,540	3.99
North Dakota State University	1,535	3.98
The Ohio State University	1,262	3.27
University of Nevada at Reno	1,232	3.19
University of Georgia	1,100	2.85

Due to an existing USDA funded project on prickly pear cactus (PPC), we asked ExtensionBot, “What are some common uses or benefits from growing PPC?”. Within 7 seconds, ExtensionBot provided the responses to the question identified in Figure 1. Note the inclusion of the links the user can quickly access to learn more information from the respective sentence.

Figure 1: ExtensionBot’s Responses to “Why Would People Grow Prickly Pear Cactus?”

Hi! My name is ExtensionBot. I can help you with your extension-related questions. I am still under development so my responses might not always be reliable. What can I help you with today?

Why would people grow prickly pear cactus?

People grow prickly pear cactus (*Opuntia* spp.) for several reasons. One significant reason is its adaptability; prickly pears thrive in various conditions, including sandy and well-drained soils, making them suitable for xeriscaping and low-water-use gardens. This cactus is particularly valued in warmer regions for its ability to tolerate heat and drought, thereby requiring minimal water once established [1, 2].

Additionally, prickly pear plants produce attractive flowers that range in color from yellow to pink, adding aesthetic value to gardens and landscapes [3, 4]. Furthermore, the edible fruits, known as tunas, and the pads, called nopales, are used in a variety of recipes, adding both culinary and nutritional benefits [5]. Many people also appreciate the unique appearance of prickly pears, which can provide texture and color in garden designs [6].

For some, prickly pears serve practical purposes, such as acting as a natural barrier due to their spiny pads, deterring unwanted access to certain areas [7]. Overall, the combination of ornamental value, low maintenance needs, and edible uses makes prickly pear cactus a popular choice among gardeners.

Learn More: 1. blogs.ifas.ufl.edu 2. blogs.ifas.ufl.edu 3. blogs.ifas.ufl.edu 4. ask.extension.org 5. extension.unr.edu 6. extension.unr.edu

Based on the importance of wheat Texas’ agricultural economy, we asked ExtensionBot, “What pests should I treat for wheat?”. In less than ten seconds, ExtensionBot provided Figure 2. As in the previous Figure, note the links to additional specific educational resources.

Figure 2: ExtensionBot’s Responses to “What Pests Should I Treat for Wheat?”

what pests should I treat for wheat?

For wheat, it's important to manage several key pests to maintain a healthy crop. Here are the main pests you should consider treating:

1. **Hessian Fly:** This pest can significantly affect wheat yields. To manage them, it is advisable to plant after the Hessian fly-safe date for your area. Seed treatments can be applied, but they generally offer limited effectiveness against this pest if planted at the wrong time [1, 2].
2. **Aphids:** These pests can transmit diseases like barley yellow dwarf virus. Although natural predators often help control their populations, you should monitor for their numbers and be prepared to treat if they exceed thresholds [3, 4].
3. **Cereal Leaf Beetle:** This insect can cause considerable damage through defoliation. Regular scouting in fields is recommended, and treatment should be applied before significant damage is done [5, 6].
4. **European Corn Borer:** This pest bores into the stem of wheat plants, making it difficult to control once inside. It's crucial to treat while the larvae are still small [7].
5. **Wheat Stem Maggot:** While this pest is generally less of a concern, it can still damage stems and should be monitored [8].

Regular scouting and timely interventions based on established pest thresholds will help manage these pests effectively. If you have a specific state in mind, please share, and I can provide localized advice.

Learn More: [1. agcrops.osu.edu](#) [2. ask.extension.org](#) [3. extension.uga.edu](#)

4. Practical implications

Extension and advisory efforts should be tailored to the unique needs and contexts of different farming communities, ensuring that farmers are not only equipped with the technical skills but also the practical understanding of how AI can address their specific challenges. Together, stakeholders and researchers can help create an extension and advisory ecosystem that fosters AI-based innovation while ensuring that solutions are scalable, sustainable, and widely accessible. ExtensionBot can connect the disparity between expertise and accessibility, advancing a community or actors with timely and accurate information. AI evidence-based solutions offer extension and advisory services capacity improvements, accelerate the transfer of knowledge to farmers, and improve farmers' trust from their participation in the co-creation of knowledge and innovations. This will foster a future where AI not only drives agricultural productivity but also supports broader societal goals, such as environmental sustainability, food security, and improved livelihoods for all stakeholders in the agricultural sector. Industry 5.0 technologies seek to include human, environmental and social aspects to directly benefit actors. ExtensionBot provides immediate applied solutions to actors regardless of actor's role in food and agricultural systems.

5. Theoretical implications

ExtensionBot aids AKIS' goals of transferring agricultural information, stimulating innovation, and exchanging solutions instantaneously to actors. AKIS reliance on transferring agricultural knowledge to farmers can be enhanced by the generative AI features of ExtensionBot (Kountios et al., 2024). The systems approach of AKIS is well-positioned to harness the attributes of ExtensionBot to meet the immediate needs of food and agricultural actors. ExtensionBot provides; a) extension and advisory systems experiences implementing and scaling AI technologies; b) immediate solutions regardless of date or time; c) searching content that could be 'hidden' if not for the RAG; d) the ability to offload knowledge to fundamental issues; e) the ability to scale according to a crisis or "hot topic"; and f) an increased capacity to gather information and understand the origins of the educational information. Investigating existing barriers that prevent institutions from participating is necessary. Addressing actor's issues "where they are" is a competitive advantage of ExtensionBot. Extension and advisory efforts should be tailored to the unique needs and contexts of different farming communities, ensuring that farmers are not only equipped with the technical skills but also the practical understanding of how AI can address their specific challenges.

6. References

- Adamopoulou, E., & Moussiades, L. (2020). Chatbots: History, technology, and applications. *Machine Learning with Applications*, 2, 10000. DOI: 10.1016/j.mlwa.2020.100006
- Extension Foundation. (2024). *ExtensionBot*. <https://extension.org/tools/extbot/>.
- Fieldsend, A. F. (2020). Agricultural Knowledge and Innovation Systems in European Union policy discourse: Quo vadis? *Studies in Agricultural Economics*, 122, 115–123. DOI: 10.7896/j.2055
- Hwang, G. J., & Chang, C. Y. (2021). A review of opportunities and challenges of chatbots in education. *Interactive Learning Environments*, 31(7), 4099–4112. DOI: 10.1080/10494820.2021.1952615
- Kountios, G., Kanakaris, S., Moulogianni, C., & Bournaris, T. (2024). Strengthening AKIS for sustainable agricultural features: Insights and innovations from the European Union: A literature review. *Sustainability*, 16(16), 7068. DOI: 10.3390/su16167068
- Kpodo, J., Kordjamshidi, P., & Nejadhashemi, A. P. (2024). AgXQA: A benchmark for advanced Agricultural Extension question answering. *Computers and Electronics in Agriculture*, 225, 109349. DOI: 10.1016/j.compag.2024.109349
- Strong, R., Sprayberry, S., Dooley, K., Ahn, J., Richards, J., Kinsella, J., Lee, C-L., Ray, N., Cardey, S., Benson, C., & Ettekal, A. (2023). Sustaining global food systems with youth digital livestock production curricula interventions and adoption to professionally develop agents of change. *Sustainability*, 15(18), 13896. DOI: 10.3390/su151813896
- Thomasson, A., Ampatzidis, Y., Bhandari, M., Ferreyra, A., Gentimis, T., McReynolds, E., Murray, S., Peterson, M., Rodriguez Lopez, C., Strong, R., Tedeschi, L., Vitale, J., & Ye, X. (2025). AI in agriculture: Opportunities, challenges, and recommendations. Council for Agricultural Science and Technology (CAST), March, 1-12. DOI: 10.62300/IAAG042514
- Wirz, C. D., Demuth, J. L., Bostrom, A., Cains, M. G., Ebert-Uphoff, I., Gagne, D. J., Schumacher, A., McGovern, A., & Madlambayan, D. (2025). (Re)Conceptualizing trustworthy AI: A foundation for change. *Artificial Intelligence*, 342, 104309. DOI: 10.1016/j.artint.2025.104309

Semantic precision in agricultural advisory: Human-in-the-loop frameworks for enhancing Large Language Models in smallholder contexts

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Short abstract

Semantic precision—defined as the linguistic accuracy, contextual clarity, and relevance essential for effective knowledge transfer—is fundamental to agronomic advisory services, especially given the increasing integration of Generative Artificial Intelligence based on Large Language Models, in short LLM-based advisory tools. This study evaluates how human-LLM collaboration affects semantic precision by comparing generic and retrieval-augmented generation (RAG)-enhanced LLMs for smallholder farmers. Through mixed-methods analysis

of 2,300+ farmer-LLM interactions across Mexico, India, and Kenya, including semantic clustering, comprehension tests, and interviews with 300+ farmers and extension agents, we identify critical gaps in AI-generated advice and propose human-in-the-loop strategies. Main findings indicate that generic LLMs produced ambiguous outputs (e.g., varying regional meanings of "leaf curl"), necessitating manual correction by experts. RAG systems significantly reduced ambiguity via hyper-localized terms (e.g., dialect-specific soil names), but still required human mediation to translate descriptors like "drought-resistant" into culturally actionable practices. Farmers using human-refined RAG outputs reported higher trust and comprehension.

Human-in-the-loop processes revealed AI limitations in handling non-textual knowledge, such as oral pest histories, underscoring the need for iterative feedback between farmers, experts, and AI. Our proposed hybrid framework utilizes lightweight semantic tuning from farmer-agent dialogues, positioning AI as a scalable collaborator augmenting human expertise.

1. Introduction and Purpose

The quality and usefulness of agronomic advice depend not just on the information itself, but on how clearly, accurately, and locally relevant it is. Over the years, agricultural extension systems have shifted—from top-down, expert-driven approaches to more participatory models, and now increasingly toward digital platforms powered by artificial intelligence. As this shift unfolds, the nature of “good advice” is also changing—farmers need recommendations they can trust, understand, and apply in their specific contexts (Rose et al., 2016; Fielke et al., 2020; Klerkx, 2020).

In many regions across the Global South, conventional extension services struggle to provide tailored, practical support. Advice is often too generic or fails to reflect the lived realities of smallholder farming (Anderson & Feder, 2004; Eastwood et al., 2017; Spielman et al., 2021). Large Language Models (LLMs), especially generative AI tools, offer exciting new possibilities to bridge these gaps. They can scale advice across languages and geographies—but they also risk reproducing the same shortcomings, particularly when they miss cultural cues, local farming practices, or the experiential knowledge that’s often central to agricultural decision-making (Brewster et al., 2023; Kuska et al., 2024; Sapkota et al., 2024).

In this study, we compare two AI tools: ChatGPT-4o, a general-purpose language model, and FarmerChat, a so-called retrieval-augmented version that in contrast to a general-purpose model trained on generic data draws from locally grounded agronomic datasets. We explore how each responds to real-life questions from smallholder farmers in Mexico, Kenya, and India—three countries that reflect diverse ecologies, languages, and digital infrastructure. We also look closely at the role of people—particularly extension agents and other intermediaries—in how they help farmers review, adjust, or translate the AI’s answers. Our aim is to understand how human input improves the clarity, trustworthiness, and practical value of digital advice.

We explore four key research questions:

- How do ChatGPT-4o and FarmerChat differ in the precision and relevance of their answers to farmers’ real-world questions?
- How do farmers and extension agents from different backgrounds (in terms of age, gender, and digital skills) ask questions—and make sense of the answers?
- What kinds of misunderstandings or mismatches come up most often, and how do users deal with them?
- What role do local experts play in improving AI-generated advice—making it more accurate, useful, and trustworthy?

These questions help us reflect not just on the technical performance of AI, but on how knowledge is shared, adapted, and made meaningful in different farming contexts. This study contributes to the growing field of responsible AI in agriculture, and supports a broader rethinking of digital extension as a hybrid space where machines and people work together.

2. Design

To answer the research questions, we used a mixed-methods approach to compare ChatGPT-4o and FarmerChat. We carried out the study in Mexico, Kenya, and India—countries chosen for their ecological variety, linguistic diversity, and different stages of digital connectivity.

Over 300 smallholder farmers and extension workers participated. We assigned them basic profiles based on age, gender, and their level of comfort with digital tools. This helped us look at how people from different backgrounds ask questions and understand answers.

Participants asked real-world farming questions—about pests, fertilizer, water, and more—using voice or text in their local language. Both LLMs generated responses, which we analyzed using three main criteria:

- **Semantic precision:** Did the answer actually address the question? Was it technically correct and locally appropriate? A team of agronomists rated each answer on a four-point scale—from excellent to erroneous.
- **Complexity:** Was the answer easy to understand? We looked at sentence structure, jargon, and clarity.
- **Contextual fit:** Did the advice reflect local conditions, crops, and farming practices?

We also looked at whether participant profiles were linked to differences in response quality. For instance, were women or low-digital-literacy users more likely to get unclear or confusing advice?

3. Findings

We found important differences between the two models. ChatGPT-4o often gave smooth, confident-sounding answers—but they weren't always grounded in the local farming reality. Sometimes, for example, it offered fertilization or pest-control tips that were better suited for large commercial farms, not smallholders.

FarmerChat, on the other hand, did better when its local datasets were solid. It used terms that felt more familiar and gave advice that was easier to act on. Still, when there were gaps in the local data, it sometimes guessed—offering suggestions that seemed plausible but weren't always accurate.

That's where human input made a real difference. When extension workers reviewed or modified the responses, farmers said they trusted the advice more and found it easier to apply. For example, abstract terms like “drought-resistant” became much clearer when translated into local crops or techniques farmers already knew.

We also saw that a user's background mattered. People with low digital skills often had a hard time interpreting more technical responses. Women and bilingual users were quick to notice when advice didn't match their context—suggesting that language and inclusion are still areas where these systems need improvement.

4. Practical Implications

This study offers several important takeaways for improving AI-driven agricultural advisory systems in smallholder contexts. First, it shows that RAG-enhanced systems like FarmerChat, trained on locally validated data, provide more semantically precise responses than general-purpose models like ChatGPT-4o. This directly responds to the question of how the two

models differ in answering real-world farmer queries. However, the advantage of RAG is not even. Older users, women, and those with lower digital skills often struggled to frame questions in ways that generated useful responses or found the answers harder to interpret. This highlights a design need: AI tools must accommodate diverse ways of asking and making sense of information. That includes developing voice-based or image-supported interfaces, using local dialects and simpler language, and incorporating trusted intermediaries who can help users navigate responses.

Second, the study shows recurring semantic mismatches—responses that, while technically accurate, fail to align with local farming practices or linguistic norms. Examples include advice that assumes irrigation practices uncommon in a region, or fertilization schedules misaligned with local cropping cycles. These mismatches often emerged when users asked broad questions or when context hints were lacking. This insight answers the third research question, shedding light on where communication breakdowns most often occur and reinforcing the importance of local specificity in AI training data.

Finally, to make semantic precision operational, advisory platforms should move beyond static message delivery toward more dynamic, participatory feedback systems. This means creating space for iterative refinement—where farmer feedback, local expertise, and AI systems interact in cycles of mutual learning. Rather than replacing extension, AI becomes a tool that augments the advisory ecosystem—responsive, localized, and embedded in human relationships of trust and understanding.

5. Theoretical implications

The findings offer several contributions to how we understand the intersection of generative AI with the social, linguistic, and ethical aspects of agricultural knowledge systems, especially for smallholder farmers. First, this work provides empirical support for the essential role of human oversight in AI-driven advisory. While retrieval-augmented generation (RAG) systems clearly improve semantic precision compared to generic LLMs, our findings show they still require human mediation. This view is shared by Eastwood et al. (2019), who point to farm advisors as key "sensemakers" in today's increasingly data-rich farming environments. Findings also show that even advanced AI must be integrated into human processes of interpretation and translation to turn localized data outputs into advice that farmers can trust and act on. This highlights that achieving true semantic precision depends on both the algorithm performance and how well humans and AI work together in a hybrid system, where AI supports—rather than replaces—local human expertise (Klerkx & Rose, 2020).

The study also offers empirical grounding for the emerging idea of "digiwork" in agricultural extension. We connect this to Nettle et al. (2025), who describe the labor of digital mediation as a vital part of advisory work in Agriculture 4.0. This research shows that extension agents and digitally skilled intermediaries are not simply passing along information; they actively work to make meaning. This is more than just correcting AI text; it's a collaborative process of transformation where AI-generated content is reframed to fit local farming logic, language, and existing trust networks. This relational work makes it clear that the practical use of AI-generated knowledge depends heavily on this often unseen social and cognitive effort. This, in turn, deepens our understanding of "digiwork" by showing how much it relies on intensive sensemaking and trust-building.

This research also sheds light on the ongoing challenge of ensuring that digital advice aligns with local language and ways of knowing. The mismatches we observed—where technically correct AI responses didn't connect with users due to different terms or assumptions about context—show that semantic precision is more than just being factually correct; it's closely

tied to how easily information can be understood, how credible it seems, and its cultural and linguistic fit. These findings add a new layer to earlier work on the vital role of local and indigenous knowledge in extension (Šūmane et al., 2018; Leeuwis & Aarts, 2011) by showing how AI changes these dynamics. Specifically, if not designed carefully, AI can create new communication barriers or make users feel disconnected. Yet, the human-in-the-loop approach also offers new ways to bridge the gap between general AI knowledge and local farmers' understanding. This suggests that AI development must not only involve users (Steinke et al., 2022) but also seriously consider the diversity of languages and communication styles.

Finally, this study brings an important equity perspective to discussions about AI in agriculture. The fact that AI-generated advice was more useful for some user profiles (based on age, gender, digital literacy) than others highlights the risk that digital innovations could unintentionally make existing knowledge gaps and power differences worse (Spielman et al., 2021). This fits with increasing concerns in the literature about the "digital divide" and how AI could maintain or even worsen biases if not designed and used with clear equity goals (Ayim et al., 2022; CGIAR, 2024 reports on AI ethics and inclusion). Our findings suggest we need to actively develop strategies so that AI advisory tools are not only clear and precise but also culturally appropriate, fair, and beneficial for everyone.

6. References

- Anderson, J. R., & Feder, G. (2004). Agricultural Extension: Good Intentions and Hard Realities. *The World Bank Research Observer*, 19(1), Article 1. <https://doi.org/10.1093/wbro/lkh013>
- Ayim, C., Kassahun, A., Addison, C., & Tekinerdogan, B. (2022). Adoption of ICT innovations in the agriculture sector in Africa: A review of the literature. *Agriculture & Food Security*, 11, 22. <https://doi.org/10.1186/s40066-022-00364-7>
- Brewster, C., Kalatzis, N., Nouwt, B., Kruiger, H., & Verhoosel, J. (2023). Data sharing in agricultural supply chains: Using semantics to enable sustainable food systems. *Semantic Web*, 14(3), 515-545. <https://doi.org/10.3233/SW-233287>
- Eastwood, C., Klerkx, L., & Nettle, R. (2017). Dynamics and distribution of public and private research and extension roles for technological innovation and diffusion: Case studies of the implementation and adaptation of precision farming technologies. *Journal of Rural Studies*, 49, 1–12. <https://doi.org/10.1016/j.jrurstud.2016.11.008>
- Eastwood, C. R., Ayre, M., Nettle, R., & Dela Rue, B. (2019). Making sense in the cloud: Farm advisory services in a smart farming future. *NJAS - Wageningen Journal of Life Sciences*, 90-91, 100305. <https://doi.org/10.1016/j.njas.2019.04.002>
- Fielke, S., Taylor, B., & Jakku, E. (2020). Digitalisation of agricultural knowledge and advice networks: A state-of-the-art review. *Agricultural Systems*, 180, 102763. <https://doi.org/10.1016/j.agsy.2019.102763>
- Klerkx, L. (2020). Advisory services and transformation, plurality and disruption of agriculture and food systems: Towards a new research agenda for agricultural education and extension studies. *The Journal of Agricultural Education and Extension*, 26(2), 131–140. <https://doi.org/10.1080/1389224X.2020.1738046>
- Klerkx, L., & Rose, D. (2020). Dealing with the game-changing technologies of Agriculture 4.0: How do we manage diversity and responsibility in food system transition pathways? *Global Food Security*, 24, 100347. <https://doi.org/10.1016/j.gfs.2019.100347>
- Kuska, M. T., Wahabzada, M., & Paulus, S. (2024). AI for crop production – Where can large language models (LLMs) provide substantial value? *Computers and Electronics in Agriculture*, 221, 108924. <https://doi.org/10.1016/j.compag.2024.108924>

-
- Leeuwis, C., & Aarts, N. (2011). Rethinking Communication in Innovation Processes: Creating Space for Change in Complex Systems. *The Journal of Agricultural Education and Extension*, 17(1), 21–36. <https://doi.org/10.1080/1389224X.2011.536344>
- Nettle, R., et al. (2025). Digiwork: how agriculture 4.0 is changing work for farm advisers. *Frontiers in Sustainable Food Systems*. Volume 9 - 2025 <https://doi.org/10.3389/fsufs.2025.1542007>
- Rose, D. C., Sutherland, W. J., Parker, C., Lobley, M., Winter, M., Morris, C., Twining, S., Ffoulkes, C., Amano, T., & Dicks, L. V. (2016). Decision support tools for agriculture: Towards effective design and delivery. *Agricultural Systems*, 149, 165–174. <https://doi.org/10.1016/j.agsy.2016.09.009>
- Sapkota, R., Qureshi, R., Hassan, S. Z., Shutske, J., Shoman, M., Sajjad, M., Dharejo, F. A., Paudel, A., Li, J., Meng, Z., Sadak, F., Hadi, M. U., & Karkee, M. (2024). *Multi-Modal LLMs in Agriculture: A Comprehensive Review*. TechRxiv. <https://doi.org/10.36227/techrxiv.172651082.24507804>
- Spielman, D. J., Lecoutere, E., Makhija, S., & Van Campenhout, B. (2021). Information and Communications Technology (ICT) and Agricultural Extension in Developing Countries. *Annual Review of Resource Economics*, 13(1), 155-176. <https://doi.org/10.1146/annurev-resource-101520-080657>
- Steinke, J., Ortiz-Crespo, B., van Etten, J., & Müller, A. (2022). Participatory design of digital innovation in agricultural research-for-development: Insights from practice. *Agricultural Systems*, 195, 103313. <https://doi.org/10.1016/j.agsy.2021.103313>
- Šūmane, S., Kunda, I., Knickel, K., Strauss, A., Tisenkopfs, T., Rios, I. des I., Rivera, M., Chebach, T., & Ashkenazy, A. (2018). Local and farmers' knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture. *Journal of Rural Studies*, 59, 232–241. <https://doi.org/10.1016/j.jrurstud.2017.01.020>

Session 2C

CRITICAL THINKING ON AI AND EXTENSION

Large Language Models (LLMs) in Agriculture: Opportunities and Challenges in Agricultural Extension Services (EAS)

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Short abstract

Large Language Models (LLMs) are artificial intelligence tools, trained on vast datasets, that demonstrate advanced natural language processing abilities, enabling them to understand and generate text that resembles human communication. With the rise of digital agriculture, Agricultural Extension and Advisory Services (EAS) continue to play an essential role in facilitating the exchange of information and knowledge among farmers. The emergence of Large Language Models (LLMs) offers new possibilities for transforming EAS delivery through their ability to interpret and generate human-like text. However, their use is still in the early stages, with limited understanding of how they align with the roles of EAS providers. Using the PRISMA framework, this rapid review identified relevant literature and conducted a thematic analysis in NVIVO. Results show that LLMs can support various advisory tasks, including question answering, climate-related insights, and pest and disease detection. These capabilities present significant opportunities for EAS to deliver more responsive and context-specific support to farmers. The findings highlight the need for targeted capacity development initiatives to equip EAS with the skills to interpret and validate LLM outputs effectively, ensuring the accurate dissemination of recommendations.

1. Purpose

As innovation intermediaries, EAS play a unique systemic role within the agricultural innovation system by ensuring that technologies align with local contexts and by promoting an enabling environment that supports farmers' adoption decisions (Abhijeet et al., 2023; Klerkx & Leeuwis, 2009). They act as consultants, educators, advisors, facilitators, and mediators, offering diverse learning and decision pathways (Cristóvão et al., 2012; Sugihono et al., 2022). Data-driven innovative farming technologies further transform farmer-advisor relationships, as this implies that EAS will not only encourage the adoption of these innovative technologies but also upgrade their capabilities to assist farmers in applying and integrating these tools into their operations (Eastwood et al., 2019). Given their natural language processing capabilities, LLMs can be integrated into EAS to enhance human expertise and support data-driven decision-making (Holzinger et al., 2022; Tzachor et al., 2023). However, it remains unclear how this process might unfold in practice. This study seeks to contribute to this emerging area of research by exploring the opportunities and limitations of LLMs in agriculture, while proposing evolving roles for EAS providers.

2. Design

A rapid review was conducted to synthesize existing evidence due to its more effective use of resources (Garritty et al., 2024). A database search was conducted between May and July 2024. The inclusion criteria focused on only peer-reviewed studies examining the application of LLMs in agricultural tasks, particularly those that align with farm-level extension services and roles. Only English-language publications were included in this review. Studies were excluded if they examined LLM applications outside the agricultural sector or discussed general AI technologies without explicitly referencing large language models. The initial search retrieved 587 articles. After removing 96 duplicates, 491 records were screened by title and abstract. Of these, 177 full-text articles were assessed, and 12 met the inclusion criteria. Ultimately, data summaries exported from Covidence were imported into NVivo for analysis.

3. Findings

3.1 LLM Opportunities and Challenges

The distribution of studies indicates that LLMs are primarily utilized in agriculture to provide technical advice and diagnostic functions. The most explored themes are Question & Answer solutions (28.57%) of the papers, Pest & Disease Identification, and Climate & Environmental Insights, each accounting for 21.43%, including only one study that tailored LLM for language support in agriculture. Data Interpretation & Integration follows with 14.29%, pointing to the potential of multimodal models that combine text, images, and structured data to support more complex agricultural analyses. Lastly, Crop Monitoring & Yield Prediction is the least represented with 7.14%

The studies generally focus on the transformative potential of LLMs, emphasizing their significance in agriculture. Limitations include misinformation, bias, and hallucination risks, particularly when models have minimal domain-specific training (Ibrahim et al., 2024; Nakasato et al., 2021). Additionally, insufficient annotated agricultural data reduces reliability, while challenges with reproducibility, adaptability, and scalability also pose significant concerns (Liang et al., 2023). Emphasis is placed on improving trust, user engagement, and transparency through better interaction design and chatbot integration (Chandra et al., 2024), while other studies caution that without proper supervision and human oversight, the benefits of these technologies may be compromised (Nakasato et al., 2021; Tzachor et al., 2023).

3.2 Implications for EAS

LLMs can analyze large volumes of agricultural data to generate insights and recommendations that support informed decision-making (Barman et al., 2024). They are also transforming communication in agriculture by enabling interaction with agronomic data through natural language queries (Ding et al., 2023). As key intermediaries, EAS are well-positioned to improve the delivery of agricultural advice by leveraging LLM capabilities. Our findings also support prior research, linking digital transitions to evolving EAS skillsets and responsibilities (Charatsari et al., 2022; Eastwood et al., 2019; Gow et al., 2020; Klerkx et al., 2019). This will enable EAS to validate and contextualize LLM-generated output, ensuring accuracy and relevance. However, these roles require strong data-centric capacities, including the ability to interpret, synthesize, and assess the credibility of LLM outputs, many of which may be absent, especially in the Global South (Ziegler et al., 2024)

4. Practical Implications

EAS can support LLM integration in agriculture, but must further evolve in their roles to utilize these tools. As traditional EAS roles change, understanding the new competencies and responsibilities needed to integrate LLMs into their workflows is essential. Rus & Kendeou (2025) note that using LLMs effectively requires technical understanding, domain knowledge, and sound judgment. In EAS, this indicates the key competencies needed to interpret and apply LLM-generated information to support farmers. Targeted assistance, including training, capacity development initiatives, and supportive institutional policies, must be implemented to enable EAS to manage the complexities of the digitalization process. Also, involving EAS and farmers in technology development is essential, as many LLMs lack agricultural vocabulary and context, making them less relevant and usable in real-world farming settings (Omara et al., 2023).

5. Theoretical Implications

The study reinforces the roles of EAS as critical intermediaries in agricultural innovation, emphasizing their role in aligning technology with farmers' needs and bridging gaps among other agricultural stakeholders to encourage inclusive innovation and promote adoption (Klerkx & Leeuwis, 2009). Although LLMs hold significant promise for agriculture, their effectiveness depends on their successful integration within broader systemic and policy frameworks (Ding et al., 2023). Therefore, further empirical research is needed to expand our understanding of the process of LLM adoption in agricultural systems. Applying a Responsible Innovation lens supports a reflexive, anticipatory, inclusive, and responsive approach to agricultural innovation (Brundage, 2016), offering deeper theoretical insights into how technologies like LLMs can be responsibly embedded within these systems.

6. References

- Abhijeet, S., Kanta K, Bardhan, R., Chouhan, N. S., Dixit, D., Tripathi, S., Pandey, A., & Ahmed, R. (2023). A Comprehensive Review on Role of Agricultural Extension Services in the Sustainable Development of Global Agriculture. *International Journal of Environment and Climate Change*, 13(10), 3514–3525. <https://doi.org/10.9734/ijecc/2023/v13i103021>
- Barman, D., Guo, Z., & Conlan, O. (2024). The Dark Side of Language Models: Exploring the Potential of LLMs in Multimedia Disinformation Generation and Dissemination. *Machine Learning with Applications*, 16, 100545. <https://doi.org/10.1016/j.mlwa.2024.100545>
- Brundage, M. (2016). Artificial Intelligence and Responsible Innovation. *PT-AI*. https://doi.org/10.1007/978-3-319-26485-1_32
- Chandra, R., Shekhar Kumar, S., Patra, R., & Agarwal, S. (2024). Decision support system for Forest fire management using Ontology with Big Data and LLMs. *ArXiv E-Prints*, arXiv:2405.11346-. <https://doi.org/10.48550/arXiv.2405.11346>
- Charatsari, C., Lioutas, E. D., Papadaki-Klavdianou, A., Michailidis, A., & Partalidou, M. (2022). Farm advisors amid the transition to Agriculture 4.0: Professional identity, conceptions of the future and future-specific competencies. *Sociologia Ruralis*, 62(2), 335–362. <https://doi.org/10.1111/soru.12364>
- Cristóvão, A., Koutsouris, A., & Kügler, M. (2012). Extension systems and change facilitation for agricultural and rural development. In *Farming Systems Research into the 21st Century: The New Dynamic* (pp. 201–227). Springer Netherlands. https://doi.org/10.1007/978-94-007-4503-2_10
- Ding, Q., Ding, D., Wang, Y., Guan, C., & Ding, B. (2023). Unraveling the landscape of large language models: a systematic review and future perspectives. *Journal of Electronic Business & Digital Economics*. <https://doi.org/10.1108/JEBDE-08-2023-0015>

- Eastwood, C., Ayre, M., Nettle, R., & Dela Rue, B. (2019). Making sense in the cloud: Farm advisory services in a smart farming future. *NJAS: Wageningen Journal of Life Sciences*, 90–91(1), 1–10. <https://doi.org/10.1016/j.njas.2019.04.004>
- Garritty, C., Nussbaumer-Streit, B., Hamel, C., & Devane, D. (2024). Rapid reviews methods series: assessing the appropriateness of conducting a rapid review. *BMJ Evidence-Based Medicine*, bmjebm-2023-112722. <https://doi.org/10.1136/bmjebm-2023-112722>
- Gow, G., Chowdhury, A., Ramjattan, J., & Ganpat, W. (2020). Fostering effective use of ICT in agricultural extension: participant responses to an inaugural technology stewardship training program in Trinidad. *The Journal of Agricultural Education and Extension*, 26(4), 335–350. <https://doi.org/10.1080/1389224X.2020.1718720>
- Holzinger, A., Saranti, A., Angerschmid, A., Retzlaff, C. O., Gronauer, A., Pejakovic, V., Medel-Jimenez, F., Krexner, T., Gollob, C., & Stampfer, K. (2022). Digital Transformation in Smart Farm and Forest Operations Needs Human-Centered AI: Challenges and Future Directions. *Sensors*, 22(8), 3043. <https://doi.org/10.3390/s22083043>
- Ibrahim, A., Senthilkumar, K., & Saito, K. (2024). Evaluating responses by ChatGPT to farmers' questions on irrigated lowland rice cultivation in Nigeria. *Scientific Reports (Nature Publisher Group)*, 14(1), 3407. <https://doi.org/https://doi.org/10.1038/s41598-024-53916-1>
- Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS: Wageningen Journal of Life Sciences*, 90–91(1), 1–16. <https://doi.org/10.1016/j.njas.2019.100315>
- Klerkx, L., & Leeuwis, C. (2009). Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological Forecasting and Social Change*, 76(6), 849–860. <https://doi.org/10.1016/j.techfore.2008.10.001>
- Liang, J. Q., Li, D. C., Lin, Y. T., Wu, S., & Huang, Z. C. (2023). Named Entity Recognition of Chinese Crop Diseases and Pests Based on RoBERTa-wwm with Adversarial Training. *AGRONOMY-BASEL*, 13(3). <https://doi.org/10.3390/agronomy13030941>
- Nakasato, C. F., Menon J, M., Seidel O, A., Spindola, S., Reali C, Anna H, & Gagliardi C, F. (2021). DEEPAGÉ: Answering Questions in Portuguese about the Brazilian Environment. *ArXiv E-Prints*, arXiv:2110.10015-. <https://doi.org/10.48550/arXiv.2110.10015>
- Omara, J., Talavera, E., Otim, D., Turcza, D., Ofumbi, E., & Owomugisha, G. (2023). A field-based recommender system for crop disease detection using machine learning. *FRONTIERS IN ARTIFICIAL INTELLIGENCE*, 6. <https://doi.org/10.3389/frai.2023.1010804>
- Rus, V., & Kendeou, P. (2025). Are LLMs actually good for learning? *AI & SOCIETY*. <https://doi.org/10.1007/s00146-025-02323-9>
- Sugihono, C., Juniarti, H. A., & Nugroho, N. C. (2022). Digital Transformation in The Agriculture Sector: Exploring The Shifting Role of Extension Workers. *STI Policy and Management Journal*, 7(2). <https://doi.org/10.14203/STIPM.2022.350>
- Tzachor, A., Devare, M., Richards, C., Pypers, P., Ghosh, A., Koo, J., Johal, S., & King, B. (2023). Large language models and agricultural extension services. *NATURE FOOD*, 4(11), 941–948. <https://doi.org/10.1038/s43016-023-00867-x>
- Ziegler, M., Lothian, S., O'Neill, B., Anderson, R., & Ota, Y. (2024). AI Language Models Could Both Help and Harm Equity in Marine Policymaking: The Case Study of the BBNJ Question-Answering Bot. *ArXiv E-Prints*, arXiv:2403.01755-. <https://doi.org/10.48550/arXiv.2403.01755>

*Tracing (Dis)Affordances in Farmer-Centric Digital Extension Systems***Eliot Jones-Garcia^{1,2}, Katharine Legun¹, Kristin Davis², Laurens Klerkx^{1,3}**¹ WUR (NL)² IFPRI (USA)³ University of Talca (Chile)

Short abstract

Digital extension (DE) platforms are increasingly framed as participatory and farmer-centric, yet questions remain about how design processes shape their use, impact, and equity. This paper addresses two core critiques: that farmer involvement in DE remains selective and superficial, and that existing frameworks often overlook how farmers adapt or repurpose tools in ways that diverge from designers' intentions. Drawing on affordance theory, the study examines how opportunities and constraints emerge through interactions between technologies, users, and their material, cultural, and socioeconomic environments. Using ethnographic case studies from Kenya and the U.S./Europe—including observations and 50 semi-structured interviews with farmers, developers, and extensionists—it explores how DE platforms support or inhibit context-sensitive design, peer learning, and sustained participation. Findings are organised by affordance dimensions and trace trade-offs between flexibility, usability, and scale. While DE systems afford iterative development and local adaptation, they also risk displacing labour onto farmers, reinforcing dependency, or obscuring critical gaps in trust and accountability. The framework developed here offers a means of evaluating DE not as a fixed product, but as a relational and evolving sociotechnical system. It provides a vocabulary for anticipating design trade-offs and assessing whose needs, capacities, and knowledge are ultimately centred.

1. Purpose

Digitalisation is reshaping agricultural extension, transforming how services are designed and delivered (Fielke et al., 2020; Ingram & Maye, 2020; Steinke et al., 2021). Mobile technologies and data-driven systems transcend geographic barriers, providing on-demand expert support and site-specific agroecological recommendations (Eichler Inwood & Dale, 2019). Social media enables peer-to-peer learning, often bypassing traditional extension channels (Coggins et al., 2025; Schoemaker et al., 2022). In response, extensionists are increasingly adopting farmer-centric digital extension (DE) platforms that integrate user-driven feedback (Eastwood et al., 2022; Kenny & Regan, 2021; Ortiz-Crespo et al., 2020; Steinke et al., 2022). These models evolve continuously, adapting to farmers' needs and fostering co-created, context-sensitive knowledge development at scale (Bull et al., 2024; Ensor & de Bruin, 2022; Klerkx, 2020, 2021).

The extant literature reflects considerable optimism about the potential of digital governance mechanisms—particularly open-source and open-access platforms—to promote farmer-driven innovation, enabling greater autonomy and reconfiguring power relations within agricultural knowledge networks (Carbonell, 2016; Kenny et al., 2021). Empirical studies highlight those digital tools designed with farmers—rather than for them—

tend to see higher levels of uptake and sustained use. Coggins et al., (2025) find that farmer-operated WhatsApp groups were more trusted and widely adopted than purpose-built apps, due to their alignment with existing communication norms and shared ownership. These findings suggest that farmer-centric design can help mitigate some of the power asymmetries embedded in DE—while still advancing a broader trajectory of technological development.

This paper is framed around two critiques of these claims. The first is practical: despite promises of inclusivity, participation in DE initiatives is often selective and superficial, with decision-making concentrated among designers, funders, and policymakers (Hyysalo & Johnson, 2024; Klerkx & Leeuwis, 2008). As a result, DE risks reinforcing inequalities in access and influence, with better-resourced farmers more likely to benefit, while marginalized actors struggle to engage or access services equitably (Bull et al., 2024; Fielke et al., 2020; Kenny et al., 2021). Few studies examine how these platforms perform beyond research and development contexts, where tools are piloted but rarely embedded in long-term, community-owned systems (Eastwood et al., 2022). There is limited evidence that such initiatives achieve a successful “exit to community”; farmers often remain dependent on external designers and institutions (Smith et al., 2021). Whether farmer-led DE enhances agency or delivers equitable outcomes thus remains uncertain (McCampbell et al., 2021, 2022).

The second critique is conceptual: existing frameworks often adopt a deterministic, technocentric lens that lacks sensitivity to diverse contexts and overlooks how farmers adapt, repurpose, or recombine digital tools in ways that diverge from design intentions (Friedman et al., 2024; Glover, 2022; Higgins et al., 2017, 2023). As a result, evaluation frameworks treat DE tools as static interventions rather than dynamic systems. Designers receive little guidance on how to adjust tools over time, limiting their ability to anticipate pitfalls or respond to farmer feedback (Coggins et al., 2021, 2025). This rigidity is reinforced by short project timelines and limited funding for long-term adaptation—constraints rarely acknowledged in existing frameworks (Saha et al., 2022; Steinke et al., 2022).

In response, this paper delivers a framework drawing from Glover’s (2022) technographic approach to affordance theory, which understands affordances as opportunities and constraints that arise through interactions among technologies, users, and their environments. These include material conditions such as infrastructure and technical access (e.g., connectivity, device availability); cultural dimensions like social meanings and practices (e.g., language, local metaphors); and socioeconomic structures—wealth, labour, policy support—that shape who can participate and benefit.

Affordance theory has been used to examine how digital tools enable or constrain participation in the design and delivery of extension services (Ditzler et al., 2018; Eastwood et al., 2022; Schoemaker et al., 2022; Sewell et al., 2017); how labour is distributed in anticipating, fitting, and assembling technologies across contexts (Higgins et al., 2023; Legun & Burch, 2021; Lundström & Lindblom, 2018, 2021; Obeng Adomaa et al., 2022); and how different forms of knowledge and learning are made visible—or excluded—through platform architecture and interaction (Ensor & de Bruin, 2022; Pawera et al., 2024).

This study builds on that work by applying Glover’s conception of disaffordances—features that restrict use, limit agency, or reveal mismatches between design and context. Extending an earlier discourse study of “farmer-centric” design narratives, it investigates how these ideals are negotiated in practice. Through grounded analysis of two DE platforms, it explores how affordances and disaffordances shape design trade-offs, constraints, and unintended uses.

It asks: ***How are affordances and disaffordances distributed through the design, delivery and implementation of farmer-centric digital extension?***

2. Approach

This study draws on two ethnographic case studies from the Global North and South, selected for their contrasting farming systems, design requirements, and stakeholder networks. Data collection included participant observation and 50 semi-structured interviews—30 with farmers and 20 with designers, developers, and extensionists—conducted over two years.

Interviews explored decision-making, access, and accountability—probing who shapes design, who benefits, and how sustainability is interpreted. Data were coded abductively in NVivo, using a combination of framework-informed and emergent codes. Findings are presented thematically, organised by the dimensions of affordance theory. Each section traces the trade-offs between specific affordances and disaffordances as they arise in DE design, delivery, and use.

DE1, based in Kenya, supports smallholder farmers through a mobile-first, multilingual platform (P1) designed for offline use and experiential learning. Features include task-oriented navigation, visual storytelling, and a Noticeboard for peer exchange. DE1 emphasises local cultural references to support self-reliance and decentralised knowledge-sharing.

DE2, developed in the U.S. and Europe, offers a modular, open-source platform (P2) for diversified farm management. Built by a farmer-developer, it allows users to log and model operations, integrate external tools, and retain data control. P2 promotes collaborative benchmarking and open knowledge exchange for environmental stewardship.

3. Findings

3.1 Material (Dis)affordances

System adaptation and behavioural change

DE platforms afford continuous technical refinement through iterative, often asynchronous collaboration. In DE1, one extensionist explained how training sessions help farmers navigate connectivity limitations by showing that the app works offline and encouraging them to share screenshots when confused—a practice that led him to suggest a “share” feature to the designer. These practical adaptations—prompted by translation challenges, user questions, or network gaps—enable systems to evolve through use. While such feedback loops support long-term improvement, they also risk disaffordances: systems may appear unfinished or unstable, with unclear boundaries between user error, infrastructural breakdown, and software design. This flexibility is most effective when sustained by proximity and resources—such as in-person onboarding—raising the question of where the burden of adaptation lies: the user, the infrastructure, or the tool.

Voluntary Customisation and Community Responsibility

Both DE1 and DE2 afford farmers the ability to localise digital tools to their agroecological and social contexts. One DE2 user built a detailed map of seed performance across his fields, using this to identify strong performers and share insights with neighbours. While many farmers value the platform’s flexibility, incremental learning curve, and capacity to reflect individual priorities, they also take on significant labour: configuring settings, inputting data, troubleshooting issues—often not just for themselves, but for the benefit of the broader community. These contributions blur the line between voluntary experimentation and designer expectation. The platforms benefit from this farmer-driven innovation, but rely

disproportionately on a small, technically adept group—raising questions about scalability and sustainability of such user-led responsibility.

Breadth and Coherence

P1 and P2 deliver a wide range of information, with the potential to uncover patterns overlooked by conventional advisory systems. In DE1, farmers praised the app’s visual storytelling and multilingual options for offering holistic, intuitive insights—not just step-by-step advice. In DE2, the ability to track cost savings and share findings was seen as similarly empowering. However, this breadth can strain coherence. As one designer put it, “You’re using your best judgement... it’s like writing laws—you have to consider the implications for the whole system.” Adding features may serve some users while alienating others; some outputs are too abstract or technical to be useful while others clash with how farmers interpret value—for example, numerical data may fail to convey biological processes meaningfully. Ultimately, scalability often depends not on fulfilling every user request, but on strategically limiting flexibility to preserve a clear and usable structure.

3.2 Cultural (Dis)affordances

Iteration and Intention

The design cultures behind DE1 and DE2 are grounded in values like sustainability, open collaboration, and incremental development. These principles have helped teams build institutional legitimacy, often acting as intermediaries between agricultural communities and technical networks. However, these same values can produce friction. As one DE2 developer reflected, the team had become “a bit too absolutist” about iteration—pushing new features without pausing to consider long-term direction or the types of relationships being built. While openness fosters flexibility, it can also obscure the need for more deliberate planning, role clarity, and alignment between technical progress and social purpose. This tension is intensified by donor demands for scale, which can displace local commitments and erode the participatory ideals they claim to promote.

Intuition and prescription

DE1’s interface privileges adaptable techniques over rigid protocols, making it accessible to a broad range of users, including older or subsistence-focused farmers. One user described a fertiliser app that delivered costed, step-by-step instructions as capital-intensive and inflexible, whereas P1 “gives you techniques,” enabling situational decision-making based on intuition and experience. Crucially, the kind of knowledge encoded in data-driven tools is not always legible or shareable—it may guide individual action but fail to circulate in ways that support collective understanding. While DE1’s audio-visual content, local language support, and offline access foster informal exchange across households and communities, gaps remain between platform logic and lived practice. Concepts like “mulching” lack direct translation, and adoption often depends more on peer validation than access alone. Even without prescriptive design, cultural fit remains fragile—and often determines whether guidance takes root.

Embracing Tradition and Translating Technology

Digital extension platforms operate at the intersection of deep-rooted cultural values and evolving individual needs. In both DE1 and DE2, technology was not simply a means of delivering advice but a way of affirming farming as a culturally embedded practice. DE1 users appreciated that the app included health and nutrition, recognising that agriculture is inseparable from family, care, and identity. Technology was seen not as a replacement for

tradition but a way to extend it—enabling generational learning, optimising family routines, and even offering space for celebration. In DE2, designers described drawing inspiration from embodied knowledge and local practice, treating knowledge as material and shaped by lived experience.

Still, platforms risk cultural misalignment when meaning is presumed rather than co-constructed. As one designer reflected, “you’re at this fundamental tension... between individual sovereignty and autonomy, and the need to do big things together... it’s like a tree.” Adoption often depends not only on individual fit but on shared uptake, visibility, and reinforcement within communities. The act of translation—between traditions and technologies, individual needs and collective rhythms—becomes central to platform legitimacy. The challenge is not simply designing for use, but for resonance: building tools that can hold both personal autonomy and the commons together in one living system.

3.3 Socioeconomic (Dis)affordances

Decentralization and need for oversight

P2’s open-source design aims to decentralise control by enabling users to contribute and adapt modular features. Governance is shaped through asynchronous discussions, open community calls, and peer-developed modules, reframing technology as a site of collective agency rather than top-down control. However, as one developer explained, this also introduces risk: “we’ve talked about making things more formal... if something’s buggy or breaks a whole P2 install, that’s a problem.” Without adequate oversight, decentralisation can replicate the very hierarchies it seeks to avoid. While openness supports long-term adaptability and cost reduction, it also demands coordination, review, and negotiation—conditions that are not always equally available. Decisions about which tools to promote are shaped as much by organisational agendas and legal constraints as by farmer input, raising questions of governance, accountability, and responsibility.

Intrinsic motivation and extrinsic demand

Both platforms enable farmers to reduce risk, diversify practices, and pursue more autonomous livelihoods—whether by applying for certification, meeting compliance standards, or bypassing intermediaries. These features are especially valued by those excluded from conventional advisory services. Yet digital participation is shaped by more than access. As one DE2 user put it, “you have to price a certain level of happiness”—referring to the economic tension between what farmers aspire to do and what systems demand. Some farmers monitor plant diversity out of intrinsic interest; others contribute only as far as time, cost, or institutional requirements allow. When data collection becomes a condition for support, it risks reinforcing inequalities between those who can afford to demonstrate value and those who cannot.

Farmer centrality and deliberative investment

While both DE1 and DE2 foster peer exchange and open participation, the success of “farmer-centricity” often hinges on informal infrastructures of trust. One DE1 user recounted learning about an ash-based method to prevent armyworms through the app. His first attempt failed—until other farmers explained that it had to be used preventively. The second attempt worked. Here, the platform enabled access, but it was peer interpretation that translated information into effective practice. These micro-adjustments reflect how farmer-centric design depends on more than open infrastructure—it requires time, connectivity, visibility, and ongoing investment in shared learning environments. Without that, even participatory systems risk reinforcing uneven capacities to engage.

4. Practical Implications

This study offers practical insight into how DE platforms are shaped by trade-offs between flexibility, usability, and scale—revealing how affordances and disaffordances emerge during design, delivery, and use.

First, it deepens understanding of how extensionists manage procedural tensions between long-term fit and rapid implementation. Existing work highlights the value of iterative design (Bull et al., 2024; Eastwood et al., 2022), but this study shows how institutional timelines, donor expectations, and limited resourcing often prevent systems from evolving with user feedback. Steinke et al. (2022) describe how the reuse of existing tools is discouraged; this study adds that designers must constantly negotiate between configurability and coherence, often under pressure to deliver proof of impact rather than process-based improvements.

Second, it contributes to debates on the distribution of labour and responsibility in DE. While platforms may foster autonomy and co-learning, they often shift the burden of innovation onto farmers. Smith et al. (2021) and Vernooij et al. (2024) argue that farmers are made responsible for delivering climate adaptation without corresponding support. This study extends those insights by showing how platform engagement depends on time, trust, and digital fluency—resources not equally distributed. Participation is shaped not just by access, but by obligations to input data, interpret outputs, and manage risk, often without institutional reinforcement.

Third, it clarifies challenges related to recognition and meaning-making. While DE platforms increasingly promote co-design, they often rely on generalised user profiles or efficiency metrics that misrepresent how farmers think, share, and act. Building on Bull et al. (2024) and Eastwood et al. (2022), this study shows how technologies overlook farmers' moral economies, seasonal logics, and cultural framings of success. Examples from Nelson et al. (2024) and Pawera et al. (2024) resonate with this finding: if tools do not reflect how farmers interpret value—through intuition, community validation, or embodied practice—they are unlikely to stick.

5. Theoretical Implications

Theoretically, this study advances a relational understanding of how DE platforms work—not as static tools, but as dynamic systems shaped by material, cultural, and socioeconomic interaction.

First, it builds on Glover (2022), Eastwood et al. (2022), and Obeng Adomaa et al. (2022) by showing how affordances are not inherent features but emergent properties of relationships. This approach allows designers and researchers to track not only what platforms enable, but how those capabilities are taken up, resisted, or reshaped by users over time.

Second, it contributes a structured way of identifying and analysing trade-offs. Rather than categorising technologies as successful or failed, the framework shows how value is continually negotiated across phases of implementation. Drawing on Bull et al. (2024) and McCampbell et al. (2021), the study challenges narratives of technological progress by revealing the frictions between platform goals and farmer realities. Affordances offer a vocabulary for recognising these frictions as central—not peripheral—to DE design.

Third, the framework contributes to anticipatory design practice. Affordances provide a lens for identifying short- and long-term impacts, including potential exclusions, dependencies, or mismatches. As Nelson et al. (2024) show, platforms designed for individual users may fail when farming is a shared practice. Likewise, the promise of interactivity or precision may obscure the relational labour required for uptake. By making trade-offs visible, this approach

helps designers avoid unintended consequences and respond more effectively to the diversity of farming lives and labour.

In sum, the framework provides both a diagnostic tool and a language for more adaptive, reflective, and inclusive design in digital extension.

6. References

- Bull, E. M., van der Cruyssen, L., Vágó, S., Király, G., Arbour, T., & van Dijk, L. (2024). Designing for agricultural digital knowledge exchange: applying a user-centred design approach to understand the needs of users. *Journal of Agricultural Education and Extension*, 30(1), 43–68. <https://doi.org/10.1080/1389224X.2022.2150663>
- Carbonell, I. M. (2016). The ethics of big data in big agriculture. *Internet Policy Review*, 5(1), 1–13. <https://doi.org/10.14763/2016.1.405>
- Coggins, S., McCampbell, M., & Sharma, A. (2021). *How have smallholder farmers used digital extension tools? Developer and user voices from Sub-Saharan Africa, South Asia and Southeast Asia*. 148, 148–162.
- Coggins, S., Munshi, S., Smith, J., Yadav, A. K., Poonia, S. P., Patil, S., Singh, N. K., Sawarn, A., Ireland, D. C., McDonald, A. J., Singh, D. K., Sherpa, S. R., & Craufurd, P. (2025). How do chat apps support the use of farming videos in agricultural extension: A case study from Bihar, India. *NJAS: Impact in Agricultural and Life Sciences*, 97(1). <https://doi.org/10.1080/27685241.2024.2420803>
- Ditzler, L., Klerkx, L., Chan-Dentoni, J., Posthumus, H., Krupnik, T. J., Ridaura, S. L., Andersson, J. A., Baudron, F., & Groot, J. C. J. (2018). Affordances of agricultural systems analysis tools: A review and framework to enhance tool design and implementation. *Agricultural Systems*, 164, 20–30. <https://doi.org/10.1016/j.agsy.2018.03.006>
- Eastwood, C., Turner, F., & Romera, A. (2022). Farmer-centred design: An affordances-based framework for identifying processes that facilitate farmers as co-designers in addressing complex agricultural challenges. *Agricultural Systems*, 195. <https://doi.org/10.1016/j.agsy.2021.103314>
- Eichler Inwood, S. E., & Dale, V. H. (2019). State of apps targeting management for sustainability of agricultural landscapes. A review. In *Agronomy for Sustainable Development* (Vol. 39, Issue 1). Springer-Verlag France. <https://doi.org/10.1007/s13593-018-0549-8>
- Ensor, J., & de Bruin, A. (2022). The role of learning in farmer-led innovation. *Agricultural Systems*, 197, 103356. <https://doi.org/10.1016/J.AGSY.2021.103356>
- Fielke, S., Taylor, B., & Jakku, E. (2020). Digitalisation of agricultural knowledge and advice networks: A state-of-the-art review. In *Agricultural Systems* (Vol. 180, p. 102763). Elsevier Ltd. <https://doi.org/10.1016/j.agsy.2019.102763>
- Friedman, N., Tan, Z., Haskins, M. N., Ju, W., Bailey, D., & Longchamps, L. (2024). Understanding Farmers' Data Collection Practices on Small-to-Medium Farms for the Design of Future Farm Management Information Systems. *Proceedings of the ACM on Human-Computer Interaction*, 8(CSCW1). <https://doi.org/10.1145/3637416>
- Glover, D. (2022). Affordances and agricultural technology. *Journal of Rural Studies*, 94, 73–82. <https://doi.org/10.1016/J.JRURSTUD.2022.05.007>
- Higgins, V., Bryant, M., Howell, A., & Battersby, J. (2017). Ordering adoption: Materiality, knowledge and farmer engagement with precision agriculture technologies. *Journal of Rural Studies*, 55, 193–202. <https://doi.org/10.1016/j.jrurstud.2017.08.011>
- Higgins, V., van der Velden, D., Bechtet, N., Bryant, M., Battersby, J., Belle, M., & Klerkx, L. (2023). Deliberative assembling: Tinkering and farmer agency in precision agriculture implementation. *Journal of Rural Studies*, 100(October 2022). <https://doi.org/10.1016/j.jrurstud.2023.103023>

- Hyysalo, S., & Johnson, M. (2024). Making sense of methods and approaches to user involvement. *Design Journal*, 27(4), 580–608. <https://doi.org/10.1080/14606925.2024.2347736>
- Ingram, J., & Maye, D. (2020). What Are the Implications of Digitalisation for Agricultural Knowledge? *Front. Sustain. Food Syst*, 4, 66. <https://doi.org/10.3389/fsufs.2020.00066>
- Kenny, U., & Regan, Á. (2021). Co-designing a smartphone app for and with farmers: Empathising with end-users' values and needs. *Journal of Rural Studies*, 82(July 2020), 148–160. <https://doi.org/10.1016/j.jrurstud.2020.12.009>
- Kenny, U., Regan, Á., Hearne, D., & O'Meara, C. (2021). Empathising, defining and ideating with the farming community to develop a geotagged photo app for smart devices: A design thinking approach. *Agricultural Systems*, 194. <https://doi.org/10.1016/j.agsy.2021.103248>
- Klerkx, L. (2020). Advisory services and transformation, plurality and disruption of agriculture and food systems: towards a new research agenda for agricultural education and extension studies. *Journal of Agricultural Education and Extension*, 26(2), 131–140. <https://doi.org/10.1080/1389224X.2020.1738046>
- Klerkx, L. (2021). Digital and virtual spaces as sites of extension and advisory services research: social media, gaming, and digitally integrated and augmented advice. *Journal of Agricultural Education and Extension*, 27(3), 277–286. <https://doi.org/10.1080/1389224X.2021.1934998>
- Klerkx, L., & Leeuwis, C. (2008). Institutionalizing end-user demand steering in agricultural R&D: Farmer levy funding of R&D in The Netherlands. *Research Policy*, 37(3), 460–472. <https://doi.org/10.1016/j.respol.2007.11.007>
- Legun, K., & Burch, K. (2021). Robot-ready: How apple producers are assembling in anticipation of new AI robotics. *Journal of Rural Studies*, 82, 380–390. <https://doi.org/10.1016/j.jrurstud.2021.01.032>
- Lundström, C., & Lindblom, J. (2018). Considering farmers' situated knowledge of using agricultural decision support systems (AgriDSS) to Foster farming practices: The case of CropSAT. *Agricultural Systems*, 159(April 2017), 9–20. <https://doi.org/10.1016/j.agsy.2017.10.004>
- Lundström, C., & Lindblom, J. (2021). Care in dairy farming with automatic milking systems, identified using an Activity Theory lens. *Journal of Rural Studies*, 87(October), 386–403. <https://doi.org/10.1016/j.jrurstud.2021.09.006>
- McCampbell, M., Rijswijk, K., Wilson, H., & Klerkx, L. (2021). A problematisation of inclusion and exclusion: Trade-offs and nuances in the digitalisation of African agriculture. In *The Politics of Knowledge in Inclusive Development and Innovation*. Routledge. 10.4324/9781003112525-18
- McCampbell, M., Schumann, C., & Klerkx, L. (2022). Good intentions in complex realities: Challenges for designing responsibly in digital agriculture in low-income countries. *Sociologia Ruralis*, 62(2), 279–304. <https://doi.org/10.1111/soru.12359>
- Obeng Adomaa, F., Vellema, S., Slingerland, M., & Asare, R. (2022). The adoption problem is a matter of fit: tracing the travel of pruning practices from research to farm in Ghana's cocoa sector. *Agriculture and Human Values*, 39(3), 921–935. <https://doi.org/10.1007/s10460-021-10292-0>
- Ortiz-Crespo, B., Steinke, J., Quirós, C. F., van de Gevel, J., Daudi, H., Gasper Mgimiloko, M., & van Etten, J. (2020). User-centred design of a digital advisory service: enhancing public agricultural extension for sustainable intensification in Tanzania. *International Journal of Agricultural Sustainability*. <https://doi.org/10.1080/14735903.2020.1720474>

- Pawera, L., Manickam, R., Wangungu, C., Bonnarith, U., Schreinemachers, P., & Ramasamy, S. (2024). Guidance on farmer participation in the design, testing and scaling of agricultural innovations. *Agricultural Systems*, 218. <https://doi.org/10.1016/j.agsy.2024.104006>
- Saha, M., Varghese, D., Bartindale, T., Olivier, P., Thilsted, S. H., Ahmed, S. I., & Olivier, P. (2022). Towards Sustainable ICTD in Bangladesh: Understanding the Program and Policy Landscape and Its Implications for CSCW and HCI. *Proceedings of the ACM on Human-Computer Interaction*, 6(CSCW1), 1–31. <https://doi.org/10.1145/3512973>
- Schoemaker, E., Talhouk, R., Kamanu, C., McDonough, E., McDonough, C., Casey, E., Wills, A., Richardson, F., & Donner, J. (2022). Social Agriculture: Examining the Affordances of Social Media for Agricultural Practices. *ACM International Conference Proceeding Series, Par F18047*, 476–489. <https://doi.org/10.1145/3530190.3534806>
- Sewell, A. M., Hartnett, M. K., Gray, D. I., Blair, H. T., Kemp, P. D., Kenyon, P. R., Morris, S. T., & Wood, B. A. (2017). Using educational theory and research to refine agricultural extension: affordances and barriers for farmers' learning and practice change. *Journal of Agricultural Education and Extension*, 23(4), 313–333. <https://doi.org/10.1080/1389224X.2017.1314861>
- Smith, H. E., Sallu, S. M., Whitfield, S., Gaworek-Michalczenia, M. F., Recha, J. W., Sayula, G. J., & Mziray, S. (2021). Innovation systems and affordances in climate smart agriculture. *Journal of Rural Studies*, 87, 199–212. <https://doi.org/10.1016/j.jrurstud.2021.09.001>
- Steinke, J., Ortiz-Crespo, B., van Etten, J., & Müller, A. (2022). Participatory design of digital innovation in agricultural research-for-development: insights from practice. *Agricultural Systems*, 195. <https://doi.org/10.1016/j.agsy.2021.103313>
- Steinke, J., van Etten, J., Müller, A., Ortiz-Crespo, B., van de Gevel, J., Silvestri, S., & Priebe, J. (2021). Tapping the full potential of the digital revolution for agricultural extension: an emerging innovation agenda. *International Journal of Agricultural Sustainability*, 549–565. <https://doi.org/10.1080/14735903.2020.1738754>

Bridging the data-action gap: potential opportunities and risks for generative AI language models in communicating data insights to poultry farms

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Short abstract

Large Language Models (LLMs) may present the opportunity to overcome the data-action gap on-farm by interpreting data and communicating clear management actions to the farmer or worker. As yet, empirical insights into LLM development, adoption factors, and opportunities/risks are limited. We present preliminary results on the development and use of a LLM aimed at improving farm management of poultry welfare. We interviewed the developer and commercial team at one organisation and a senior farm manager, who oversees the farms using the technology. We will soon conduct on-farm interviews. Our preliminary findings identify several opportunities and risks of the use of LLMs to overcome the data-action gap.

1. Purpose

Precision livestock technologies offer the potential to monitor animal behaviour ^{24/7}¹. However, if data cannot be easily interpreted and acted upon by humans (e.g. farmer, worker), benefits may not occur in practice. Lack of interoperability and user-friendly data consistently rank highest in barriers to farm technology use². A potential innovation to help overcome the data-action gap on-farm is the use of generative AI through the use of Large Language Models (LLMs). These models use AI-based algorithms trained on data to understand patterns and generate human language, for example interpreting data and communicating text-based actions to the farmer. Our work responds to early research that has started to explore the opportunities and risks afforded by LLMs in on-farm agricultural extension^{3,4,5}. These existing studies have explored the (potential) use of LLMs in a variety of agricultural extension contexts^{6,7,8}. These papers also give an overview of LLMs already developed (or being developed) by different organisations, including Farmer.Chat by Digital Green, Kissan GPT (India), and an emergent system from Bayer. From these initial papers, different opportunities and risks of the use of LLMs in agricultural extension emerge. However, empirical data in this area is lacking and our study begins to address this gap. We use a case study from the UK to investigate the potential of LLMs to overcome the data-action gap on-farm.

2. Design

The fieldwork is ongoing as a result of delays caused by an avian influenza outbreak in the UK, which restricted access to farms. Farm visits and interviews will be conducted before ESEE 2025. Our study is built around a case study involving a technology company working in the poultry sector. This company has developed a technology designed at predicting drinking behaviour of chickens, using sensors and AI to interpret historical drinking behaviour, and then predict what the next 15 minutes of drinking behaviour should look like. If there is an anomaly – either chickens drink more or less than usual – the system utilises data from environmental sensors in the barns to diagnose a problem. For example, there could be problems with ventilation or humidity. The company believe there is a correlation between the anomaly data and welfare scores at slaughter, and therefore see the technology as an opportunity to use data to improve management at the first sign of problems. They have developed a LLM to communicate actions to farm managers/workers via text on an app based on the problem diagnosed – for example, ‘House 3 has the most factors negatively affecting trends in activity. Concerns most commonly occur during the time range of 1200-1400. The most common contributing factor is a reduction in internal humidity levels. Adjust the ventilation system’. The company are interested in exploring further how LLM-enabled management actions are being used and are perceived, as well as if there are ways communication could be done differently to better motivate action. We used a qualitative approach to capture the story of LLM development. We conducted a group interview of the LLM development team, focusing on why the technology was developed, if and how it was developed with end users, perceived opportunities and risks, and potential ways in which the technology could be modified to improve extension. We also conducted a group interview with the commercial team at the same company, who are more user-facing, on the same topics. We were also interested to capture the view of users and conducted fieldwork in line with the appropriate management structures. We conducted an interview with a senior farm manager, who oversees activities across several poultry farms, focusing on their involvement in development, if and how they use the LLM-enabled outputs, opportunities and risks, and potential avenues for further development to improve

extension. We also plan to conduct on-farm walking interviews with on-site farm managers (and possibly workers) to explore the same topics, but also to understand more broadly how data from different technologies is used on-farm (if at all). On these farm visits, we also intend on demonstrating alternative outputs from the LLM and gaining user feedback.

3. Findings

3.1 The design process and adoption

A member of the commercial team articulated the need for the technology, and communication of data insights, to make things simple: *“We tried to simplify things, they were still getting information overload...they want simplicity”*. To achieve this, the company integrated LLMs (initially ChatGPT) into the existing model that the technology was using to interpret drinking anomaly data. The human effort required to interrogate data to reach a conclusion could then be bypassed by using the LLM to process data and communicate a text-based management action to the farmer. Initially, challenges included the communication being overly wordy, sometimes contradictory, and exhibiting a degree of hallucination, which required developers to refine prompts to make the LLM output *“clear and concise”* (Developer team) and adjust settings to prioritise accuracy to the data source rather than warmth in communication style. Initially the data source used by the LLM contained all the data available for a farm, requiring complex queries to stipulate what should or should not be factored into the text response. Creating a separate data viewer with precise data on which the LLM outputs should be based made the queries easier to write. The design process was iterative with tweaks needed to enable the LLM to communicate clear and actionable data. The commercial team acknowledged that the technology was initially developed with the vision to support practical on-farm decision making. In practice, whilst the company does still work with smaller scale independent farming operations, the focus has shifted towards large-scale integrated farming businesses that manage multiple farm sites, and farm equipment suppliers wanting to monitor the performance of their technology installations. The views of those paying for the product were highlighted as easier to consider whereas direct feedback from farm workers who may act on the data was harder to obtain: *“it’s hard to get genuine feedback from the farm hands because they’re just doing their job, aren’t they?”* (Developer team). It will be valuable to gain the farm perspective on how future developments (described in 3.4) could utilise a user-centred design process and the opportunities and challenges afforded by this. From the initial interviews, key drivers of adoption were noted: performance benefit, including speed and clarity of actions, and transparency of welfare for assurance schemes, and market access.

3.2 Extension opportunities and risks afforded by LLMs

Focusing efforts and enabling a quick response, but at what cost?

The commercial team was very keen that the LLM was used to focus data insights provided by the broader model, enabling clear management actions to be communicated *“We got engaged with language models because we wanted to summarise things ... [from a user-perspective] I know there’s problems, there’s problems everywhere – I’m farming animals, there’s not a perfect world. So, just tell me where my main problem is so I can go and focus on it.”* Developers, the commercial team, and senior farm manager saw an opportunity for LLMs to enable quick, clear management action on-farm, which could offer opportunities to incentivise or penalise based on performance or speed: *“What we want to do is actually reward those farms that ... react to a notification in the app, “let’s go and fix that”, whereas*

you can see other farmers are going "I was notified, but I'll wait til after my breakfast and I've took the kids to school before I actually looked at it"

Human surveillance for transparent animal welfare?

Linked to drivers of adoption, data collected by the broader model and actions communicated by the LLM (if they are actioned) could help a farm to illustrate that they are taking actions to address welfare. This might be within a company, as a member of the senior farm management team, who oversees several farms, praised the potential of 'Big Brother': *"I personally see them as a Big Brother looking over my shoulder, covering my back. The human lacks things. AI should pick it up and flag it"*. The data could also be a key part of market access or farm assurance schemes: *"If [supermarkets] are saying if you want to sell to me, we need to have data that exists like this ... it will be mistrust, but they'll abide by it, it will make them do their jobs ... at the end of the day the main goal is the welfare of the animals, isn't it? Making sure that they're treated as they should be."* (Developer Team).

Data governance

Lack of data privacy with the use of LLMs has been identified in the wider literature. Developers noted that they had considered this potential problem; speaking of the broader technology, rather than just the LLM: *"we'll never have anything older than 120 hours-worth of data ... when you sign up to our app we're very clear in terms and conditions, what we do with the data, how we manage it for GDPR, etc. ... We're doing everything we can to make sure that the data is private"*.

Tailoring to user preferences linked to misinterpretation and misinformation

The commercial team and senior farm manager understood that different users want to engage with data in different ways: *"It varies from person to person ... people want to see the data the way they can absorb it better."* LLMs were seen as a way of communicating priority actions clearly, although the commercial team recognised that *"one of the biggest risks would be misinterpretation"*. There was some discussion of the potential for misinformation (e.g. AI flagging things it should not) and users misinterpreting instructions. Developers saw an opportunity to use LLMs to overcome language barriers, but noted that current translation solutions are not always completely accurate. To mitigate risks of misinterpretation, the commercial team also saw an opportunity for LLMs to change communication styles for different cultures and address neurodiversity across farm management teams and workers: *"we are global, the needs of the Middle East are quite different to the needs of Lincolnshire ... some parts of the world, you just instruct people, and in other parts of the world, you have to convince, cajole, and motivate them"*. *"I would estimate double the percentage of people working on livestock are dyslexic to the general population ... So, you have to be very careful about how long the text is and what's in it, because it gets misinterpreted or misread quite easily – but dyslexia is a positive, not a negative because that's what makes them so amazing with animals..."*

Humans in the loop

The senior farm manager was keen to stress the value of still having humans in the loop: *"for trust, I think one key factor is – which they cannot get rid of – is humans. That you're gonna have to build a relationship with the farmer or with the customer through humans."*

Potential next steps for increased engagement with data

Interviewees spoke of potential developments of the LLMs for different purposes, saying that the team have *“freedom to just go and explore and play”* (commercial team). Considerations are being made of how to make the communications from the LLMs more entertaining to the farm user: *“I think audio is one option and we have looked ... almost create a daily podcast that’s entertaining and educate through entertainment ... with the language models, I’m going to become an entertainment business, where you’re going to feel entertained by your own data in a way that makes you engage with it. I’m not trying to educate you. I’m trying to entertain you”* (commercial team). As mentioned above (3.3.4), the ability for the LLMs to enable a company to talk to different cultures in a way that recognises and accommodates varying societal norms: *“[with LLMs], how do we get it such that I’m not just talking to an American in the same way as I’m talking to a Middle Eastern person ... which cultures would want humour? Which cultures will want just whole different ways of presenting stuff? There are some societies that a female voice isn’t met in the same way because a female maybe deemed to be more suited to domestic roles at home not necessarily running podcasts.”*

4. Practical Implications

Early data illustrate that there is potential for users to be integrated better into the design of LLMs. There are opportunities for LLMs in overcoming the on-farm data-action gap, but also risks that need to be accounted for, even if that risk could be seen as an opportunity from another perspective.

Theoretical Implications

We add to the nascent literature on the opportunities and risks afforded by LLMs in agricultural extension. We note based on early data the potential for LLMs to be used in a way that perpetuates inequality e.g. gender/culture equality, surveillance capitalism; even where efforts are well-intentioned. This suggests a need to mitigate (unconscious) biases and generalisations that stem from global applications being developed from a single cultural lens. Thus, embedding equity, diversity and inclusion within the development of LLMs for extension is vital to their potential accessibility and attractiveness for a range of individuals and cultures.

5. References

- Schillings, J. et al. (2021). <https://www.frontiersin.org/journals/animal-science/articles/10.3389/fanim.2021.639678/full>
- Da Silveria, F. et al. (2021). <https://www.sciencedirect.com/science/article/abs/pii/S0168169921004221>
- Tzachor, A. et al. (2023). <https://www.nature.com/articles/s43016-023-00867-x>,
- de Clercq, D. et al. (2024). <https://www.frontiersin.org/journals/artificial-intelligence/articles/10.3389/frai.2024.1326153/full>
- Marinoudi, V. et al. (2024). <https://www.sciencedirect.com/science/article/pii/S277237552400282X>
- Ibrahim, A. et al. (2024). <https://www.nature.com/articles/s41598-024-53916-1>
- Silva, B. et al. (2023). <https://arxiv.org/abs/2310.06225>, 8) Yang, T. et al. (2024). <https://www.sciencedirect.com/science/article/abs/pii/S0921344924000910#sec0014>

Farmers' data sovereignty in the age of generative AI: implications for agricultural education and extension

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Short abstract

This study examines how generative AI (genAI) systems influence farmers' data sovereignty and discusses the resulting implications for the direction of agricultural advisory efforts and data governance education. Through analysis of academic literature, industry reports and data policies within the OpenAI ecosystem, this study reveals that while genAI technologies promise to accelerate digital transformation, they present significant challenges to farmers' data sovereignty, specifically concerning their privacy and control. The examined policies, focusing on compliance with pre-generative AI regulations and standards, insufficiently address new privacy threats and limited user control over data entered into AI models. With expansive policies aimed at accumulating data for AI training, genAI platforms are evolving into centralized hubs concentrating agricultural knowledge and economic power. Responsible implementation of genAI demands that farmers and advisors are educated on both the benefits and opportunities of genAI applications in agriculture, as well as the risks associated with this technology. Under these changing dynamics, data governance education needs to move beyond traditional approaches to data sovereignty to encompass collective data governance structures, sector-specific oversight of AI models as well as mechanisms that ensure farmers have fair access to these tools and appropriate control over their use in agriculture.

1. Purpose

This paper aims to explore the effects of generative AI systems on farmers' data sovereignty and their implications for agricultural advisory systems and data governance education. With the increasing integration of AI-powered conversational applications into various technological ecosystems, a question arises regarding the potential transformation of human-machine data flows, and their utilization for collecting and aggregating user data to an extent never before witnessed. Questions regarding both the protection of privacy and data control rights when interacting with AI systems hold particular relevance for farmers. Previous studies on digital agriculture, incorporating smart farming and IoT, have shown that assurances regarding data rights and control directly influenced trust and fostered technology adoption (Jayashankar et al., 2018; Jaku et al., 2019). In the European context, data sovereignty has become a central concern, regarded as a strategic tool for addressing the growing concentration in data markets. Initially associated with privacy protections and data localization requirements, this concept has evolved into a wider framework that also encompasses individuals' ability to assert control over how their data is accessed, used, and shared – including the right to port data between digital technology providers in order to mitigate potential lock-in effects (Hummel et al., 2021). Yet, different policy frameworks and regulatory environments across regions result in significant variations in the actual sovereignty over agricultural data. Even within more advanced regulatory systems, such as those in Europe, the level of digital rights awareness remains insufficient, potentially shaping

asymmetrical relationships between farmers and service providers. With its intrinsic complexities and transformative potential, generative AI is expected to further amplify these challenges. A critical examination of how farmers' data is handled within emerging genAI ecosystems is therefore essential. Such an understanding is key to developing targeted advice and education that empower farmers to make informed decisions and protect their interests under these novel digital dynamics.

2. Methodological approach

The analysis draws on concepts and theoretical frameworks developed in data governance research, particularly those related to ethical and responsible digitalization aimed at ensuring individual data sovereignty (Hummel et al., 2021; Koskinen et al., 2023; OECD, 2024). The latter is understood as the individual users' right to robust privacy protection regarding their personal data, as well as the right to control how their data is accessed, stored, shared and used, including control and decision-making over the use and sharing of data generated by or relating to their activities. From this perspective, the study examines privacy policies and data governance practices of genAI platforms with a particular attention paid to the extent to which they formally recognize and uphold the principles of individual data sovereignty. The ecosystem of applications and services built on OpenAI's GPT models was selected as the primary subject of analysis, given their dominant position in the generative AI landscape, significant global user base, and the potential to expand in the agricultural sector. The analysis centers on policies and practices of GenAI providers in different regions to offer a wider context for evaluating how farmers' data sovereignty might be affected, and what this means for agricultural advisory systems and data governance education.

The study combines a structured review of academic and industry literature with a document analysis of data policies. To identify relevant works the search strategy was performed across arXiv, Google Scholar, IEEE Xplore, Scopus, and Web of Science databases using search terms related to generative AI, ChatGPT, data sovereignty, data policies, and digital agriculture. The document analysis part builds on publicly available materials issued by OpenAI and affiliated providers within the GPTs ecosystem, including privacy policies, terms of service and additional documents related to generative AI models and data governance. In total, 14 data policy documents issued by OpenAI and affiliated GPT providers – Farmers' Business Network (NormSM) and non-profit Digital Green Foundation (Farmer.Chat) were analysed (Table 1/Supplementary Materials)⁸. The following dimensions derived from the literature review were used when evaluating the data policy documentation: a) privacy protection, b) transparency over data processing and storage, c) control over data access and use, d) data ownership issues and e) data portability rights (Hellmeier & von Scherenberg, 2023; Hummel et al., 2021; Koskinen et al., 2023; Ryan et al., 2024).

3. Findings

Early research and analyses demonstrate that generative AI applications can become a breakthrough tool in the agricultural sector, promising a significant acceleration of digital transformation (Pallottino et al. 2025; Sai et al., 2025). These technologies bridge the digital divide by offering conversational interfaces that speak the farmer's language, making digital

⁸ This analysis excludes some significant genAI models for agriculture still in development. For instance, the AI assistant for agronomists by Microsoft, EY, and Bayer (based on Azure OpenAI) which is planned to become commercially available for licencing in the near future.

tools more accessible even to those with limited technical expertise (Singh et al., 2024). At the same time, numerous studies recognize a series of risks associated with genAI for both organizations and individual users (Mitra et al, 2025). Apart from controversies related to intellectual property rights, especially copyright infringements in training data, serious concerns regarding privacy and data management issues, including the risk of disclosing sensitive personal information even from data considered non-personal, are often reported in academic and industry publications (Khowaja et al., 2024; OECD, 2024). Research and tests done by computational scientists question the effective ability to ensure privacy and control over user data within the complex and black-box systems powering the development of genAI agents (Jaff et al., 2024; Mitra et al., 2025). Concerns and doubts raised are further amplified by the fact that these technologies themselves are still rapidly evolving, and their capabilities are not yet fully understood. The genAI models also fundamentally change the frameworks for controlling data as an economic resource, as they take over a significant part of the activities in the data value chain, generating new data and outputs, including synthetic data, which are incorporated into the next cycle of data training and increasing model accuracy (Kazdan et al., 2024). This mechanism blurs the traditional notions of data ownership and complicates the attribution of value derived from its processing.

Reflecting a conventional business approach, analysis of selected genAI platforms' policies that target individual users reveals they are primarily compliance driven, not displaying a proactive approach to meaningfully advance individual data sovereignty. Data policy documents formally reflect regulations and standards established in respective operational jurisdictions before the widespread emergence of generative AI. These range from extensive legal protections, such as those shaped by GDPR and other data acts in the EU, and similar regulations like CCPA in California and LGPD in Brazil, to more limited regulatory frameworks in other regions. Yet, they often fall short of adequately addressing novel privacy threats and the limited control of individual users over their data fed into the genAI models. Among the fundamental priorities evident in the reviewed data governance policies is the aggregation of and expanded access to data required for AI model training and operation.

Table 1: Data policies of selected genAI platforms targeting individual users by key dimensions

Dimensions	Core elements	ChatGPT (Europe)	ChatGPT (ROW)	Norm SM (USA, Canada, Australia, Brazil)	Farmer.Chat (India, Kenya, Nigeria)
Privacy protections	The users are protected from improper access, use, disclosure, and excessive collection of their data	+-	+-	+-	+-
Transparency	The users know which data is collected, how it is used, where it is stored and how long it is retained	+-	+-	+-	+-
User control	The users have the ability to view, correct, delete, and limit how their data is used	+-	+-	+-	+-
Data ownership	The user retains ownership right to input data and the data generated from the interaction with the service	++	++	+-	--
Portability	The users have the ability to move their data (input and output data) to another service	++	+-	+-	+-

Legend: ++ clearly defined user rights and control; +- user rights and control defined, but with notable exceptions or gaps; -+ limited user rights and control, partially defined; -- very limited or unclear user rights and control

Source: own elaboration.

Privacy policies of genAI service providers with open systems such as OpenAI, although formally offering standard security measures to protect user data, are weakened by the specific operational functionalities that involve real-time information retrieval across different services. In OpenAI's platform, this is exemplified by custom actions for GPTs (allowing the AI to interact with external, third-party services) which expose user data to these third parties under potentially different and less protective policies (Iqbal et al., 2024; Jaff et al., 2024). This creates a complex privacy landscape that may not be immediately transparent to users. For user groups like farmers, who rely on various data sources in their work such as real-time weather forecasts or market data streams, interacting with such services poses particular risk of exposing sensitive operational information to broader data ecosystems, without adequate safeguards (Kaur et al., 2022). Data policy documents of platforms specifically addressed to farmers – both NormSM and Farmer.Chat – seem to acknowledge these risks by advising their users not to share sensitive personal information, though these warnings do not extend to operational farm data like yields or specific agronomic practices.

The analysed policies include separate sections outlining user control mechanisms, yet do not inform the users how the inherent specifics of large-scale AI models fundamentally change the framework and conditions for exercising that control. Full transparency would require explaining that data used for training becomes embedded in the model and often cannot be fully or easily removed (Snyder, 2024). The OpenAI platform, which uses individual user data for model training by default, provides an explicit opt-out mechanism and also offers a temporary chat mode where conversations are neither stored or used for training. The reviewed NormSM and Farmer.Chat policies inform users that their data will be used to improve their services but lack specific information on model training and consequently do not offer explicit options to prevent data from being used in this process. Interestingly, the general-purpose OpenAI informs users about their ownership of both input and output data and their portability rights, which is likely driven by strategic motivations to shift copyright responsibility to users. Farmer-oriented platforms within this ecosystem do not provide the same level of rights. NormSM, as part of the FBN's services, acknowledges farmers' ownership rights to raw agricultural data but retains ownership of aggregated data and analytics, whereas Farmer.Chat's policies explicitly grant the service provider "perpetual and irrevocable" licensing rights over farmers' data. Overall, data policies in the analysed ecosystem strongly reflect the growing demands of AI models for data, further weakening farmers' position in the data value chain and restricting their data sovereignty.

Considering the scale requirements of AI models, such accumulation and absorption of data enable technology providers to deliver more accurate and effective solutions at a faster pace, thereby supporting long-awaited improvements in agricultural productivity and the optimisation of farming practices (Pallottino et al., 2025; Sai et al., 2025). However, this process simultaneously concentrates knowledge and economic power within the proprietary ecosystems of tech giants. Even non-profit foundations operating in this space, such as Digital Green Foundation, often rely on computational resources and data processing capabilities of these same technology corporations. As a result, farmers are becoming increasingly entangled in dependent and asymmetrical relationships, which expose them both to substantial privacy risks and increased economic vulnerability (Hackfort et al., 2024). The rapid development of genAI applications appears to intensify these power dynamics.

4. Practical Implications

Responsible deployment of generative AI in agriculture requires both educating farmers about the significant possibilities and benefits associated with this technology and making them aware of potential risks. Along with developing the ability to work effectively with generative AI systems, the key issue is to increase the awareness of farmers and their human advisors regarding how these technologies function and how to properly manage agricultural data in interactions with these systems.

5. Theoretical Implications

The significant changes in the traditional data value chain caused by generative AI necessitate a thorough examination to adequately conceptualize socio-technological frameworks for supporting farmers' data sovereignty in the digital age. Analysis of the selected genAI ecosystem suggests that educational approaches to data sovereignty focused solely on managing individual data assets may be inadequate given the complexities of these new systems. New elements within conceptual frameworks – centered on collective governance structures, sector-specific oversight of AI models and fair access to models trained on farmers' data – may be necessary to effectively empower farmers under these changing digital dynamics.

6. References

- Hackfort, S., Marquis, S., & Bronson, K. (2024). Harvesting value: Corporate strategies of data assetization in agriculture and their socio-ecological implications. *Big Data & Society*, 11(1), 20539517241234279. DOI: 10.1177/20539517241234279
- Hellmeier, M., & von Scherenberg, F. (2023). A Delimitation of Data Sovereignty from Digital and Technological Sovereignty. In *Thirty-first European Conference on Information Systems*, Kristiansand, Norway.
- Hummel, P., Braun, M., Tretter, M., & Dabrock, P. (2021). Data sovereignty: A review. *Big Data & Society*, 8(1). DOI: 10.1177/2053951720982012
- Iqbal, U., Kohno, T., & Roesner, F. (2024). LLM platform security: applying a systematic evaluation framework to OpenAI's ChatGPT plugins. In *Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society*, 7, 611-623. DOI: 10.48550/arXiv.2309.10254
- Jaff, E., Wu, Y., Zhang, N., & Iqbal, U. (2024). Data Exposure from LLM Apps: An In-depth Investigation of OpenAI's GPTs. *arXiv preprint*. DOI: 10.48550/arXiv.2408.13247
- Jakku, E., Taylor, B., Fleming, A., Mason, C., Fielke, S., Sounness, C., & Thorburn, P. (2019). If they don't tell us what they do with it, why would we trust them?" Trust, transparency and benefit-sharing in Smart Farming. *NJAS - Wageningen Journal of Life Sciences*, 90–91. DOI: 10.1016/j.njas.2018.11.002
- Jayashankar, P., Nilakanta, S., Johnston, W. J., Gill, P., & Burres, R. (2018). IoT adoption in agriculture: the role of trust, perceived value and risk. *Journal of Business & Industrial Marketing*, 33(6), 804-821. DOI: 10.1108/JBIM-01-2018-0023
- Kaur, J., Hazrati Fard, S. M., Amiri-Zarandi, M., & Dara, R. (2022). Protecting farmers' data privacy and confidentiality: Recommendations and considerations. *Frontiers in Sustainable Food Systems*, 6, 903230. DOI: 10.3389/fsufs.2022.903230
- Kazdan, J., Schaeffer, R., Dey, A., Gerstgrasser, M., Rafailov, R., Donoho, D. L., & Koyejo, S. (2024). Collapse or Thrive? Perils and Promises of Synthetic Data in a Self-Generating World. *arXiv preprint*, DOI: 10.48550/arXiv.2410.16713
- Khowaja, S. A., Khuwaja, P., Dev, K., Wang, W., & Nkenyereye, L. (2024). ChatGPT needs spade (sustainability, privacy, digital divide, and ethics) evaluation: A review. *Cognitive Computation*, 16(5), 2528-2550. DOI: 10.1007/s12559-024-10285-1

-
- Koskinen, J., Knaapi-Junnila, S., Helin, A., Rantanen, M. M., & Hyrynsalmi, S. (2023). Ethical governance model for the data economy ecosystems. *Digital Policy, Regulation and Governance*, 25(3), 221-235. DOI: 10.1108/DPRG-01-2022-0005
- Kshetri, N. (2024). Navigating EU Regulations: Challenges for U.S. Technology Firms and the Rise of Europe's Generative AI Ecosystem, *Computer*, 57(10), 112-117. DOI: 10.1109/MC.2024.3433088
- Mitra, B., Cramer, H., Gurevich, O. (2025). Sociotechnical Implications of Generative Artificial Intelligence for Information Access. In: White, R.W., Shah, C. (eds) *Information Access in the Era of Generative AI. The Information Retrieval Series*, 51. Springer, Cham. DOI: 10.1007/978-3-031-73147-1_7
- OECD (2024). Shaping a rights-oriented digital transformation (2024). OECD Digital Economy Papers, June 2024, No 368.
- Pallottino, P. et al. (2025). Applications and perspectives of Generative Artificial Intelligence in agriculture. *Computers and Electronics in Agriculture*, 230, 109919. DOI: 10.1016/j.compag.2025.109919
- Ryan, M., Gürtler, P., & Bogucki, A. (2024). Will the real data sovereign please stand up? An EU policy response to sovereignty in data spaces. *International Journal of Law and Information Technology*, 32, eaae006. DOI: 10.1093/ijlit/eaae006
- Sai, S., Kumar, S., Gaur, A. , Goyal, A., Chamola, V., & Hussain, A. (2025). Unleashing the Power of Generative AI in Agriculture 4.0 for Smart and Sustainable Farming. *Cognitive Computation* 17, 63 DOI: 10.1007/s12559-025-10420-6
- Singh, N., Wang'ombe, J., Okanga, N., Zelenska, T., Repishti, J., Jayasankar, G.K., Mishra, S., Manokaran, R., Singh, V., Rafiq, M.I., Gandhi, R., & Nambi, A. (2024). Farmer. Chat: Scaling AI-Powered Agricultural Services for Smallholder Farmers. *arXiv preprint*. DOI: 10.48550/arXiv.2409.08916
- Snyder, A. (2024). Machine forgetting: How difficult it is to get AI to forget, AXIOS, January 12, 2024, <https://www.axios.com/2024/01/12/ai-forget-unlearn-data-privacy> (accessed: April 30, 2025).

Session 3C

FARMERS AND ADVISORS FACING DIGITAL: TRANSPARENCY, ACCESS, GOVERNANCE, MISINFORMATION...

Beyond the Screen: The real-world Consequences of Anti-social Behavior and Online Toxicity in Agricultural Knowledge Sharing on Social Media

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Short abstract

This study investigates the impact of online anti-social behavior on agricultural extension services (AES) using a mixed-methods approach. Quantitative content analysis of 3,818 social media comments related to a failed Vietnamese coconut tree project in Bangladesh revealed prevalent toxicity, insults, and threats targeting agricultural officials and extension personnel. Thematic analysis of interviews with eight extension agents highlighted the psychological impact, erosion of motivation, strained stakeholder relationships, coping mechanisms, and barriers to knowledge dissemination caused by this online negativity. The findings underscore how social media, while offering reach for technology diffusion, can become a hostile environment hindering AES effectiveness when initial setbacks are amplified online, and fundamental extension practices are bypassed. This research provides practical insights for managing online engagement and theoretical contributions to understanding digital backlash in agricultural innovation.

1. Purpose

In today's interconnected world, social media is a powerful tool for information exchange, enabling individuals and organizations to share knowledge instantaneously with vast audiences. For agricultural extension services (AES), these platforms offer an invaluable opportunity to engage directly with farmers, providing timely updates, advice, and resources to improve productivity and sustainability (Klerkx 2021; Naika et al., 2021; Klerkx 2020; Kassem et al., 2021; Billah et al., 2024; Kabir et al., 2023). Social media facilitates communication and speeds up the spread of innovative agricultural technologies by highlighting their potential through engaging visuals and testimonials. This helps spark interest and encourages adoption among farming communities. However, relying solely on quick digital dissemination without following established protocols for technology validation and contextual adaptation can create unforeseen challenges. A notable example of this is the Vietnamese coconut tree project, a government-led initiative in Bangladesh aimed at transforming coconut production. The project introduced high-yield dwarf hybrid coconut varieties from Vietnam, which promised up to 250 coconuts annually—significantly higher

than the 50–60 coconuts produced by local varieties (Prothom Alo, 2017). These shorter, faster-yielding trees were intended to meet domestic coconut demand and bolster export markets, positioning Bangladesh as a competitive player in global agriculture (Newsfounded, 2022). The Vietnamese coconut tree project represents a significant departure from the traditional method of agricultural technology diffusion, which typically follows a structured process. This standard process begins with basic research, progresses to applied research, and then moves through extensive multi-location farming systems research and testing within the extension system before new innovations reach farmers. Such a systematic approach ensures that new technologies are adapted to local conditions and validated across various agroecological environments, minimizing risks and increasing the likelihood of successful adoption. In contrast, the Vietnamese coconut tree project bypassed critical steps like multi-location trials. This deviation was likely driven by the desire for rapid dissemination through social media, which utilized engaging audio-visual content. Although social media effectively generated initial enthusiasm and wide adoption among farming communities, the lack of attention to crucial factors—such as agroecological suitability and comprehensive management practices—ultimately resulted in disappointing outcomes for many farmers (The Business Standard, 2021). Consequently, the very platforms that initially facilitated swift adoption also became channels for the rapid spread of negative feedback and disillusionment. This situation illustrates how bypassing systematic validation in favor of expedited, social media-driven diffusion can backfire. Moreover, this disappointment quickly escalated online, where social media users—often misinformed or sensationalizing issues—launched harsh criticisms against agricultural officials. This phenomenon was related to the anti-social behavior—characterized by toxic comments, harassment, and derogatory language—poses a significant threat to the integrity and success of AES initiatives conducted through social media (Haythornthwaite, 2023; Woodside, 2008; Lee et al., 2005; Soares et al., 2023; Gruzdt et al., 2023). Such behavior creates barriers to effective communication, intimidates participants, and undermines the credibility of agricultural professionals. The controversy surrounding the Vietnamese coconut tree project serves as a compelling case study to explore these dynamics. This study aims to examine the extent and characteristics of anti-social behavior in online agricultural discussions, focusing on reactions to the Vietnamese coconut tree project in Bangladesh. Additionally, it investigates the impact of this behavior on the motivation and performance of extension personnel, seeking to understand how online toxicity affects their ability to fulfill their roles effectively.

2. Design

This study adopted an exploratory sequential mixed-methods approach to investigate the prevalence and impact of anti-social behavior in online agricultural discussions, focusing on the Vietnamese coconut tree incident in Bangladesh. The methodology integrated quantitative content analysis of social media comments with qualitative thematic analysis of interviews, comprehensively examining online toxicity and its effects on agricultural extension personnel.

2.1 Quantitative Phase: Content Analysis of Social Media Comments

Data Collection and Analysis

The quantitative phase of this study analyzed 3,818 user comments directly related to the Vietnamese coconut tree incident, collected from two Facebook posts and two YouTube videos. These posts were purposefully selected based on their direct relevance to the incident and high engagement metrics (likes, shares, comment volume), with the aim of capturing a representative sample of online discourse. To identify high-engagement

Facebook posts, CrowdTangle—a social media analytics platform—was used to locate content with significant interaction. The selection process prioritized posts published during the peak of the controversy, identified through temporal analysis of engagement trends to ensure the data reflected the most active and relevant discussions. NodeXL—an open-source social network analysis tool—was employed to efficiently compile user comments from two relevant videos for YouTube data extraction. To preserve data integrity, comments were filtered to exclude irrelevant or spam content, ensuring the analysis focused solely on responses directly tied to the incident. A rigorous methodology was applied to quantify anti-social behavior in the sample of 3,818 comments. This dataset provided a robust snapshot of online discussions about the agricultural challenges involving the Vietnamese coconut tree incident. After data collection, the comments underwent systematic content analysis using a predefined coding scheme with six categories of anti-social behavior: Toxicity, Severe Toxicity, Insult, Profanity, Identity Attack, and Threat. Notably, individual comments could be coded into multiple categories. To assess intensity, a three-point severity scale was applied: Low (1), Medium (2), and High (3). Each instance of anti-social behavior in a comment was categorized and assigned a severity score. For example, if 470 comments in “YouTube Post-1” contained Toxicity, the frequency (N) for Toxicity in that post was 470. Severity Scores were calculated by summing the severity points (1, 2, or 3) for all instances of a category within a post. For example, if Toxicity in a post received scores of 2, 3, and 1 across three comments, the Severity Score would be $2 + 3 + 1 = 6$. This approach quantified both the prevalence and intensity of anti-social behavior, enabling a nuanced analysis of negative interactions related to the incident.

2.2 Qualitative Phase: Thematic Analysis of Interviews

Data Collection and Analysis

The qualitative phase involved semi-structured interviews with eight Department of Agricultural Extension (DAE) personnel, selected through purposive sampling to ensure diverse and relevant perspectives. Participants were chosen based on three criteria: (1) direct involvement in areas affected by the Vietnamese coconut tree incident, (2) awareness of the online discussions surrounding the incident, or (3) active use of social media platforms for extension services. This sampling strategy ensured that interviewees had first-hand experience with the challenges posed by online toxicity or were positioned to provide informed insights into its professional impacts. The study recruited eight agricultural extension personnel (66.7% response rate) through purposive sampling across roles and regions affected by the Vietnamese coconut incident. Semi-structured interviews (45-60 minutes) conducted via Zoom/WhatsApp explored experiences with online toxicity, professional impacts, and coping strategies, guided by findings from prior quantitative analysis. Transcripts underwent thematic analysis in Atlas.ti using **Braun and Clarke’s (2006) framework**: familiarization, coding, theme development/review, and reporting. The mixed-methods design enabled triangulation—quantitative toxicity patterns (e.g., platform differences, identity attacks) contextualized qualitative themes (e.g., emotional stress, reduced engagement), providing a holistic understanding of anti-social behavior’s impact on extension services.

3. Findings

Quantitative Findings on Anti-Social Behavior

The comparative analysis of anti-social behavior across two YouTube posts, visually represented in horizontal bar charts, reveals distinct patterns in the frequency and severity of negative online interactions about the Vietnamese coconut tree incident. **In YouTube**

Post-1, the most frequently observed category was toxicity, followed by severe toxicity and insult. The corresponding severity scores mirrored this trend, with toxicity exhibiting the highest intensity. Conversely, profanity displayed the lowest frequency and severity. Notably, YouTube Post-1 demonstrated a substantially greater magnitude of both the prevalence and intensity of all examined categories of anti-social behavior when contrasted with YouTube Post-2. In contrast, **YouTube Post-2** presented a significantly lower overall scale of negative interactions. Here, profanity was the most frequent category, while toxicity and insult also exhibited relatively higher frequencies compared to severe toxicity, identity attack, and threat, which were the least frequent. The severity scores in YouTube Post-2 were markedly reduced across all categories, with profanity displaying the highest intensity, followed by toxicity and insult. These visualizations underscore a considerable disparity in the level of online negativity between the two YouTube discussions, with Post-1 exhibiting a far more hostile environment.

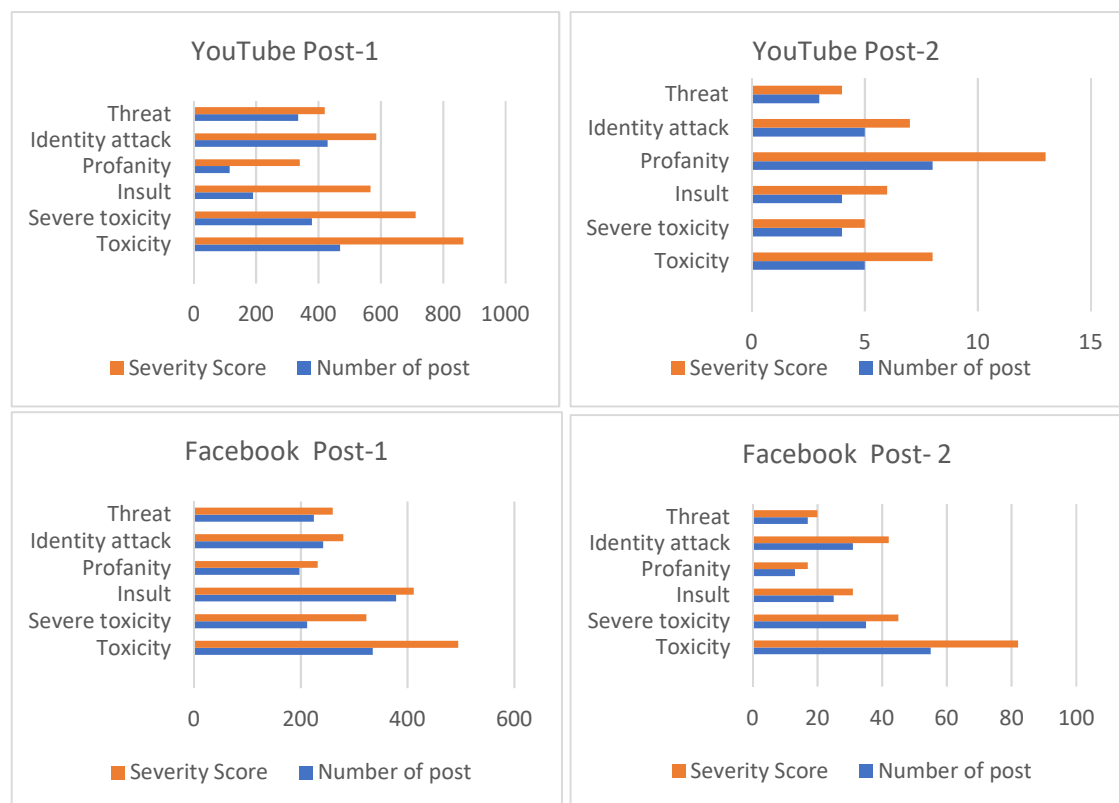


Figure 1: Showing frequency and severity of negative online interactions

Similarly, the analysis of two Facebook posts, illustrated through analogous horizontal bar charts, indicated varying anti-social behaviour patterns. In **Facebook Post-1**, toxicity was the most frequent negative interaction, followed by insults and identity attacks. The severity scores generally aligned, with insult displaying the highest intensity, closely followed by toxicity. Threat and profanity exhibited the lowest severity. In contrast, **Facebook Post-2** showed a different distribution and a reduced frequency and severity scale. Toxicity was again the most frequent category, followed by insult and identity attack. The severity scores in this post indicated toxicity as the most intense, followed by insult and identity attack. Overall, Facebook Post-1 demonstrated a higher magnitude of both the frequency and severity of most forms of anti-social behavior compared to Facebook Post-2, suggesting a more pronounced level of negative sentiment within the discussions of the former platform.

Qualitative Findings on the Influence of Anti-social Behavior in Job Performance and Motivation

The thematic analysis of interviews with agricultural extension personnel highlighted the significant consequences of online toxicity stemming from the Vietnamese coconut tree incident. The first theme, **psychological impact and emotional well-being** revealed that exposure to hostile online comments, including personal attacks, adversely affected the mental health of extension professionals. Participants reported increased stress, anxiety, and demoralization due to the online backlash. The second theme, **erosion of professional enthusiasm and motivation**, showed a decline in passion and drive among extension personnel. Continuous criticism and a lack of appreciation led to discouragement and reluctance to engage on online platforms meant for outreach and support. The third theme, **impact on communication and stakeholder relationships**, indicated that the toxic online environment strained relationships between extension personnel and farmers, undermining trust and hindering effective communication. Despite these issues, the fourth theme, **coping mechanisms and resilience strategies**, described how extension professionals managed the negative online landscape. Strategies included limiting social media engagement and seeking colleague support, although their effectiveness varied. Finally, the fifth theme, **barriers to effective knowledge dissemination**, illustrated how the toxic environment obstructed the core functions of agricultural extension services. Fear of online harassment and eroded trust made sharing information and providing timely advice challenging, ultimately hindering agricultural progress. Together, these themes demonstrate how online toxicity negatively impacts extension personnel's mental well-being, motivation, and communication capabilities, creating barriers to knowledge sharing and undermining the credibility of both individuals and their institutions.

4. Practical and Theoretical Implications

This research offers practical guidance for agricultural extension services (AES) navigating digital communication. Understanding online anti-social behavior helps develop strategies for managing online interactions and fostering constructive environments for extension personnel. The study emphasizes the need for integrated approaches to technology diffusion, combining social media with robust on-the-ground support and proactive communication. Furthermore, it highlights the psychological impact of online toxicity on extension personnel, informing the development of support systems and training. **Theoretically**, it advances the understanding of how anti-social behavior impacts motivation, performance, and emotional well-being in digital agricultural contexts. Identifying key themes like eroded enthusiasm and barriers to communication offers a framework for future research. It highlights the value of mixed-methods approaches in addressing complex online interactions. These insights are vital for fostering inclusive digital environments and enhancing agricultural extension services.

5. References

- Billah, M. M., Rahman, M. M., Mahimairaja, S., Lal, A., & Naidu, R. (2024). Farmers' exposure to communication media in receiving agriculture extension and rural advisory services for farm sustainability. *Journal of Sustainable Agriculture and Environment*, 3(3), e70000.
- Gruzd, A., Soares, F. B., & Mai, P. (2023). Trust and Safety on Social Media: Understanding the Impact of Anti-Social Behavior and Misinformation on Content Moderation and Platform Governance. *Social Media and Society*, 9(3). <https://doi.org/10.1177/20563051231196878>

-
- Haythornthwaite, C. (2023). Moderation, Networks, and Anti-Social Behavior Online. *Social Media and Society*, 9(3). <https://doi.org/10.1177/20563051231196874>
- Kabir, K. H., Rahman, S., Hasan, M. M., Chowdhury, A., & Gow, G. (2023). Facebook for digital agricultural extension services: The case of rooftop gardeners in Bangladesh. *Smart Agricultural Technology*, 6, 100338.
- Kassem, H. S., Alotaibi, B. A., Ghoneim, Y. A., & Diab, A. M. (2021). Mobile-based advisory services for sustainable agriculture: Assessing farmers' information behavior. *Information Development*, 37(3), 483-495.
- Klerkx, L. (2020). Advisory services and transformation, plurality and disruption of agriculture and food systems: towards a new research agenda for agricultural education and extension studies. *The Journal of Agricultural Education and Extension*, 26(2), 131-140.
- Klerkx, L. (2021). Digital and virtual spaces as sites of extension and advisory services research: social media, gaming, and digitally integrated and augmented advice. *The Journal of Agricultural Education and Extension*, 27(3), 277-286.
- Lee, K., Ashton, M. C., & Shin, K. H. (2005). Personality correlates of workplace anti-social behavior. *Applied Psychology*, 54(1), 81-98. <https://doi.org/10.1111/j.1464-0597.2005.00197.x>
- Naika, M. B., Kudari, M., Devi, M. S., Sadhu, D. S., & Sunagar, S. (2021). Digital extension service: quick way to deliver agricultural information to the farmers. In *Food technology disruptions* (pp. 285-323). Academic Press.
- Soares, F. B., Gruz, A., Jacobson, J., & Hodson, J. (2023). To troll or not to troll: Young adults' anti-social behaviour on social media. *PLoS ONE*, 18(5 May). <https://doi.org/10.1371/journal.pone.0284374>
- Woodside, A. (2008). Anti-social behaviour: Profiling the lives behind road rage. *Marketing Intelligence and Planning*, 26(5), 459-480. <https://doi.org/10.1108/02634500810894316>
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Understanding Farmers' Willingness to Engage in Online Sustainability Training: Evidence from Slovenia

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Short abstract

This study explores the factors influencing Slovenian farmers' intention to engage in sustainability-related training, with a focus on online learning as an increasingly relevant mode of agricultural knowledge transfer. Using the extended Theory of Planned Behaviour (TPB), we analysed survey data from 4742 farmers who participated in agri-environmental, organic farming, or animal welfare training. Structural Equation Modelling (SEM) was applied to test the original and extended TPB model, which included satisfaction with training (content, lecturer, and training design). Findings highlight perceived behavioural control and attitudes as the strongest predictors of intention to participate in future training. Satisfaction with previous training also significantly influenced intention, but participants in online training were generally less satisfied compared to those in traditional settings. The study reveals that access to ICT, digital skills, and demographics (e.g., age, gender) shape

farmers' training mode preferences. These results emphasise the importance of designing ICT-based advisory services that are tailored to diverse farming audiences and address engagement and accessibility challenges.

1. Purpose

Information and communication technology (ICT) plays an increasingly important role in modernising agricultural advisory systems and enhancing farmers' access to sustainability-related knowledge (Klerkx, 2021; Giulivi et al., 2023). Despite notable investments and the rapid introduction of online training formats, particularly during the COVID-19 pandemic (Michaelis et al., 2022), there is limited empirical insight into the factors that facilitate or hinder farmers' participation in such training environments (Klerkx, 2021; Yang & Yang, 2023a). Farmers represent a heterogeneous group in terms of socioeconomic background, education level, digital skills, and learning preferences (Klerkx, 2021; Huber et al., 2024). Designing effective online learning environments thus requires a better understanding of these differences and how they shape training participation (Yang & Yang, 2023a).

This study explores the factors influencing farmers' intentions to engage in knowledge transfer activities, with a particular focus on their preferences regarding online versus in-person formats. The research was conducted in Slovenia, where online training in agri-environmental, organic, and animal welfare topics was introduced in response to pandemic-related restrictions. Drawing on survey data from 4,742 farmers, we analyse the psychological and contextual determinants of their willingness to participate in training and assess how experiences with different training formats influence their satisfaction.

2. Theoretical Framework

Our theoretical approach (Figure 1) is based on the Theory of Planned Behaviour (TPB) (Ajzen, 1991), a well-established theory that has often been used to explain individuals' behaviour in various settings, including agriculture (Sok et al., 2021) and education (e.g. Hollett et al., 2020; Lung-Guang, 2019). TPB posits that behavioural intention is shaped by three key factors: attitudes toward the behaviour, subjective norms, and perceived behavioural control (Fishbein & Ajzen, 2010).

In the context of farmer training, TPB provides a robust framework for understanding beliefs about the value of training, perceived social expectations, and the individual's confidence in their ability to participate. We extend the TPB framework with additional constructs relevant to online learning (TPB-SAT model). Educational research has shown that satisfaction significantly influences learners' continued engagement with online courses (Abdullah et al., 2022; Chiu et al., 2007; Lu et al., 2019). In our study, training satisfaction is conceptualised through three dimensions: the quality of the lecturer, the content of the training, and the design of the training sessions (Gopal et al., 2021).

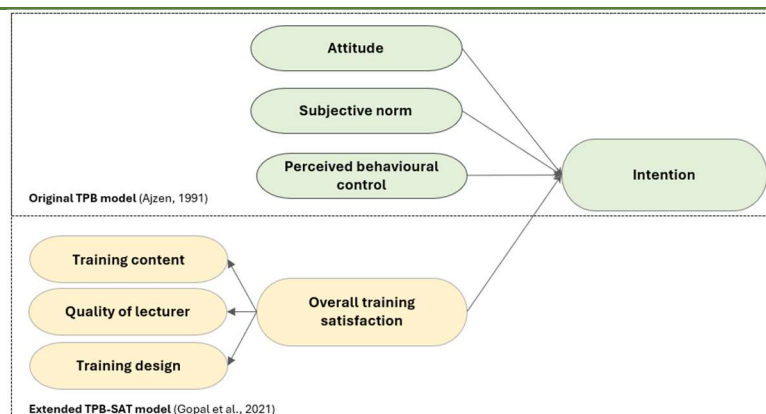


Figure 1: Theoretical research framework based on the extended Theory of Planned Behaviour (TPB)

3. Methodology

The study collected empirical data using a structured survey instrument developed through a multi-stage process. The initial step involved a review of existing TPB applications in agriculture and education, based on which core constructs and corresponding measurement items were identified. These items were adapted through four focus groups with experts in agricultural economics and advisory services, followed by a pilot test with 15 farmers and validation by five agricultural advisors. The final survey comprised four sections: (1) introduction and informed consent, (2) 19 TPB-based statements measuring attitudes, subjective norms, perceived behavioural control, and four statements on intention to participate in future training, (3) 16 statements evaluating satisfaction with content, lecturer, and training delivery, and (4) socio-demographic and farm characteristics.

Data collection took place between November and December 2021 during training programmes on Organic Farming (OF), Animal Welfare (AW), and Agri-environment-climate Measures (AECM). These trainings, offered in both online and in-person formats, provided a unique opportunity to explore format-specific differences. Online surveys were distributed after 38 virtual sessions across all Slovenian regions, while printed surveys were distributed at 16 in-person trainings in central and eastern Slovenia. From a total training population of over 20,000 farmers, 5471 surveys were returned (27.9% response rate), of which 4742 were retained for analysis after data cleaning.

We began the analysis with descriptive statistics and data preparation, including transformations and imputations. Then, Structural Equation Modelling (SEM) was used to assess the TPB and extended TPB-SAT models, combining confirmatory factor analysis with structural path estimation. To test the impact of training format on satisfaction, we additionally developed the TPB-SAT-Setting model. Furthermore, we developed logistic and mixed-effects models to explore predictors of training format choice and variation in satisfaction by training location.

4. Findings

The results support earlier evidence that the Theory of Planned Behaviour (TPB) provides a useful framework for understanding farmers' intention to participate in agricultural training (Hall et al., 2019a). Among the TPB components, perceived behavioural control emerged as the strongest predictor of intention to engage in future training ($\beta = 0.41$, $p < 0.001$). This suggests that farmers' confidence in their ability to access and follow training plays a crucial role in shaping their willingness to participate. Positive attitudes toward training also had a strong effect ($\beta = 0.37$, $p < 0.001$), confirming the relevance of farmers' belief in the value

and usefulness of training. In contrast, subjective norms had no significant influence on intention ($\beta = 0.18$, $p < 0.01$), possibly due to the individualised and lecture-based format of the training sessions, which offered few opportunities for peer interaction.

Although the inclusion of overall training satisfaction only moderately improved the model's explanatory power, satisfaction proved to be a significant predictor of future participation. Among the satisfaction components, training content was the most influential ($\beta = 0.942$), followed by the quality of the lecturer ($\beta = 0.811$) and training design ($\beta = 0.725$). Satisfaction with training was notably lower among participants in online sessions; the largest dissatisfaction was with the content of the training ($\beta = -0.498$), followed by the training design ($\beta = -0.479$) and the quality of the lecturer ($\beta = -0.365$).

Based on the binary logit regression model, farmers were significantly more likely to participate in online training if they had a reliable internet connection, computer equipment, and knowledge of participating in online events. Online training was also more commonly attended by farmers with limited time or transportation options. Women and older farmers showed a higher tendency to participate in online formats, contrasting with previous findings suggesting that younger farmers are more likely to adopt digital tools (e.g. Khan et al., 2022; Yang & Yang, 2023b; Cai et al., 2024). This may reflect the flexibility and accessibility benefits that online learning provides to farmers with transportation difficulties, physical limitations and health concerns. However, the probability of participating in in-person training increased with a higher proportion of household income derived from farming.

5. Practical implications

The findings point to several practical implications for the design and delivery of agricultural training. First, the strong influence of perceived behavioural control underlines the need to minimise structural and psychological barriers to participation, particularly in online contexts. Farmers' ability to participate is shaped by their confidence, access to infrastructure, and prior experience, suggesting that introductory digital training or structured onboarding could be beneficial, especially for older or less digitally literate users. Second, satisfaction with training was a key determinant of future participation. This highlights the importance of adapting training materials to the online format, rather than simply transferring content from in-person settings. In our study, lower satisfaction in online formats was most pronounced about content delivery, which may reflect reduced engagement, interactivity, and opportunities for clarification. These limitations could be addressed with shorter, modular sessions, interactive digital tools, and features that allow real-time interaction, such as discussion forums or live Q&A.

Third, preferences for training format were not only influenced by ICT access, but also by time availability and farmers' everyday routines. Online training was more attractive to those constrained by off-farm employment or transportation issues, including older and female farmers. This suggests that training schedules should be flexible and tailored to diverse farming profiles. For example, offering recordings or repeated time slots, including evening sessions, could better accommodate farmers with competing responsibilities.

Despite the lower satisfaction observed among participants in online formats, our findings also underscore the potential of online training as a flexible and inclusive knowledge transfer tool. Online formats proved especially valuable for farmers constrained by time, mobility, or geographic location. This suggests that with appropriate design, digital delivery can complement traditional methods and extend training access to groups who might otherwise be excluded. To fully realise this potential, however, it is essential to move beyond one-size-fits-all approaches and invest in digital pedagogies tailored to farmers' learning preferences and technological contexts.

6. Theoretical Implications

Our research is among the first quantitative studies to analyse factors that affect farmers' intentions to attend training, particularly in an online setting (Hall et al., 2019), and it offers several theoretical contributions. First, the integration of satisfaction-related variables into the Theory of Planned Behaviour (TPB) framework represents a methodological advancement that can be extended to other areas of behavioural research. Second, the study reinforces existing evidence that perceived behavioural control, and attitudes are the most influential TPB components, while subjective norms appear to play a comparatively minor role, especially in traditional, lecture-based learning environments. Finally, the findings underscore the importance of examining digital learning not only through a technological lens but also from the perspectives of behavioural intention, user experience, and accessibility.

7. References

- Abdullah, S. I. N. W., Arokiyasamy, K., Goh, S. L., Culas, A. J., & Manaf, N. M. A. (2022). University students' satisfaction and future outlook towards forced remote learning during a global pandemic. *Smart Learning Environments*, 9(1), 15. <https://doi.org/10.1186/s40561-022-00197-8>
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Cai, Y., Qi, W., & Yi, F. (2024). Effects of ICT-based extension service use on fertilizer knowledge and use efficiency: Evidence from litchi farmers in rural China. *Environmental Development*, 49, 100944. <https://doi.org/10.1016/j.envdev.2023.100944>
- Chiu, C.-M., Chiu, C.-S., & Chang, H.-C. (2007). Examining the integrated influence of fairness and quality on learners' satisfaction and Web-based learning continuance intention. *Information Systems Journal*, 17(3), 271–287. <https://doi.org/10.1111/j.1365-2575.2007.00238.x>
- Fishbein, M., & Ajzen, I. (2010). *Predicting and Changing Behavior: The Reasoned Action Approach*. Taylor & Francis.
- Giulivi, N., Harou, A. P., Gautam, S., & Guereña, D. (2023). Getting the message out: Information and communication technologies and agricultural extension. *American Journal of Agricultural Economics*, 105(3), 1011–1045. <https://doi.org/10.1111/ajae.12348>
- Gopal, R., Singh, V., & Aggarwal, A. (2021). Impact of online classes on the satisfaction and performance of students during the pandemic period of COVID 19. *Education and Information Technologies*, 26(6), 6923–6947. <https://doi.org/10.1007/s10639-021-10523-1>
- Hall, A., Turner, L., & Kilpatrick, S. (2019a). Using the theory of planned behaviour framework to understand Tasmanian dairy farmer engagement with extension activities to inform future delivery. *The Journal of Agricultural Education and Extension*, 25(3), 195–210. <https://doi.org/10.1080/1389224X.2019.1571422>
- Hollett, R. C., Gignac, G. E., Milligan, S., & Chang, P. (2020). Explaining lecture attendance behavior via structural equation modeling: Self-Determination Theory and the Theory of Planned Behavior. *Learning and Individual Differences*, 81, 101907. <https://doi.org/10.1016/j.lindif.2020.101907>
- Huber, R., Bartkowski, B., Brown, C., El Benni, N., Feil, J.-H., Grohmann, P., Joormann, I., Leonhardt, H., Mitter, H., & Müller, B. (2024). Farm typologies for understanding farm systems and improving agricultural policy. *Agricultural Systems*, 213, 103800. <https://doi.org/10.1016/j.agsy.2023.103800>

-
- Khan, N. A., Gao, Q., Ali, S., Shahbaz, B., Khan, P., & Abid, M. (2022). Analyzing ICT-enabled agricultural advisory services in Pakistan: Evidence from a marginalized region of Punjab province. *Electronic Commerce Research*, 22(4), 1107–1129. <https://doi.org/10.1007/s10660-020-09442-z>
- Klerkx, L. (2021). Digital and virtual spaces as sites of extension and advisory services research: Social media, gaming, and digitally integrated and augmented advice. *The Journal of Agricultural Education and Extension*, 27(3), 277–286. <https://doi.org/10.1080/1389224X.2021.1934998>
- Lu, Y., Wang, B., & Lu, Y. (2019). Understanding Key Drivers of Mooc Satisfaction and Continuance Intention To Use. *Journal of Electronic Commerce Research*, 20(2). https://scholarworks.utrgv.edu/is_fac/27
- Lung-Guang, N. (2019). Decision-making determinants of students participating in MOOCs: Merging the theory of planned behavior and self-regulated learning model. *Computers & Education*, 134, 50–62. <https://doi.org/10.1016/j.compedu.2019.02.004>
- Michaelis, S., Schubbert, A., Gieseke, D., Cimer, K., Zapf, R., Lühken, S., March, S., Brinkmann, J., Schultheiß, U., & Knierim, U. (2022). A comparison of online and live training of livestock farmers for an on-farm self-assessment of animal welfare. *Frontiers in Animal Science*, 3. <https://www.frontiersin.org/articles/10.3389/fanim.2022.915708>
- Sok, J., Borges, J. R., Schmidt, P., & Ajzen, I. (2021). Farmer Behaviour as Reasoned Action: A Critical Review of Research with the Theory of Planned Behaviour. *Journal of Agricultural Economics*, 72(2), 388–412. <https://doi.org/10.1111/1477-9552.12408>
- Yang, L., & Yang, G. (2023a). Predicting disadvantaged smallholder farmers' intention to take distance learning: Evidence from China. *Asia Pacific Education Review*, 24(3), 399–413. <https://doi.org/10.1007/s12564-022-09761-w>
- Yang, L., & Yang, G. (2023b). Predicting disadvantaged smallholder farmers' intention to take distance learning: Evidence from China. *Asia Pacific Education Review*, 24(3), 399–413. <https://doi.org/10.1007/s12564-022-09761-w>
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Digital Insights into Greenwashing: an NLP analysis of social media discourse

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Short abstract

The increasing visibility of corporations has made strategic communication critical to maintaining reputational credibility. Social media platforms, as venues for narrative debate, enhance public opinion on environmental issues. This study uses Natural Language Processing to evaluate 1,847 tweets on X (previously Twitter) about greenwashing in the European Union in 2024. The data show a prevalence of negative emotion (95.2%), including sentiments of skepticism, irony, and wrath against corporate sustainability discourse. These findings underline the discursive role of digital publics in combating greenwashing and emphasize the importance of honest, verifiable communication based on environmental concern.

Keywords: greenwashing, sustainability, ‘Natural Language Processing’, NLP, ‘X’, ‘Artificial Intelligence’.

1. Introduction

The role of social communication stands out as it contributes to the construction of public opinion, acting as a catalyst for debates. One such digital tool, X, has stood out in recent years as a point of debate. This dynamic also manifests itself when it comes to greenwashing. After all, on the one hand, users, companies, and civil society organizations introduce accusations that link corporations to the practice of greenwashing; and on the other hand, this content – which can range from personal opinions to journalistic articles – is amplified by media outlets focused on sustainability (Blazkova et al., 2023).

With this in mind, this study analyzes the intricacies and trends of social media posts about greenwashing in order to highlight the main occurrences and recurrences of sentiment analysis. The research is founded on an analysis of posts from the social platform X (Twitter), across one year and limited to European Union countries. Thus, the study tracks, categorizes, and analyzes data using AI-powered media monitoring technology combined with Natural Language Processing (NLP), to obtain a better understanding of greenwash posts on Twitter. This methodology enables a broad analysis to engage with social media interactions and public perception (Molenaar et al., 2024; Amangeldi et al., 2024; Marcec and Likic, 2022; EL Barachi et al., 2021).

The main objective of this research is to gain insights into the phenomenon of greenwashing on platform X, by building a database that serves as an empirical basis for identifying recurrences and discursive trends related to the topic. With this empirical perspective, the proposal seeks to reflect on the patterns of interaction between digital content and greenwashing narratives, expanding and complementing the efforts of recent investigations, such as those Oppong-Tawiah and Webster (2023) by Blazkova et al. (2023) and Sharma et al. (2024).

2. Conceptualizing Greenwashing in the Digital Age

Greenwashing has been the focus of study in recent years, as scholars seek to conceptualize the term. Works such as that of Spaniol et al. (2024) have added to these searches by identifying 79 academic definitions, which in summary fit into six criteria for considering a practice under the term: a claim of relevant environmental performance; explicit involvement of an organization; the marketing of a product or service; impossibility of verifying the accuracy of the claim; misleading intent; and search for competitive advantage.

These criteria contribute to the definition of the phenomenon in a practical way, since, despite the extensive academic production on the subject, there is still no universally accepted standardized definition when it comes to greenwashing (De Freitas Netto et al., 2020). In addition, the conceptual delimitation remains complex, since some authors restrict greenwashing only to environmental aspects, while others introduce another term, such as bluewashing, to encompass social dimensions, expanding and complicating its scope (De Freitas Netto et al., 2020).

From this perspective, Greenwashing (and, in some cases, bluewashing) occurs in a digital environment, through the use of social media communications designed with the aim of misleading or deceiving consumers through green marketing, in a competitive context, in which it allows companies to obtain reputational benefits while maintaining a competitive image as sustainable corporations (Sailer et al., 2022).

In this competitive arena, the deliberate use of fake news as a green marketing strategy provides companies with competitive advantages by attracting consumers through ecological and sustainability-oriented messaging (Szabo and Webster, 2021; Dimitrieska et al., 2017; Lyon and Montgomery, 2015). For this reason, as research on greenwashing advances, concern about its broader impacts has also grown, particularly in light of the doubts it raises among stakeholders regarding the actual environmental performance of organizations (Kim and Lyon, 2015; Lyon and Montgomery, 2015).

Therefore, misleading environmental digital communications and marketing tend to influence individuals to form positive beliefs about certain products, policies, ideas, or practices that are only ostensibly sustainable (Lyon and Montgomery, 2015) or do not achieve the proposed results of sustainable causes. In the 21st century, this effect has been amplified through dynamic digital environments, given that social media platforms accelerate the dissemination of false or misleading information, shaping the perceived reality and interpretation of environmental messages (Khan et al., 2022; McLuhan, 1994; Sunstein, 2018; Thompson, 1995; Castells, 2004, 2007, 2013; Tufekci, 2017).

3. Methodological scope

Using a mixed-methods technique, this case study combines qualitative and quantitative content analysis. Expanded through the methodological frameworks suggested by Neuendorf (2017) and Grimmer & Stewart (2013), it follows Bardin's (2011) ideas for content analysis by combining conventional approaches with Natural Language Processing (NLP) tools⁹. This hybrid approach seeks to investigate how greenwashing narratives spread on social media and affect public opinion inside corporate communication.

The empirical corpus consists of 1,847 English-language posts published on the social media platform X (formerly Twitter) throughout 2024. To ensure thematic relevance, posts were collected using the keywords “greenwash”, “greenwashing”, and “greenwashed”. Geolocation filters were applied to limit the dataset to European Union countries¹⁰. Posts from automated accounts (bots), duplicates, and off-topic content were removed during a preliminary cleaning phase to improve data quality.

Table 1: Sentiment analysis categories

Sentiment Category	Definition
Positive	Expresses approval, optimism, or endorsement of environmental actions or discourse.
Neutral	Presents information or reports events without expressing judgment or emotion.
Negative	Conveys criticism, skepticism, or disapproval of greenwashing practices or claims.

Table created by the author from research data.

These results were initially made with softwares tools and then validated by the author and then AI-drive¹¹ was performed, which allowed the automated classification and detection of discursive patterns in the entire data set. Therefore, the models used are fine-tuned with previously annotated datasets, consequently contributing to better categorization, especially when there is a need to detect critical/optimistic or informative tones. Finally, the

⁹ The methodology applied by pre-trained deep learning models: BERT and RoBERTa on a broad scale.

¹⁰ Geolocation was done by profile, and the data was manually validated.

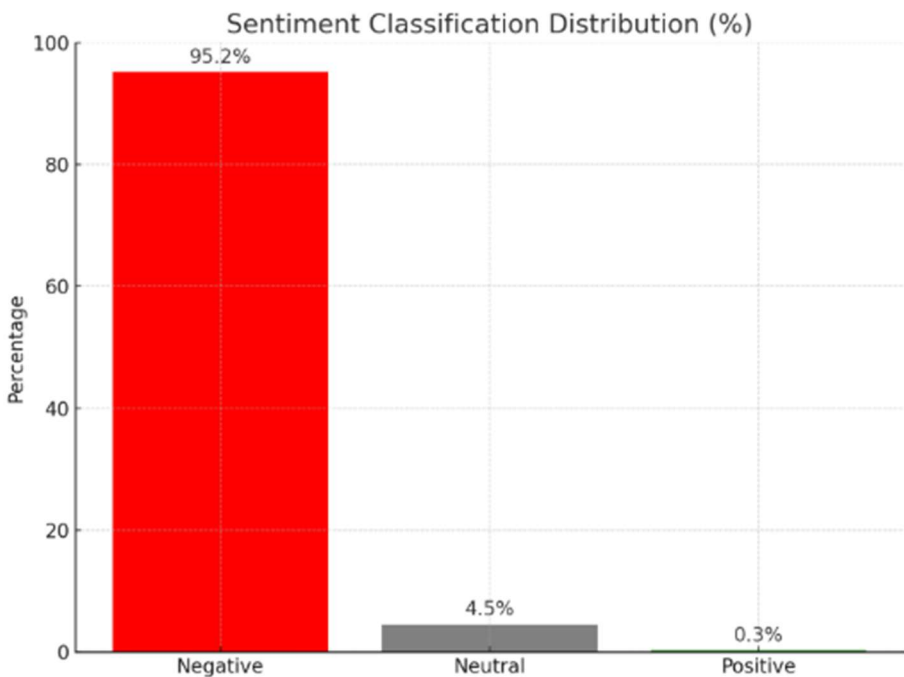
¹¹ These results were first generated using software tools, manually checked by the author, and then analyzed using AI-driven models.

analysis is completed with statistical visualizations in addition to the export of examples to illustrate the data. Therefore, this hybrid strategy (Neuendorf, 2017; Grimmer and Stewart, 2013) revealed both recurrent themes and dominant emotional tones, providing a broader view of how greenwashing discourse is constructed in the digital environment.

4. Emotional dynamics surrounding greenwashing

The results of the greenwashing phenomenon reveal an emblematic paradox, which highlights the discrepancy between the environmental discourse promoted by corporations and their actual practices. Thus, communication becomes a tool that promotes dissimulation — on a stage where companies strategically stage ecological commitments in the race for legitimacy in contemporary markets increasingly focused on sustainability issues. With the corpus of analysis of 1,847 posts shared on the X platform, during the period of one year (2024), were selected by keywords such as "greenwash", "greenwashing" and "greenwashed", geographically centered on the countries of the European Union, it is possible to notice a largely critical discursive tendency. The results (Graph 1) of the sentiment analysis reveal that 95.2% of the posts convey negative sentiments, 4.65% tend to be neutral posts and 0.3% demonstrate positive sentiments (Table 2). The frequency of adverse responses indicates a prevailing trend of public doubt and critical involvement with corporate sustainability stories.

Graph 1: Distribution in sentiment analysis around Greenwashing on X



Graph created by the author from research data.

Table 2 - Example of content in the most recurring category

Sentiment Category	Posts on X
Negative	Green lie! Company X ¹² pollutes rivers while pretending to be sustainable.
	Another greenwashing campaign: the product still comes in plastic.
	Company Y talks sustainability but maintains exploitative practices.

Table created by the author from research data.

¹² This document represents an expanded summary of an analytical report. Therefore, the names of the companies involved have been deliberately omitted to preserve confidentiality and maintain the focus on thematic insights rather than specific corporate actors.

In the negative sentiment category (95.2%), lexical items such as “misleading,” “hypocrisy” “greenwashing”, “false marketing,” and “environmental fraud” recur frequently. These posts typically denounce inconsistencies between corporate environmental rhetoric and concrete practices, citing cases where companies promote recycling initiatives while simultaneously producing toxic waste or maintaining environmentally destructive supply chains. Thus, the tweets point to the tendency towards disruptive communication, which aims to denaturalize dominant narratives and consequently expose the ideological contradictions of corporate green demands.

The second most recurrent sentiment category is neutral (4.65%), which performs a distinct discursive function as it consists of information or reports of events without expressing judgment or emotion. The posts are generally informative in nature, often replicating factual content from unofficial sources, regulatory agencies or non-governmental organizations. The results show institutional recommendations, sustainability updates or policy announcements. Although ostensibly neutral, this category contributes to the circulation and normalization of greenwashing discourse in European digital environments.

Finally, although quantitatively marginal (0.3%), the positive sentiment category reveals important symbolic elements. These posts express European citizens’ support, approval and optimism towards environmental initiatives, using terms such as “hope”, “commitment” and “green innovation”. Therefore, the category endorses that, when discussing greenwashing, it is essential not only to expose deceptive practices, but also to highlight conducts seen as exemplary and the need to foster factually real and constructive narratives that enrich not only public discourse and support transformative engagement with environmental responsibility.

5. Final discussions

This research allowed the detection of patterns at a macro level and the discursive interpretation at a micro level, which enabled the conclusion, through a comprehensive view focused on how greenwashing is framed in the EU digital public sphere. The study of 1,847 messages in English posted on X over a period of one year (2024), focusing on countries in the European Union, found a prevalence of 95.2% of negative opinions against greenwashing. Although a small portion of the posts express neutral (4.65%) or positive (0.3%) sentiments, the predominant tone of emphasis lies in the tendency towards criticism, shaping the digital discursive environment in which corporate authenticity is questioned by public opinion when the subject is sustainability.

With a focus on Europeans, the finding corroborates the idea that greenwashing tends to be presented more as a type of corporate misconduct (Spaniol et al., 2024; De Freitas Netto et al., 2020). Given that the posts on X analyzed are critical, emphasizing the disparities linked between the disputes of organizational environmental rhetoric and the concrete corporate action actually implemented, dialoguing with the idea of Spaniol et al. (2024) that points out the existence of unverifiable statements and misleading intentions are at the heart of public distrust.

It is important, therefore, to highlight that this critical engagement takes place in a regulatory and cultural environment increasingly influenced by the European Union’s sustainability goals. Thus, greenwashing tends to be an indicator of ethical divergence and a trigger for public debate about the authenticity of sustainable change (Banerjee, 2017). Given that what is at stake is not only the genuineness of environmental claims, but also the reliability of issues linked to sustainability as a guiding principle of contemporary capitalist leadership.

From this viewpoint, public discussions about greenwashing go further than cursory criticism; they uncover fundamental symbolic conflicts related to environmental management, corporate credibility, and ethical conduct in a time characterized by swift digital reproduction and exposure. These dynamics are not marginal but fundamental to the creation of meaning concerning sustainability in marketing digital.

6. References

- Amangeldi, D.; Usmanova, A.; Shamoï, P. (2024). *Understanding Environmental Posts: Sentiment and Emotion Analysis of Social Media Data*. IEEE Access. <https://doi.org/10.1109/ACCESS.2024.3371585>
- Banerjee, S. B. (2017). *Corporate Environmentalism and the Greening of Strategic Marketing: Implications for Marketing Theory and Practice*. In *Greener Marketing* (pp. 16-40). Routledge. <https://doi.org/10.4324/9781351283083-1>
- Blazkova, T.; et al. (2023). Greenwashing debates on Twitter: Stakeholders and critical topics. *Journal of Cleaner Production*, 427, 139260. <https://doi.org/10.1016/j.jclepro.2023.139260>
- Castells, M. (2004). *The Network Society* (pp. 3-45). Londres: Edward Elgar. <https://doi.org/10.4337/9781845421663>
- Castells, M. (2007). Communication, power and counter-power in the network society. *International Journal of Communication*, 1(1), 29-52.
- Castells, M. (2013). *Communication Power*. Oxford University Press.
- de Freitas Netto, S. V.; Sobral, M. F. F.; Ribeiro, A. R. B.; & Soares, G. R. D. L. (2020). Concepts and forms of greenwashing: A systematic review. *Environmental Sciences Europe*, 32, 1-12. <https://doi.org/10.1186/s12302-020-0300-3>
- Dimitrieska, S.; Stankovska, A.; & Efremova, T. (2017). The six sins of greenwashing. *Economics and Management*, 13(2), 82-89.
- El Barachi, M.; AlKhatib, M.; Mathew, S.; & Oroumchian, F. (2021). A novel sentiment-analysis framework for monitoring the evolving public opinion in real time: Case-study on climate change. *Journal of Cleaner Production*, 312, 127820. <https://doi.org/10.1016/j.jclepro.2021.127820>
- Gatti, L.; Pizzetti, M.; & Seele, P. (2021). Green lies and their effect on intention to invest. *Journal of Business Research*, 127, 228-240. <https://doi.org/10.1016/j.jbusres.2021.01.028>
- Grimmer, J.; & Stewart, B. M. (2013). Text as data: The promise and pitfalls of automatic content-analysis methods for political texts. *Political Analysis*, 21(3), 267-297. <https://doi.org/10.1093/pan/mps028>
- Hooper, L.; & Gilding, P. (2024). *Survival of the Fittest: From ESG to Competitive Sustainability*. University of Cambridge Institute for Sustainability Leadership. <https://doi.org/10.2139/ssrn.4713536>
- Khan, A.; Brohman, K.; & Addas, S. (2022). The anatomy of “fake news”: Studying false messages as digital objects. *Journal of Information Technology*, 37(2), 122-143. <https://doi.org/10.1177/02683962211037693>
- Kim, E. H.; & Lyon, T. P. (2015). Greenwash vs. brownwash: Exaggeration and undue modesty in corporate-sustainability disclosure. *Organization Science*, 26(3), 705-723. <https://doi.org/10.1287/orsc.2014.0949>
- Krippendorff, K. (2018). *Content Analysis: An Introduction to Its Methodology* (4.^a ed.). Sage. <https://doi.org/10.4135/9781071878781>
- Lyon, T. P.; & Montgomery, A. W. (2015). The means and ends of greenwash. *Organization & Environment*, 28(2), 223-249. <https://doi.org/10.1177/1086026615575332>

- Marcec, R.; & Likic, R. (2022). Using Twitter for sentiment analysis towards AstraZeneca/Oxford, Pfizer/BioNTech and Moderna COVID-19 vaccines. *Postgraduate Medical Journal*, 98(1161), 544-550. <https://doi.org/10.1136/postgradmedj-2021-140685>
- McLuhan, M. (1994). *Understanding Media: The Extensions of Man*. MIT Press. <https://doi.org/10.4324/9780203426647>
- Molenaar, A.; Lukose, D.; Brennan, L.; Jenkins, E. L.; & McCaffrey, T. A. (2024). Using natural-language processing to explore social-media opinions on food security: Sentiment-analysis and topic-modeling study. *Journal of Medical Internet Research*, 26, e47826. <https://doi.org/10.2196/47826>
- Neuendorf, K. A. (2017). *The Content Analysis Guidebook* (2.^a ed.). Sage. <https://doi.org/10.4135/9781071802878>
- Oppong-Tawiah, D.; & Webster, J. (2023). Corporate-sustainability communication as “fake news”: Firms’ greenwashing on Twitter. *Sustainability*, 15(8), 6683. <https://doi.org/10.3390/su15086683>
- Sharma, U.; Rudinac, S.; Demmers, J.; van Dolen, W.; & Worring, M. (2024). GreenScreen: A multimodal dataset for detecting corporate greenwashing in the wild. In *International Conference on Multimedia Modeling* (pp. 96-109). Springer Nature. https://doi.org/10.1007/978-3-031-56435-2_8
- Sailer, A.; Wilfing, H.; & Straus, E. (2022). Greenwashing and bluewashing in Black Friday-related sustainable fashion marketing on Instagram. *Sustainability*, 14(3), 1494. <https://doi.org/10.3390/su14031494>
- Spaniol, M. J.; Danilova-Jensen, E.; Nielsen, M.; Rosdahl, C. G.; & Schmidt, C. J. (2024). Defining greenwashing: A concept analysis. *Sustainability*, 16(20), 9055. <https://doi.org/10.3390/su16209055>
- Sunstein, C. R. (2018). *#Republic: Divided Democracy in the Age of Social Media*. Princeton University Press. <https://doi.org/10.1515/9781400884711>
- Szabo, S.; & Webster, J. (2021). Perceived greenwashing: The effects of green marketing on environmental and product perceptions. *Journal of Business Ethics*, 171, 719-739. <https://doi.org/10.1007/s10551-020-04461-0>
- Thompson, J. B. (1995). *The Media and Modernity: A Social Theory of the Media*. Stanford University Press.
- Tufekci, Z. (2017). *Twitter and Tear Gas: The Power and Fragility of Networked Protest*. Yale University Press. <https://doi.org/10.25969/mediarep/14848>

How are digital platforms hybridizing agricultural advisory systems? The case of Agroconsultas Online in Argentina

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Short abstract

Purpose: There is growing interest in understanding how digitalization transforms advisory systems through advisory apps focused on, e.g., weather information and plant health, and data platforms offering insight to foster farm performance (Coggins et al., 2025; Klerkx, 2021). It has been argued that advisors develop new skills and services, such as data curation and interpretation, in response to the digitalization of advisory services (Eastwood et al., 2019) but that digital advisory services are complimentary to and do not fully replace human advisors (Ding et al., 2022). However, there are still limited empirical insights into online advisory platforms' demand and supply dynamics and how both farmers and advisors engage with them. Therefore, this paper studies the supply and demand dynamics of an Argentinean advisory platform, Agroconsultas Online.

Design: The research employed a qualitative case study methodology based on analysis of platform use data and additional in-depth semi-structured interviews. The research focused on two distinct groups: six platform users (agricultural producers and advisors) and four agricultural experts who provide services through the platform. All interviews were recorded, transcribed, and analyzed using an inductive approach to identify emerging patterns and themes in the digitalization of agricultural extension services.

Findings: The study reveals that digital platforms create new patterns in how advisory services are accessed and delivered without replacing traditional extension channels. Key findings include: i) digital advisory services (such as for pest management, crop rotation schemes, livestock nutritional programs) complement existing extension methods (such as face-to-face advice) by providing immediate access to specialized knowledge through direct contact with top leading experts; ii) the platform serves multiple functions, such as a technical knowledge repository, a space for real-time problem-solving, and a professional social network for agricultural stakeholders; iii) for advisors who provide services through the platform, it delivers valuable insights into on-ground challenges across different geographical areas, informing their research and recommendations, as well as gaining visibility, and receiving payments for this recommendations; iv) users benefit from both synchronous (direct consultations) and asynchronous (archived responses, digital library) knowledge access.

Theoretically, the study contributes to understanding how digital transformation reshapes advisory systems and shows the emergence of hybrid extension systems where digital and traditional (non-virtual human-led) interactions coexist and complement each other. It adds to the literature evidence on new patterns in online advisory platforms' demand and supply dynamics and how both farmers and advisors engage with them. The research also

illuminates how digital platforms can serve as both knowledge repositories and dynamic spaces for professional interaction, suggesting new frameworks for analyzing agricultural knowledge systems in the digital age.

Practically, this research demonstrates how digital platforms can enhance access to agricultural expertise, which is particularly beneficial for producers in remote areas. The findings suggest that digital extension services can effectively connect advisors and producers by creating new channels for information dissemination and exchange and professional networking.

Keywords: digital transformation, digital extension, emerging economies

References:

- Coggins, S., Munshi, S., Smith, J., Yadav, A.K., Poonia, S.P., Patil, S., Singh, N.K., Sawarn, A., Ireland, D.C., McDonald, A.J., Singh, D.K., Sherpa, S.R. & Craufurd, P. (2025). How do chat apps support the use of farming videos in agricultural extension: A case study from Bihar, India, *NJAS: Impact in Agricultural and Life Sciences*, 97:1, 2420803, DOI: 10.1080/27685241.2024.2420803
- Ding, J., Jia, X., Zhang, W., Klerkx, L., 2022. The effects of combined digital and human advisory services on reducing nitrogen fertilizer use: lessons from China's national research programs on low carbon agriculture. *International Journal of Agricultural Sustainability* 20, 1136-1149.
- Eastwood, C., Ayre, M., Nettle, R., Dela Rue, B., 2019. Making sense in the cloud: Farm advisory services in a smart farming future. *NJAS - Wageningen Journal of Life Sciences* 90-91, 100298.
- Klerkx, L. (2021) Digital and virtual spaces as sites of extension and advisory services research: social media, gaming, and digitally integrated and augmented advice, *The Journal of Agricultural Education and Extension*, 27:3, 277-286, DOI: 10.1080/1389224X.2021.1934998

Advancing Dairy Extension: A Digital Living Laboratory Approach to Knowledge Mobilization in the Canadian Dairy Sector

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Short abstract

The WELL-E initiative is a national research program that applies a Digital Living Laboratory (DLL) model to close the gap between scientific innovation and on-farm application in the Canadian dairy sector. With a focus on animal welfare, AI integration, and digital innovation, WELL-E aims to generate actionable knowledge, enable practical adoption, and build system-wide capacity. Early work has centered on developing a robust knowledge translation and

transfer (KTT) strategy grounded in literature, systems mapping, and engagement with advisory networks.

WELL-E employs a dual push-pull KTT model, blending structured dissemination (e.g., training modules, videos) with participatory strategies that ensure tools and messages are co-developed with stakeholders. Findings emphasize the importance of trusted messengers, multi-modal delivery, and the integration of pedagogical principles in digital resource design. WELL-E's mapping of Canada's dairy KTT ecosystem—hosted on Kumu—has identified fragmentation and opportunities for improved collaboration.

This work offers both practical and theoretical contributions. It provides a scalable model for digital extension grounded in systems thinking, while reinforcing that digital tools alone are insufficient—effective KTT requires trust, contextual fit, and continuous evaluation. WELL-E's early lessons highlight a path forward for AI-enabled extension services that are credible, collaborative, and impactful.

1. Purpose

The [WELL-E initiative](#) is a national research program designed to improve the welfare and longevity of Canadian dairy cows through the responsible and strategic integration of scientific knowledge, digital innovation, and farmer engagement. As a Digital Living Laboratory (DLL), WELL-E brings together researchers, farmers, industry advisors, and technology experts to co-develop and test solutions that are practical, science-based, and tailored to on-farm realities.

WELL-E's KTT approach is grounded in three clear objectives:

- **Generate actionable knowledge:** Conduct research focused on animal welfare and longevity by integrating artificial intelligence (AI), sensor data, and real-time decision support tools. This knowledge must not only advance the science, but be usable and relevant to those working directly with dairy cattle.
- **Enable practical adoption:** Build and implement evidence-based KTT strategies that ensure research results are shared in ways that are understandable, credible, and compelling to farmers, advisors, and other stakeholders. Emphasis is placed on diverse learning preferences, trusted messengers, and digital and in-person communication formats.
- **Build system-wide capacity:** Strengthen Canada's dairy extension ecosystem by enhancing connections between knowledge generators (e.g., researchers), mobilizers (e.g., advisors), and users (e.g., producers). WELL-E aims to improve knowledge flow, reduce duplication, and promote coordinated, long-term capacity development.

These objectives reflect WELL-E's broader vision: **a Canadian dairy sector that is welfare-focused, technologically advanced, and driven by continuous learning and collaboration.**

The initiative recognizes that real change requires more than scientific breakthroughs—it requires aligning people, processes, and platforms to support lasting on-farm impact.

This presentation focuses on the early KTT and extension aspects of the WELL-E initiative, which has involved:

- Conducting an in-depth literature review on KTT models, strategies, and evaluation frameworks in agricultural research;
- Developing a national interactive mapping tool of Canada's dairy extension and advisory ecosystem using the Kumu platform;
- Outlining a vision and set of work packages for long-term KTT and capacity development within WELL-E.

2. Design and Approach

WELL-E's Design & Approach

The DLL model used by WELL-E fosters co-development between researchers, farmers, and industry partners to collaboratively test and refine solutions. Unlike traditional top-down approaches, these models rely on open communication, ongoing feedback, and shared decision-making to ensure solutions are practical and aligned with real-world needs. Agriculture and Agri-Food Canada (AAFC) emphasizes three core LL principles: addressing practical challenges, building diverse partnerships, and testing innovations in real settings—all of which promote continuous knowledge exchange and meaningful impact (AAFC, 2024). A key operational pillar for WELL-E is the stakeholder-driven steering committee, comprising farmer organizations, research institutions, government agencies, and sector experts. This governance model ensures that KTT activities are needs-driven and scientifically sound. The committee plays a central role in setting strategic priorities, funding activities, and reviewing performance metrics to ensure accountability.

Crafting a KTT Strategy for WELL-E

To inform the development of a robust KTT strategy for WELL-E, an environmental scan and literature review was conducted. This review examined existing KTT models, tools, and strategies within agriculture—particularly the dairy sector—with a focus on identifying best practices and lessons learned. The analysis prioritized frameworks that support knowledge co-creation and adoption, including push, pull, exchange, and integrated models, as well as DLL approaches that emphasize participatory engagement and real-world application. The methods also included a scan of key advisory actors within the Canadian dairy ecosystem, such as veterinarians, nutritionists, peer farmers, extension officers, and milk board representatives. These individuals were assessed for their potential role as knowledge brokers and their influence on producer decision-making. Special consideration was given to how farmer communication preferences and trust dynamics shape uptake of research knowledge.

Mapping Canada's KTT Ecosystem

A key early innovation for WELL-E is the creation of a digital infrastructure to support coordination and collaboration. One important element of this was to visually map the actors in the Canadian KTT ecosystem. Using Kumu's (<https://kumu.io/>) dynamic layering and filtering tools, stakeholders can explore a created map in multiple views, enabling both a high-level overview of national engagement patterns and granular details about individual organizations. The platform supports custom tagging, embedded links, and searchable nodes, making it both a visual and strategic planning tool. It can be exported into spreadsheets for further analysis or embedded in websites to promote transparency and collaboration.

3. Findings

Key KTT Strategies

The environmental scan and literature review highlight several core strategies essential for designing impactful KTT initiatives, particularly within the evolving context of digital agriculture.

First, building trust through meaningful relationships is foundational. Research shows that producers are more likely to engage with and act on information when it is delivered by trusted advisors such as veterinarians, peers, or nutritionists (Ritter et al., 2017; Roche et al.,

2020). These individuals often serve as translators of scientific knowledge, contextualizing it in ways that align with farm realities. For WELL-E, this reinforces the importance of activating and supporting advisory networks to serve as intermediaries in digital knowledge dissemination—ensuring that emerging tools and data insights from AI or sensors are made relevant and accessible through personalized support.

Second, the medium and format of communication matters. Canadian dairy producers continue to prefer traditional formats—such as print literature, in-person meetings, and on-farm demonstrations—yet digital tools are gaining traction among younger and more tech-savvy audiences (Roche et al., 2020). This highlights the need for a multi-modal approach that pairs digital innovations (e.g., dashboards, online training modules) with relational, human-centred touchpoints. Blending formats respects audience diversity and increases the likelihood of engagement across demographics.

Third, pedagogical principles must guide the design of digital extension materials. The literature emphasizes that learning is most effective when it is experiential, socially facilitated, and grounded in real-world contexts (Millar & Curtis, 1997; Leeuwis, 2004). WELL-E can apply these insights by designing interactive, farm-based training content and facilitating small-group digital learning sessions that build community around new technologies. Benchmarking tools, case studies, and peer-led videos are especially powerful when paired with farm-specific insights that show producers how their practices compare to others and where improvements can be made (Sumner et al., 2018; Wilson et al., 2023).

Finally, KTT strategies must be anchored by clear goals, metrics, and evaluation frameworks. Many programs fail to measure impact due to vague objectives and poor alignment between activities and outcomes (Berberi et al., 2021). WELL-E can avoid this pitfall by embedding mixed-methods evaluation from the outset—combining pre/post assessments, user feedback, and behaviour tracking—to monitor the use and influence of digital decision tools, training resources, and advisory interventions.

Taken together, these findings suggest that successful KTT in digital agriculture requires not only credible tools and content, but also trusted messengers, tailored delivery, active learning, and measurable outcomes. WELL-E is well-positioned to lead in this space by integrating these principles into its extension strategy.

Based on these findings, WELL-E's long-term KTT strateg will embrace a dual push-pull KTT model with DLL principles and systems thinking. This model reflects principles outlined by Lavis et al. (2003) and aligns with strategies advocated in the knowledge mobilization literature. Push strategies disseminate evidence-based practices using structured channels—e.g., webinars, infographics, animated videos, and technical fact sheets—tailored for advisors, veterinarians, and farmers. Pull strategies engage stakeholders in identifying research priorities and shaping knowledge dissemination formats. Focused group consultations, feedback loops, and on-farm learning forums allow for iterative refinement of both research activities and messaging.

Mapping Canada's KTT Ecosystem

WELL-E has developed a [publicly accessible system map](#) hosted on the Kumu platform. This map visualizes actors in the Canadian dairy KTT ecosystem, categorizing them by organizational type (e.g., research institute, producer organization, government body), geographic region, and primary function (e.g., knowledge generator, mobilizer, user). The map allows users to explore interconnections across the sector, identify underrepresented areas, and understand how actors are clustered by theme or geography.

This exercise has yielded several important insights. First, mapping the Canadian dairy KTT ecosystem revealed both strengths and structural weaknesses. The Kumu platform has

effectively highlighted actor density in regions such as Ontario and Quebec, while also illustrating a lack of formalized connections in neighbouring provinces. Key advisory roles—such as veterinarians, nutritionists, and milk board field staff—emerge as central hubs, yet many knowledge brokers operate in silos.

This fragmentation limits the sector's capacity for coordinated messaging and learning. Actors frequently lack visibility into related initiatives, resulting in duplication and missed partnership opportunities. Moreover, the dynamic nature of the sector means that the Kumu map requires ongoing updates and governance to remain relevant—raising questions about sustainability, custodianship, and integration into long-term KTT infrastructure.

Despite these challenges, the map has already been used to identify strategic entry points for information exchange and training. It offers a roadmap for fostering cross-organizational collaboration, enhancing knowledge equity, and aligning national extension efforts. By overlaying project data and identifying regional gaps, the map also supports evaluation, helping WELL-E and its partners track diffusion, engagement, and system responsiveness.

4. Practical Implications

WELL-E offers a replicable model for building knowledge mobilization strategies that align with both scientific innovation and real-world adoption. Its work to date underscores that successful extension in digital agriculture must blend technological tools with human-centered engagement. The findings reaffirm that producers continue to rely heavily on trusted intermediaries, particularly veterinarians, nutritionists, and peer farmers, as entry points for understanding and applying scientific knowledge. For WELL-E, this necessitates formal support and training for advisory networks, enabling them to act as conduits for digital insights emerging from AI and sensor platforms.

A second practical implication is the importance of matching communication format to learning preference. By developing modular training resources, visual aids, and decision-support tools that can be accessed online or delivered in-person, WELL-E can accommodate the diversity of its audience. The incorporation of farm-based benchmarking tools, peer-led case studies, and small-group learning sessions helps to contextualize abstract research findings in ways that producers can relate to and act on.

Lastly, the emphasis on embedding evaluation frameworks from the outset ensures WELL-E's activities are accountable, strategic, and improvement-oriented. Tracking how tools are accessed, who is engaging, and what changes result on-farm will allow the initiative to continuously refine its KTT approach and provide credible impact reporting to funders and stakeholders.

5. Theoretical Implications

WELL-E is contributing to a growing body of theory that situates knowledge mobilization as a dynamic, context-specific process that depends not only on content delivery but on the relational and institutional systems through which knowledge flows. The program advances the conceptual understanding of KTT by illustrating how push and pull mechanisms can be meaningfully integrated within a Living Laboratory framework—one that treats knowledge not as a fixed product to be transferred, but as a co-constructed outcome shaped by farmers, advisors, and researchers in real time.

Additionally, WELL-E will demonstrate how credibility, social proof, and contextual fit shape the uptake of new knowledge and tools. The initiative reinforces that communication effectiveness is contingent on alignment between content, messenger, and medium, and that digital tools must be paired with social supports to drive behavioural change.

Finally, WELL-E's commitment to mapping and evaluating its ecosystem highlights the need to embed systems thinking into future KTT theory. Rather than viewing adoption as a linear

outcome, the initiative positions knowledge use as a networked and iterative process—one influenced by power dynamics, institutional trust, and the spatial and social configurations of extension systems.

6. References

- Agriculture and Agri-Food Canada [AAFC]. (2023). Living Laboratories Initiative. Retrieved from <https://agriculture.canada.ca/en/science/living-laboratories-initiative> Last accessed on May 9, 2025.
- Berberi, A, Beaudoin, C, Nguyen, V, Bronson, K, McPhee, C, Joncoux, S, Jasmin, J-F, and Schillo, RS. (2021). Report: Knowledge gaps in evaluating the effectiveness and impacts of Living Labs focused on environmental and agricultural sustainability. https://socialecology.ca/wp-content/uploads/2022/02/1.2-KSG_Report_LivingLabs.pdf
- Lavis JN, Robertson D, Woodside JM, McLeod CB, & Abelson J. (2003). How can research organizations more effectively transfer research knowledge to decision makers? *The Milbank Quarterly*, 81(2), p.221-248. DOI: <https://doi.org/10.1111/1468-0009.t01-1-00052>
- Leeuwis, C. (2004). Communication for Rural Innovation: Rethinking Agricultural Extension, 3rd Ed. Oxford, UK: Blackwell Publishing.
- Millar, J and A. Curtis. (1997). Moving farmer knowledge beyond the farm gate: An Australian study of farmer knowledge in group learning. *European Journal of Agricultural Education and Extension* 4(2):133-142.
- Ritter C, Jansen J, Roche S, Kelton DF, Adams CL, Orsel K, Erskine RJ, Benedictus G, Lam TJGM, and Barkema H. (2017). Determinants of farmers' adoption of management-based strategies for infectious disease prevention and control. *Journal of Dairy Science*. 100(5) 3329-3347. <https://doi.org/10.3168/jds.2016-11977>
- Roche, SM, Renaud, DL, Genore, R, Bauman, CA, Croyle, S, Barkema, HW, Dubuc, J, Keefe, GP, and Kelton, DF. (2020). Communication preferences and social media engagement among Canadian dairy producers. *Journal of Dairy Science*, 103(12): 12128-12139. DOI: <https://doi.org/10.3168/jds.2020-19039>
- Sumner, C. L., von Keyserlingk, M. A. G., & Weary, D. M. (2018). How benchmarking motivates farmers to improve dairy calf management. *Journal of Dairy Science*, 101(4), 3323-3333. DOI: <https://doi.org/10.3168/jds.2017-13596>
- Wilson, D.J., Roche, S.M., Pempek, J.A., Habing, G., Proudfoot, K.L., & Renaud, D.L. (2023). How benchmarking motivates colostrum management practices on dairy farms: A realistic evaluation. *Journal of Dairy Science*, 106(12), 9200-9215. DOI: <https://doi.org/10.3168/jds.2023-23383>

TOPIC 4 – Education, advisory services and the wider AKIS's contribution to social

inclusion and the health and wellbeing of farmers and communities

Convenors: David Rose; Jorie Knook; Mark Moore; Tomas Russell

Session 1D

GENDER, EXTENSION AND RESILIENCE

Gender Realization and Women's Inclusion in Citrus Value Chains for Livelihood: A Case of Citrus Industry in Pakistan

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Short abstract

Citrus cultivation is a livelihood asset for the citrus growers in the center of the Punjab province of Pakistan. At present, the citrus industry encounters many challenges. Gender mainstreaming and the inclusion of women are somatises percevies as ris by the citrus industrie, dépite the facto That incombe frome citrus pochards is a primer source of livelihood for smallholder farmers in Pakistan. The project sites are two villages in Sargodha District, Punjab, Pakistan: Village 10NB on Bhalwal Road and Village 118NB on Silanwali Road. A qualitative research method, specifically the focus group discussion (FGD) approach, was employed to address the research questions. Data were analysed using Phenomenological analysis method for qualitative research and quantitative data was analyzed using descriptive statistics. The study concluded That the people of Sargodha demonstrate gender awareness and recognize the importance of women's participation in the citrus value chain to enhance the livelihoods of smallholder citrus farmers. The key constraints to women's inclusion in the citrus industrie were identifie as social and cultural normes, land ownership, access to finance, technologique éducation, and participation in decision-making. The study also highlighted areas where women could actively contribute to the citrus industry; however, it emphasized that women must receive prior training to effectively engage in these roles.

Keywords: harvesting, citrus, marketing, packaging, value chain

1. Purpose

Citrus farming is a lifeline for poor rural families in Sargodha, Punjab, Pakistan. Growing higher-value citrus crops offers a potential pathway to greater prosperity for local farmers. However, the reality is quite different for the tens of thousands of Pakistani citrus farmers who cultivate three-quarters of the national crop on farms smaller than five hectares. With 31 per cent of Pakistan's rural population living below the poverty line (Farooq & Ahmad, 2020), this project contributes to ACIAR's vision of a world "where poverty has been reduced

and the livelihoods of many improved through more productive and sustainable agriculture emerging from collaborative international research" (ACIAR, 2018, p.6).

The project also aligns with Australia's strategy for aid investment in agriculture, fisheries, and water, particularly in its focus on improving productivity along agricultural value chains and increasing smallholder participation in markets and engagement with the private sector (DFAT, 2015).

In the field, women face significant challenges. Despite contributing heavily to agricultural work alongside men, they encounter constraints such as limited mobility and lack of freedom to work independently. Women often require accompaniment by men or other women to access agricultural fields, restricting their autonomy. Moreover, they have limited access to training and extension services, which are predominantly delivered by men through government agencies or private agribusinesses. Their agricultural responsibilities are compounded by the burden of domestic chores, further limiting their opportunities for advancement.

This situation presents an important opportunity for Australia-Pakistan research collaboration through the Citrus Value Chains Project, now in its third operational year in the heart of Sargodha's citrus-growing region. The study discussed here was part of this ongoing ACIAR-funded project.

Key themes explored through literature review and focus group discussions (FGDs) included cultural barriers, gender inclusion, social well-being, women's financial empowerment in relation to land and natural resources, gender roles and responsibilities, participation in decision-making, religious belief systems, Access to technology and extension services, poverty levels, and the recognition of women's contributions in agriculture.

2. Design

2.1 Project Sites

Village 118 NB (Sillanwali) and Village 10 NB (Bhalwal) were selected as sites for implementing project activities. Sillanwali and Bhalwal are Tehsils in District Sargodha, a region wellknown for Kinnow production. The selection of these villages followed a rigorous process. Initially, two prominent citrus processors in Sargodha—recognized for their active role in fruit procurement—were identified. Interviews were then arranged with these processors to gather detailed insights about the villages from which they source citrus fruits. To ensure consistency in data collection and analysis, face-to-face interviews were conducted using a semi-structured questionnaire.

2.2 Sample Selection

Purposive sampling was followed for the baseline data collection. About Thirty smallholder households (less than 12.5 acres) from 118 NB and 20 smallholder households from 10 NB were selected for data collection. Five families from each village were selected and registered as member farmer superior to the baseline survey based on the variables such as operational land holding, growing citrus and willing to participate in the project activities. Approximately 10 households of labourers were deliberately chosen from each village for baseline interview data collection.

2.3 Data Collection and Analysis

The baseline survey was conducted using a questionnaire. Extensive training was provided to enumerators on using Kobo Toolbox for data entry and analysis. The survey instrument was created by teams from the University of Sargodha, University of Faisalabad, and Australian partners, incorporating feedback from all project components. It included sections on livelihood capitals, production costs, marketing, and farmer practices.

Questionnaires under went daily checks and edits. Data was entered into KOBO TOOLBOX, generating a report with survey results and tables.

3. Findings

3.1 Involvement in farming

All male farmers reported full-time involvement in farming in both villages. However, due to prevailing social norms and restrictions, women are often discouraged from participating in citrus farming, resulting in minimal presence or involvement in citrus fields. Women experience resistance when participating in citrus farming, as societal taboos surrounding females involvement in fieldwork regardless of land size create hesitation and reinforce the cycle of limited female participation in agricultural activities.

In 118 NB, one to two females indicated supporting their male counterparts in citrus farming tasks. Similarly, in 10 NB, a few females mentioned working in a citrus nursery. Moreover, a female respondent shared that before her marriage, she used to assist her father with various citrus-related tasks at home, including fruit harvesting, picking dropped fruits, and weeding.

3.2 Gender and social networking

In village 118 NB, Female participation in technical decision-making is significantly limited due to their limited knowledge about citrus farming and lack of linkage with extension departments. In village 10NB only males have access to public and private organizations, as females have limited involvement in citrus cultivation, leading them to perceive it as unnecessary to know or access these departments.

3.3 Household decision making

When asked about who in the household makes the decision, 60% of the respondents in village 118 NB and 63% of the respondents in village 10 NB responded that males in their households make major decisions. 26% of the respondents in 118 NB and 24% in 10 NB mentioned that both males and females collectively make major decisions. While 14% of the respondents in village 118 NB and 13% of the respondents in village 10 NB responded that females in their households make major decisions

Table 1: Decision making in Household

Gender	118 NB (%)	10 NB (%)
Males	60.0	63.0
Both	26.0	24.0
Females	14.0	13.0
Total	100	100

3.4 Gender involvement in citrus production

One aspect of gender involvement in citrus production was assessed by asking whether women participate in any farming activities. In Village 118 NB, 15.52% of respondents answered "yes," while 84.48% responded "no." Similarly, in Village 10 NB, only 13.79% of respondents reported that women perform some activities, whereas 86.21% said they do not. In all other citrus management activities from ploughing to post-harvest and marketing there is no involvement of females in both the villages.

Table 2: Gender involvement in citrus

	118 NB (%)	10 NB (%)
Is there any activity performed by females?	No: 84.48 Yes: 15.52	No: 86.21 Yes: 13.79
If yes, which activity	Livestock management and vegetables for home: 15.52	Livestock, Nursery raising, weeding and caring: 13.79

3.5 Attitude on gender roles in relation to Human capital

This section addresses gender norms related to human capital and capacity building. Respondents were asked to express their perceptions on a given set of indicators using three response options: 1=agree, 2=disagree, and 3=undecided. In Village 118 NB, the majority of respondents agreed with the indicators presented. According to the responses, men were primarily seen as responsible for managing children's education, attending trainings to improve Kinnow farm management, consulting and involving women in decision-making, and maintaining influence and control over family matters. Women, in turn, were expected to support men in fulfilling these responsibilities. Conversely, women were viewed as primarily responsible for caring for sick family members, ensuring children attend school, managing household nutrition, developing skills for supplementary income generation, and handling various domestic tasks within the household budget. Men were expected to support women in these roles. A slightly higher percentage of respondents were undecided about certain indicators, such as the man's role in supporting women with family nutrition, the woman's role in improving income-generating skills, and the man's role in supporting skill development for women's income generation.

Table 3: Attitude on gender roles in relation to Human Capital

Attitude on Gender roles	Agree (%)	Undecided (%)	Dis-agree (%)
A man's role is to take care of children's education.	89.65	6.9	3.45
A woman's role is to support a man to take care of children's education.	89.66	8.62	1.72
A woman's role is to look after the sick in the family.	82.76	13.79	3.45
A man's role is to support a woman to look after the sick in the family.	91.38	8.62	0
A woman's role is to send children to school.	91.38	8.62	0
A man's role is to support a woman to send children to school.	93.11	5.17	1.72
A man's role is to attend trainings to improve Kinnow farm management.	75.87	22.41	1.72
A man's role is to support women to improve skills for additional income generation for the family.	75.86	20.69	3.45
A man's role is to consult / include women in all type of decision.	81.04	17.24	1.72
A women's role is to actively take part in decision making	87.93	8.62	3.45
A man's role is to influence and control of family matters	81.04	10.34	8.62
A women's role is to support him in controlling family matters.	84.49	13.79	1.72
A women's role is to manage all diversified activities / care work of household and manage with the income limit	89.65	6.90	3.45

4. Practical Implications

Based on the survey results, it was concluded that in both studied villages (118 NB and 10 NB), women have no practical involvement in citrus field activities. Cultural norms consider female participation in orchard work a social taboo.

5. Theoretical Implications

Since there is no practical involvement of women in the citrus value chain, it is essential to identify on-farm and off-farm opportunities for their participation. Capacity building programs should be developed for female laborers interested in working in the field, focusing on various citrus farming activities. Additionally, exposure visits to processing units and meetings with progressive female farmers should be organized to encourage and motivate female growers and laborers.

6. References

- Australian Centre for International Agricultural Research (2018). *ACIAR 10-year strategy 2018 – 2027, Research that works for developing countries and Australia*, Australian Government: Canberra.
- Australian Centre for International Agricultural Research (2019). *ACIAR Annual Operation Plan 2019-20*. Reterieved on April 19, 2025 from <https://aciarc.gov.au/publication/corporate-publications/annual-operational-plan-2019-20>
- Department of Foreign Affairs and Trade (DFAT) (2015). *Strategy for Australia's aid investments in agriculture, fisheries and water*, Australian Government: Canberra. Reterieved on April 19, 2025 from <https://www.dfat.gov.au/sites/default/files/strategy-for-australias-aid-investments-in-agriculture-fisheries-and-water.pdf>
- Pakistan Institute of Development Economics (2020). Report. Reterieved on April 11, 2025 from <https://www.pide.org.pk>

The Power of Workforce Resilience and Cooperative Extension

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Short abstract

1. Purpose

Resilience, an ability to adapt to and overcome difficult situations, is a vital quality in home and work environments. Natural and manmade traumatic events affect all, but those who navigate them by prioritizing well-being (mental, physical, and emotional) and remaining optimistic, will thrive beyond the event. Building resilience in today's workplace may require more than recovery from difficulties, adaptability, creativity, and sustained motivation (Norris et al., 2022). A resilient workforce enhances productivity, collaboration, and contributes to positive organizational culture (Jackson et al., 2007). The Cooperative

Extension System (CES) emphasizes resilience building through workforce development to address skills gaps (Sitsofe, 2024), economic sustainability (Guibert et al., 2023), and farmers' climate change adaptive capacities (Asare-Nuamah et al., 2019; Osumba et al., 2021; Tesfaye et al., 2019). We explored resilience building through OneOp—a virtual professional development initiative for service providers. OneOp helps mitigate employee burnout, foster innovation, and sustain effective service delivery for military families during crises. OneOp's strategies are applicable to Extension by helping farmers and farming communities navigate stressful events, such as economic uncertainty from weather- and market-related events.

2. Methodology

This study employed a mixed-methods evaluation of six OneOp professional development webinars conducted between 2020 and 2022, aimed at supporting resilience among service providers working with military families. The webinars were strategically designed around key themes: emotional regulation, effective communication, stress management, and recognition of internal and external resilience threats. Post-evaluation data were collected from 833 participants, comprising military-affiliated service providers—including those from all branches of service, DoD contractors, and federal agency personnel— as well as Cooperative Extension and university-affiliated professionals. Quantitative data assessed participant achievement of learning objectives using Likert-scale ratings, while qualitative, open-ended responses captured perceived impacts of the training on professional practice. The educational approach incorporated adult learning theory, peer-to-peer engagement, and content tailored to high-stress occupational environments. Webinars were further supported by reinforcing resources such as blogs, podcasts, and asynchronous learning modules to build a comprehensive virtual learning network.

3. Findings

Between 2020 and 2022, OneOp hosted a series of six professional development webinars focused on building resiliency among professionals supporting military families as they navigated the evolving challenges of the COVID-19 pandemic. The sessions included Communication Power Moves: Part Two – Working with Difficult Clients, Keep Calm and Carry On: Working with Difficult Clients, Need to Refuel? Tools for Self-Care and Resilience, Resilience in a Pandemic-Impacted Era, Risk and Resilience: Understanding Secondary Traumatic Stress Post-Pandemic, and Surmounting Social Isolation and Loneliness. These webinars were led by subject matter experts in workforce culture and client relations and were grounded in evidence-based practices for addressing professional stress and burnout. A central theme throughout the sessions was the importance of self-awareness and personal agency in fostering resilience. Participants were introduced to a range of techniques tailored to high-stress occupational settings, including occupational stress management, mindfulness, emotional regulation, and strategies for distinguishing between internal and external sources of workplace adversity. The training emphasized collaborative problem-solving, effective communication, and mutual support within organizations as key components of long-term resilience-building. The webinars collectively engaged 833 participants, with 63% representing military-affiliated service providers from across all branches of the U.S. military, the Department of Defense (DoD), DoD contractors, Veterans Affairs, and other federal agencies. The remaining 37% were affiliated with Cooperative Extension, universities, non-federal agencies, and community-based organizations. This diverse participation base reflects the broader ecosystem supporting military families beyond installation boundaries. Evaluation data indicated strong gains in participant knowledge and confidence across all domains. All participants (100%) recognized risk and

resilience factors related to secondary traumatic stress and identified coping strategies for managing loneliness. Nearly all (99%) reported improved ability to reconnect with others after disruptions and enhanced their active listening, mirroring, and environmental awareness skills. Additionally, 98% acknowledged the importance of personal “refueling” before, during, and after client engagement, and 94% gained practical strategies for supporting personal and client resilience amid ongoing pandemic challenges. Open-ended feedback reinforced these outcomes, with participants noting how the webinars promoted positive coping strategies, improved situational awareness, and increased their ability to respond to workplace stress and frustration with greater professionalism and adaptability. Overall, these sessions affirmed the value of structured, accessible training in helping professionals cultivate and apply resilience in their work and organizational environments.

4. Practical and theoretical implications

The COVID-19 pandemic exposed significant stressors that tested the resilience of individuals and communities, often resulting in trauma and disruption. While the immediate threat of the pandemic has subsided, climate change continues to pose a serious risk to global food and agricultural systems. Recent findings suggest that pluralistic agricultural extension systems have contributed to a 40% increase in social resilience and a 32% increase in economic resilience among smallholder farmers (Odongo et al., 2023). Programs like OneOp can further strengthen Cooperative Extension’s capacity to support these vulnerable communities by equipping professionals with the tools needed to build resilience in the face of climaterelated challenges. OneOp exemplifies a scalable, virtual training model that delivers accessible, topic-specific content to geographically dispersed professionals, grounded in adult learning principles. The success of such initiatives underscores that resilience is not simply an inherent trait, but a skillset that can be intentionally developed through focused, community-driven strategies. Theoretically, this approach aligns with existing research on occupational well-being, burnout prevention, and organizational learning. It also expands this knowledge base by demonstrating how resilience strategies can be effectively applied across sectors. Practically, incorporating resilience-focused training within Cooperative Extension creates a more adaptable workforce capable of responding to ongoing disruptions—whether from public health crises, climate instability, or resource limitations. As these global and local challenges persist, OneOp serves as a replicable model for embedding resilience education into professional development across Extension systems and allied networks.

Keywords

Resilience, well-being, mental health, Extension, stress

5. References

- Asare-Nuamah, P., Botchway, E., & Onumah, J. A. (2019). Helping the helpless: Contribution of rural extension services to smallholder farmers’ climate change adaptive capacity and adaptation in rural Ghana. *International Journal of Rural Management*, 15(2), 244-268. <https://doi.org/10.1177/0973005219876211>
- Guibert, G., Turner, A., Frantz, J., Lewandowski, J., & Hyde, I. (2023). Building resilience in economic development: A systems approach for sustainable growth. Argonne National Laboratory, Development Administration, U.S. Department of Commerce. <https://nerde.anl.gov/api/media/3b99e4f8-746d-4cb3-84c0-046e5f6eb207.pdf>
- Jackson, D., Firtko, A., & Edenborough, M. (2007). Personal resilience as a strategy for surviving and thriving in the face of workplace adversity: a literature review. *Journal of Advanced Nursing*, 60(1):1- 9. <https://doi.org/10.1111/j.1365-2648.2007.04412.x>

-
- Norris, D., Cramm, H., Baluck, K., Schwartz, K.D., & Whelan, J. (2022). Cultivating family resiliency in the context of the military to civilian transition and mental health problems. *Journal of Military & Veterans' Health*, 30(3), Article 6. [https://doi-
ds.org/doi/10.2022-58564767/JMVH Vol 30 No 3](https://doi-
ds.org/doi/10.2022-58564767/JMVH Vol 30 No 3)
- Odongo, H. J., Opio, A., Mwesigye, A., & Bariyo, R. (2023). Contribution of pluralistic agriculture extension service provision to smallholder farmer resilience. *Journal of Sustainable Development*, 16(6), 79-102. <https://doi.org/10.5539/jsd.v16n6p79>
- Osumba, J. J. L., Recha, J. W., & Oroma, G. W. (2021). Transforming agricultural extension service delivery through innovative bottom-up climate-resilient agribusiness farmer field schools. *Sustainability*, 13(7), 3938. <https://doi.org/10.3390/su13073938>
- Sitsofe, P. (2024). Workforce development in rural Ontario: An examination of experiences and strategies. [Master's thesis, The University of Guelph]. <https://hdl.handle.net/10214/28776>
- Tesfaye, A., Hansen, J., Tesfahun Kassie, G., Radeny, M., & Solomon, D. (2019). Estimating the economic value of climate services for strengthening resilience of smallholder farmers to climate risks in Ethiopia: A choice experiment approach. *Ecological Economics*, 162, 157-168. <https://doi.org/10.1016/j.ecolecon.2019.04.019>
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Does Climate Adaptation Improve Food Security and Household Well-being? The Critical Role of Information and Misinformation in Shaping Adaptation and Resilience

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Short abstract

This study investigates the impact of climate adaptation measures on household food security and well-being in a marginalized and climate-vulnerable region of Pakistan, with a specific focus on the role of information and misinformation. Drawing on the Model of Private Proactive Adaptation to Climate Change (MPPACC), the research explores how access to credible advisory services and exposure to misinformation influence farmers' adaptation decisions. Using a mixed-methods approach—including household surveys, key informant interviews, and focus group discussions—the study applies propensity score matching (PSM) to quantify the effects of adaptation measures such as water management, climate-smart seeds, cultivation date adjustments, and fertilizer use. The findings reveal significant yield improvements, contributing directly to improved food and nutritional security. Regression and thematic analyses highlight that access to trustworthy information enhances resilience, while online misinformation undermines adaptation by fostering skepticism and confusion. The study offers theoretical contributions by integrating information and misinformation exposure into the MPPACC framework and practical insights for strengthening advisory services and countering misinformation. Policymakers are encouraged to invest in credible, accessible information systems alongside technical interventions to enable effective adaptation. Overall, the study demonstrates that resilience to climate change is shaped not only by resources and practices but also by the quality of information farmers use to guide their decisions.

1. Background and Purpose

Climate change poses significant and growing challenges to agricultural communities, particularly in low- and middle-income countries where livelihoods are highly climate-sensitive (Zahnow et al., 2025). Increasingly frequent and severe climate events, such as droughts, floods, and heatwaves, threaten crop yields, food availability, and rural households' general well-being (Bahadur Rahut & Ali, 2017). In response, farmers adopt various adaptation strategies to cope with these impacts. However, the effectiveness of these adaptations depends not only on access to resources and technologies but also on the quality of information guiding these decisions (Khan et al., 2022). In many contexts, misinformation or incomplete knowledge can hinder adaptive capacity, exacerbate vulnerability, and reduce resilience.

This research examines farmers' adaptation to climate change and the impact of adaptation measures on household well-being and food security, particularly within the context of their information access and misinformation exposure.

2. Theoretical framework

The study draws on the Model of Private Proactive Adaptation to Climate Change (MPPACC), which emphasizes the factors influencing farmers' ability to adapt and build resilience. The MPPACC, developed by Grothmann & Patt (2005), posits that individual adaptation decisions are influenced by two primary cognitive processes: risk appraisal and adaptation appraisal. Risk appraisal involves an individual's perception of the severity and probability of climate-related threats, while adaptation appraisal assesses the perceived efficacy of adaptive responses, self-efficacy, and the costs associated with adaptation. These appraisals are shaped by various factors, including personal experiences, socio-economic conditions, and, notably, social discourse, the information individuals receive from media, peers, and institutions.

In this study, we focus particularly on the role of social discourse in shaping farmers' adaptation decisions and hence contribute to enhanced household food security. We explore how farmers receive information about climate change from diverse sources such as social media platforms, friends, colleagues, neighbors, and government agencies. Recognizing the growing concern over misinformation, we specifically examine how exposure to inaccurate or misleading information within these social networks can distort risk and adaptation appraisals, potentially hindering proactive adaptation behaviors.

3. Methodology

This research was conducted in South Punjab, a socially marginalized and climate-vulnerable region of Pakistan. The area is characterized by high poverty incidence, limited institutional support, and recurring exposure to climate-related shocks such as droughts, floods, and heat stress, making it an appropriate setting for the study (Sarkar, 2022; Zahra et al., 2018).

A mixed-method research design was employed, where data were collected from household surveys (204), key informant interviews (10), and focus group discussions (5). The household surveys captured detailed information on demographics, information access, exposure to misinformation, adaptation strategies, food consumption, and household well-being indicators. Key informant interviews were conducted with local officials, agricultural extension workers, and representatives of NGOs and community-based organizations to gather expert insights into local adaptation policies, support systems, and information dissemination mechanisms.

Descriptive statistics, econometric analysis, and thematic analysis were used to analyze the data. Specifically, propensity score matching (PSM) was utilized to quantify the impact of the

most adopted climate adaptation measures on household well-being, focusing on crop yields and their contribution to food and nutritional security. The PSM was used to control for potential selection bias by matching adopters and non-adopters of specific adaptation strategies based on observable characteristics, to allow for a more robust estimation of causal effects (Dehejia & Wahba, 2002). Thematic analysis of qualitative data further enriched the findings by highlighting how access to accurate information—or exposure to misinformation—affects adaptation decisions, and thus, contributes to food security and household wellbeing.

4. Findings

The study reveals three key findings. First, the adoption of climate adaptation measures, such as improved water and fertilizer management, climate-smart seeds, and adjusted cultivation dates, leads to substantial improvements in wheat yields and, consequently, household food security. Second, access to credible advisory services plays a positive role in enabling effective adaptation. Third, exposure to misinformation, especially through online sources, negatively influences farmers' decisions, sometimes deterring the adoption of beneficial practices. Together, these results highlight the dual importance of adopting climate-smart practices and ensuring access to reliable information.

Specifically, the PSM analysis showed significant wheat yield increases from climate adaptation measures: water management (199.77 kg/ha), climate-smart seeds (259.39 kg/ha), cultivation date adjustments (314.68 kg/ha), and fertilizer management (284.49 kg/ha). These yield gains translate to improved food security, reduced market dependency, and enhanced self-sufficiency, as wheat is a staple food crop in Pakistan, consumed up to three times a day. With climate-smart seeds, a farmer cultivating 3.24 hectares (average farm size) could harvest an additional 860 kg of wheat per season, providing approximately 2.92 million kilocalories—enough to meet the annual calorie needs of about seven individuals, based on an average daily requirement of 2,200 kcal per person. This improvement in wheat yield significantly contributes to household food security and nutrition, ensuring more stable access to essential calories and reducing reliance on external food sources.

These quantitative findings are further reinforced by qualitative insights from the field, where farmers consistently linked improved yields with increased food availability, reduced financial stress, and a greater sense of control over their livelihoods. Such changes were also associated with a higher likelihood of children attending school regularly and households reporting fewer instances of meal skipping during lean seasons. These secondary effects suggest that adaptation measures can generate multidimensional benefits that go beyond agricultural productivity, enhancing overall household well-being.

The regression analysis reveals that advisory services enhance adaptation, while exposure to online misinformation hinders adaptation decisions by fostering skepticism. The role of misinformation varies, with offline misinformation showing mixed effects. Findings from the thematic analysis further highlight the crucial role of conventional advisory services in enhancing farm resilience by providing guidance that boosts farmers' confidence in adopting climate adaptation measures. These findings suggest that access to advisory services and credible information plays a crucial mediating role in the adoption of adaptation measures, thereby enhancing household food security and overall well-being.

Importantly, the findings reveal that not all information sources are equal. While formal advisory services were generally trusted and acted upon, information obtained from social media and peer networks often lacked credibility and consistency. In some cases, misinformation, such as exaggerated claims about seed performance or conspiracy theories about fertilizers, discouraged farmers from adopting effective practices, even when they

were available and affordable. This points to the urgent need for interventions that improve digital literacy, verify climate information, and strengthen the presence of credible advisory networks in rural areas. As climate risks intensify, the ability to distinguish accurate from misleading information may prove as vital to resilience as access to seeds and water itself.

5. Practical implications

The findings have important practical implications for policymakers, development practitioners, and agricultural extension and advisory service providers. The research shows that access to reliable advisory services significantly enhances the adoption of climate adaptation practices, which in turn improve crop yields, food security, and household well-being. Conversely, misinformation—especially from digital platforms—can inhibit these positive outcomes by discouraging trust in evidence-based practices. This highlights the need for strengthening formal information channels and increasing the reach and effectiveness of agricultural advisory services.

Policymakers should prioritize the development of locally grounded, trusted communication networks that deliver timely, accurate, and actionable information to farmers. This includes investing in training for extension workers, developing climate-smart messaging in local languages, and promoting media literacy to help farmers critically evaluate online content. Additionally, collaboration with community leaders and traditional information brokers can help bridge gaps between scientific knowledge and local decision-making. By addressing both the supply and credibility of information, these interventions can support more effective adaptation, reduce vulnerability, and contribute to broader development goals in climate-affected rural areas.

6. Theoretical Implications

This study contributes to the theoretical framework, MPPACC, by emphasizing the critical role of social discourse, particularly information and misinformation exposure, in shaping farmers' adaptive decisions, which influence crop yield and hence household food security. It advances the theoretical understanding of adaptive decisions by integrating the informational dimension as a key determinant of adaptation. Traditionally, the existing frameworks have focused on physical, economic, and institutional resources; this research highlights that informational assets are equally vital. Accurate and trustworthy information enables timely and effective decision-making, while misinformation, especially from online sources, can generate skepticism, delay responses, and lead to maladaptive practices.

The study proposes that adaptation is not merely a function of personal capacity or resources but is also deeply rooted in the narratives and knowledge systems available to a community. In doing so, it suggests expanding existing theoretical models to more explicitly account for the influence of communication environments, media literacy, and institutional trust. This opens new avenues for research on how informational ecosystems interact with behavioral adaptation across different socio-ecological settings, particularly in the context of climate change.

7. References

- Bahadur Rahut, D., & Ali, A. (2017). Coping with climate change and its impact on productivity, income, and poverty: Evidence from the Himalayan region of Pakistan. *International Journal of Disaster Risk Reduction*, 24, 515–525.
<https://doi.org/10.1016/j.ijdrr.2017.05.006>
- Dehejia, R. H., & Wahba, S. (2002). Propensity score-matching methods for nonexperimental causal studies. *Review of Economics and Statistics*, 84(1), 151–161.

-
- Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change*, 15(3), 199–213. <https://doi.org/10.1016/j.gloenvcha.2005.01.002>
- Khan, N. A., Ma, W., Owusu, V., & Shah, A. A. (2022). Does ICT-based farm advisory improve farmers' adaptation to climate change? Evidence from Pakistan. *Climate and Development*, 1–16. <https://doi.org/10.1080/17565529.2022.2143232>
- Sarkar, S. (2022). Pakistan floods pose serious health challenges. *BMJ*, o2141. <https://doi.org/10.1136/bmj.o2141>
- Zahnow, R., Yousefnia, A. R., Hassankhani, M., & Cheshmehzangi, A. (2025). Climate change inequalities: A systematic review of disparities in access to mitigation and adaptation measures. *Environmental Science & Policy*, 165, 104021. <https://doi.org/10.1016/j.envsci.2025.104021>
- Zahra, K., Ashraf, A., Zafar, T., & Yaseen, B. M. (2018). Marginality and social exclusion in Punjab, Pakistan: A threat to urban sustainability. *Sustainable Cities and Society*, 37, 203–212. <https://doi.org/10.1016/j.scs.2017.11.009>
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Building Capacity for Mental Health Education in Rural Texas: Qualitative Insights from a Mental Health First Aid Grant Program

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Short abstract

The “Reducing Opioid Use and Misuse through Adult Mental Health First Aid in Rural Texas” (MHFA_RTX) initiative (2020–2023), funded by USDA-NIFA, addressed the intersection of mental health and opioid use disorders in underserved rural communities across Texas. Using the Adult Mental Health First Aid (AMHFA) curriculum, this trauma-informed, community-based program trained 595 rural residents—including educators, first responders, healthcare providers, and others—to recognize, respond to, and support individuals experiencing mental health and substance use challenges. The training emphasized early intervention via the ALGEE action plan, naloxone education, self-care, and coalition-building.

A qualitative analysis of participant feedback revealed five key impact areas: increased crisis response confidence, real-life application of ALGEE, emotional resilience and empowerment, improved mental health literacy, and burnout prevention. These outcomes demonstrate that AMHFA effectively builds individual and community capacity to address behavioral health challenges while reducing stigma and fostering local support systems. The program also expanded access to critical mental health knowledge in areas facing professional shortages and systemic barriers to care. MHFA_RTX highlights the promise of Extension-led, culturally responsive public health education in reducing opioid misuse and supporting behavioral health equity in rural America—underscoring its potential as a scalable model for similar high-need settings.

1. Purpose

The “Reducing Opioid Use and Misuse through Adult Mental Health First Aid (AMHFA) in Rural Texas” (MHFA_RTX) initiative (2020–2023), funded by the U.S. Department of Agriculture’s National Institute of Food and Agriculture (USDA-NIFA), was developed in response to urgent mental health and substance use challenges that were especially acute in rural Texas during the years 2015–2019. During this time, high rates of co-occurring mental health and opioid use disorders underscored the need for integrated care approaches—particularly as over 60% of individuals with opioid use disorder were also living with a mental health condition (Davis, Lin, Liu, & Sites, 2017; Nam, Matejkowski, & Lee, 2017). Many rural residents with mental illness reported unmet treatment needs, driven by stigma, lack of awareness, and concerns related to privacy or employment (Ali, Teich, & Mutter, 2017; Substance Abuse and Mental Health Services Administration [SAMHSA], 2017). To address these challenges, MHFA_RTX employed the Mental Health First Aid (MHFA) model, which has been shown to improve mental health literacy, reduce stigma, and enhance early intervention skills among non-clinical first responders such as educators, caregivers, and service providers (National Council for Behavioral Health, 2019).

The initiative also responded to an ongoing and critical shortage of mental health professionals across Texas. As of 2018, over 430 areas in the state were designated Mental Health Professional Shortage Areas, with only 34.5% of service needs being met and more than 580 additional providers required to close the gap (Health Resources and Services Administration, 2015). These shortages were especially pronounced in rural regions, which experienced disproportionately high rates of poverty, substance use, suicide, and limited access to treatment (Benson & Aldrich, 2019; Centers for Disease Control and Prevention [CDC], 2018). Drawing on successful community coalition models from other states, MHFA_RTX implemented a localized, multi-tiered strategy for prevention, intervention, and recovery support in rural communities (Wilson, Bangs, & Hattin, 2017). The program’s purpose was to train rural residents to recognize signs of mental health crises, respond appropriately, reduce stigma, and promote harm reduction—ultimately aiming to reduce opioid misuse and improve behavioral health outcomes in underserved regions.

To address these challenges, MHFA_RTX utilized the Adult Mental Health First Aid (AMHFA) model, an evidence-based approach proven to increase mental health literacy, reduce stigma, and improve early response skills among non-clinical community members (National Council for Behavioral Health, 2019). Drawing from successful community coalition models, MHFA_RTX implemented a localized, multi-tiered strategy for prevention, intervention, and recovery support—ultimately aiming to reduce opioid misuse and improve behavioral health outcomes in underserved regions.

The purpose of this initiative was to evaluate the effectiveness of the Adult Mental Health First Aid (AMHFA) model in addressing co-occurring mental health and opioid use challenges in rural Texas communities by improving mental health literacy, reducing stigma, and strengthening early intervention and response capacity among non-clinical community members. The initiative also aimed to assess the role of Extension systems and localized coalition strategies in mitigating provider shortages and enhancing behavioral health outcomes in underserved regions.

2. Approach

The initiative employed a trauma-informed, multi-level intervention model grounded in the Adult Mental Health First Aid curriculum. A total of 595 participants from across rural Texas received free training, including educators, first responders, law enforcement officers, healthcare workers, military personnel, and other key community stakeholders.

The training focused on five major content areas:

- Recognition of mental health and substance use disorders
- Application of the ALGEE model (Approach, Listen Nonjudgmentally, Give Reassurance and Information, Encourage Professional Help, Encourage Self-Help and Support)
- Naloxone education for opioid overdose reversal
- Self-care and burnout prevention
- Community coalition development

To evaluate training impact, a qualitative thematic analysis was conducted using responses to the AMHFA Evaluation question: “What was the most helpful part of the course? Why?” A total of 132 usable responses were analyzed to identify recurring themes.

3. Findings

Analysis revealed five dominant themes reflecting the training’s effectiveness in building community-level mental health capacity (See Table 1):

- 1. Confidence in Crisis Management and Preparedness**
Participants expressed greater ability and readiness to identify and respond to mental health crises, with ALGEE cited as a practical and structured tool.
- 2. Application of the ALGEE Model in Real-Life Situations**
Trainees described using the ALGEE model in diverse real-life contexts, highlighting its relevance across personal and professional situations.
- 3. Emotional and Psychological Benefits of AMHFA Training**
Many reported increased emotional resilience, hope, and motivation to support others—especially those living with mental illness or addiction.
- 4. Knowledge and Understanding of Mental Health**
Improved awareness of mental health symptoms, conditions, and treatment pathways was noted as particularly valuable in rural areas lacking mental health infrastructure.
- 5. Self-Care and Burnout Prevention**
Participants recognized the importance of maintaining their own mental well-being, especially those in caregiving and frontline roles.

Table 1: Summary of Key Findings from AMHFA Participant Feedback

<i>Theme</i>	<i>Description</i>	<i>Representative Participant Feedback</i>
1. Confidence in Crisis Management and Preparedness	Participants reported increased confidence in recognizing and responding to mental health crises, citing ALGEE as a clear and actionable model.	<ul style="list-style-type: none"> - "Learning ALGEE in depth makes me feel confident in my ability to help during a mental health crisis." - "The training was significant because it organizes your approach to better assist someone." - "... it will help me to help others in crisis."
2. Application of the ALGEE Model in Real-Life Situations	ALGEE was praised for its flexibility and practical utility in real-world interactions, including personal situations and professional settings.	<ul style="list-style-type: none"> - "ALGEE teaches individual methods to implement when dealing with individuals in distress." - "I used ALGEE when my daughter had an anxiety episode—it helped her calm down faster." - "Analyzing different scenarios to

		apply ALGEE helped me understand the action steps better."
3. Emotional and Psychological Benefits of Training	Many felt more hopeful and less helpless, with an increased sense of agency in addressing mental health issues in others.	- "I am more hopeful and feel less helpless when I recognize someone may be struggling." - "It really has changed my attitude 100%. I have a mentally ill son who struggles with addiction." - "As a chaplain, this enhances my ability to support service members."
4. Knowledge and Understanding of Mental Health	The training broadened participants' understanding of mental health disorders, symptoms, and stigma, especially useful in underserved rural contexts.	- "I learned more tools and have a clearer understanding of mental illness." - "There isn't just one mental illness—I understand that now."
5. Self-Care and Burnout Prevention	Participants recognized the need for self-care as mental health supporters and appreciated the training's emphasis on personal wellbeing.	- "Self-care was also helpful to highlight." - "We are humans and will have burn-out—it's important to acknowledge that."

4. Practical Implications

MHFA_RTX demonstrates how evidence-based training programs can effectively meet the needs of rural communities by addressing the "Four A's" of behavioral health access: Accessibility, Availability, Affordability, and Acceptability (Wilson et al., 2015). Notable outcomes include:

- Strengthened crisis response capacity at the community level
- Increased mental health help-seeking behavior in rural populations
- Distribution of naloxone and overdose prevention education
- Reduced stigma and improved understanding of mental illness
- Development of new or expanded community coalitions for mental health support

These outcomes show the potential for scalable, sustainable public health strategies to improve behavioral health outcomes in similarly underserved contexts—especially through the platform of Extension programming.

5. Theoretical Implications

The initiative reinforces and expands several key behavioral health theories while highlighting the evolving role of Extension education in addressing rural mental health disparities.

- Findings validate Mental Health First Aid (MHFA) as an adaptable and scalable model for improving mental health literacy and reducing stigma in rural and underserved communities.
- By training individuals to recognize and respond to mental health challenges, MHFA empowers community members with critical intervention skills, aligning with theories of capacity-building and community-based health promotion.
- Extension systems are uniquely positioned to broaden mental health outreach and impact, particularly through rural-focused programming that integrates mental

health literacy and opioid misuse education to reduce stigma and promote help-seeking behavior.

- The use of ethnocentric programming has shown effectiveness in engaging conservative or underserved populations, supporting the importance of tailoring interventions to local values and beliefs.
- Collaborations with health providers, schools, and libraries increase access to behavioral health resources and promote sustainability, aligning with ecological models and systems theory.
- The program emphasizes preventive education and early intervention, supporting a shift away from reactive clinical models and reinforcing the value of proactive public health strategies.
- Extension-led initiatives serve as a platform for building resilience and self-care skills among rural residents, including caregivers, farmers, and frontline service providers.
- Ongoing assessment and responsiveness to evolving community needs reflect best practices in implementation science and continuous improvement.

These findings inform the development of evidence-based public health policies and educational programming within Extension, further establishing its role in promoting mental health equity in rural communities.

6. References

- Ali, M.M., Teich, J.L. & Mutter, R. (2017, January). Reasons for not seeking substance use disorder treatment: Variations by health insurance coverage. *The Journal of Behavioral Health Services & Research*, 44(1):63-74. doi: 10.1007/s11414-016-9538-3.
- Centers for Disease Control and Prevention (2018, December 19). In *Understanding the epidemic*. Retrieved from <https://www.cdc.gov/drugoverdose/epidemic/index.html>
- Davis, M.A., Lin, L.A., Liu, H., & Sites B.D., (2017, July). Prescription opioid use among adults with mental health disorders in the United States. *Journal of the American Board of Family Medicine*, 30 (4), 407-417: doi: 10.3122/jabfm.2017.04.170112.
- Health Resource Services Administration (2019). *HPSA Find*. Retrieved from <https://data.hrsa.gov/tools/shortage-area/hpsa-find>
- Nam, E., Matejkowski, J., & Lee, S. (2017, March) Racial/ethnic differences in contemporaneous use of mental health and substance use treatment among individuals experiencing both mental illness and substance use disorders. *Psychiatric Quarterly* 88(1):185-198. doi: 10.1007/s11126-016-9444-0.
- National Council for Behavioral Health, (2019) In *About*. Retrieved from <https://www.mentalhealthfirstaid.org/about>
- Substance Abuse and Mental Health Services Administration (2017). In *2017 NSDUH Detailed Tables*. Retrieved from <https://www.samhsa.gov/data/report/2017-nsduh-detailed-tables>
- Wilson, W., Bangs, A., & Hattin, T. (2015). *The future of rural behavioral health*. National Rural Health Association.

Session 2D

YOUNG FARMER MENTAL HEALTH AND TRUSTED SPEAKERS

The role of farm advisory service in boosting resilience of young farmers

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Short abstract

This paper deals with the newly established farms, boosted by the measures of the common agricultural policy aimed to support generational renewal and the setting up of young farmers. More precisely, the paper aims to analyse the eventual impact of a set of agricultural services (either individual or collective) on the farms' resilience. With this purpose, we have collected data from a Farm Advisory Service company located in an area specialized in the fruit and vegetable sector of central Italy. Services are classified according to the intensity of use and a service efficacy indicator is calculated. The results confirm the good impact of the agricultural services on the resilient farms with respect to ceased farms, despite not all services provide the farms with the same support and the same impact.

1. Purpose

The low rate of generational renewal in the farming sector of Europe has been recognized as the young farmers problem (Eistrup et al., 2019) and has stimulated several interventions within the CAP framework of the last programming periods (Djuric et al., 2019). The resilience of the young farmers relies also on the support the farm advisory services can provide them with, through targeted actions of advisory support, training, information and knowledge transfer. Accordingly, the role of farm advisory services on the newly established farm enterprise is paramount and is recently funded by the common agricultural policy within the AKIS (Agricultural Knowledge and Information System) whose objective is to accompany businesses in the critical moments of their life cycle, from birth to the criticalities they encounter during their development (EC, 2023). Consequently, the farm advisory services serve as engine and assume a multifunctional role for promoting the farm resilience, or the farm innovative paths, alongside the variety of trajectories the farms take on (Soriano et al., 2023; Labarthe, 2022; De Rosa et al., 2023).

This paper deals with the farm resilience, which is identified as the farm's ability to absorb disturbances, to adapt, and to transform (Darnhofer, 2021; Meuwissen et al., 2019). The farming system includes actors "who influence the farm" and are able to raise the farm's capability of absorbing external shocks by showing robustness, adaptability and transformability (Meuwissen et al., 2019). Among actors affecting the farm resilience, this

paper focuses on the role of farm advisory services (Charatsari et al., 2024). Accordingly, drawn on the community resilience framework (Farny, Dentoni, 2025), in this paper we will analyze the farm resilience, through the lens of a networked adaptive capacity, boosted by the farm advisory services. Our central research question is how farm advisory services promote the resilience of young farmers. To provide preliminary answers, we rely on data from the past 20 years.

2. Design

The empirical analysis is grounded on a case study methodology (Yin, 2018). More precisely, a mixed approach, joining exploratory and explanatory research is carried out, with the purpose of:

- a. describing the evolution of young farms set up within two programming periods of the Common Agricultural Policy: 2000-2006, and 2007-2013;
- b. linking the (eventual) persistence of these farms to the intensity in the adoption of farm advisory services.

By referring to both descriptive/exploratory and explanatory case study, this approach allowed us to provide evidence through an explorative and descriptive analysis aimed to verify how resilient the farms are, and to explain the role of services to secure higher levels of resilience.

In order to answer the research question, we have conducted an empirical analysis, with the purpose of testing the impact of farm advisory services on the resilience of young farmers located in a fruit and vegetable district in the province of Latina. The analysis is carried out on a sample of 85 newly established farms, set up within the framework of the CAP programming period 2000-2006 (37 farms) and 2007-2013 (48 farms). The sample is drawn on the dataset of a farm advisory company established in 1995 through an intervention (ob.5b reg2052/90) and operating for 30 years in the AKIS system, in an area with high specialization in the fruit and vegetable sector.

The analyzed dataset concerns the newly installed farms involving those who ceased their activities. The dataset was cross-referenced with information relating to the relationships with the AKIS system. This means to analyze access to agricultural support services articulated in training (for instance, participation in training courses), farm advisory services (e.g. use of individual consultancy services or through Producers' Organizations, etc.), information (participation in fairs, farms field days, etc.), and experimentation services (for instance, participation in experimental projects), provided by the advisory company. Therefore, agricultural services "consumed" by the newly installed farms in the two programming periods were classified into either individual or collective, and are divided into the following four groups:

- Advisory services
- Training
- Information
- Field experimentation activities.

Farms benefitting of the grants for the setting up of young farmers were classified according to the intensity of use of services as follows:

- 1= No use of service
- 2 = low use of services
- 3 = average use of services
- 4 = good use of services
- 5 = high use of services.

As far as training is concerned, we have monitored the number of courses attended by the young farmers. The farm advisory services were analyzed through the individual services the farm has used since the installment (support for technical and managerial aspects, getting funded by the CAP, etc.). Information activities include participation in the fairs at national and international level, field trips, seminars concerning technical and economic issues, etc. Finally, field experimentation includes participation in projects with actors of the AKIS system (for instance, universities, research centers, etc.).

An average score on service consumption has been calculated (*avscore*) for both programming periods (2000-06, and 2007-2013). The index is weighted on the basis of the farm's years of life.

Moreover, we have identified a potential "service efficacy index" in the two periods under observation.

$$Sei = \frac{avscore\ Fi_j}{avscore\ TOTAL_j}$$

Where:

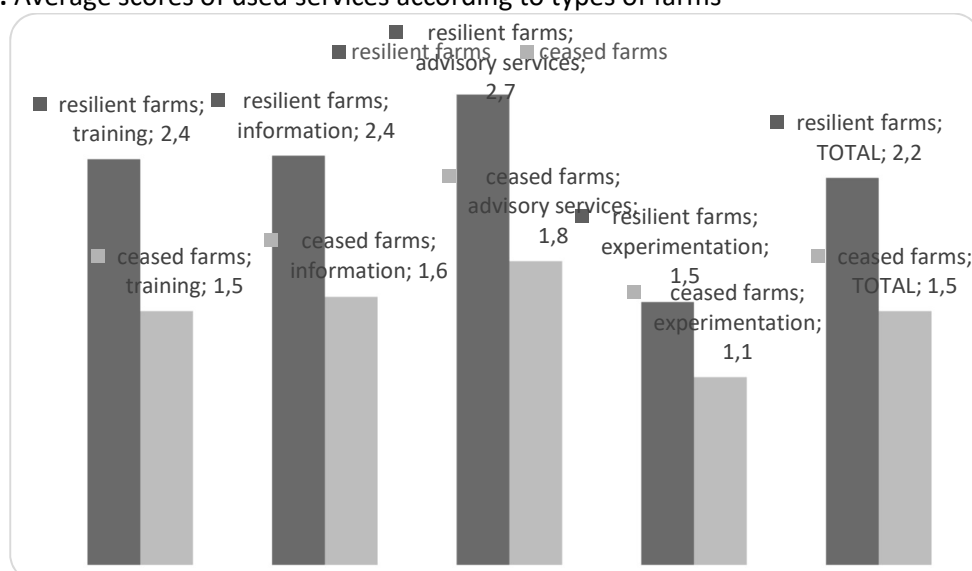
- *i* refers to resilient or ceased farms
- *j* refers to the type of service (training, information, advisory services, experimentation)

Values between 0 and 1 evidence lower efficiency with respect to the total, while higher values than 1 highlight good service performance.

3. Findings

Figure 1 shows the results of the empirical analysis, by evidencing the differences between the two programming periods in term of the farms' resiliency. The figure divides the farm into ceased farms (closed down farms) and resilient farm (still working farms).

Figure 1: Average scores of used services according to types of farms



Source: Authors' elaboration

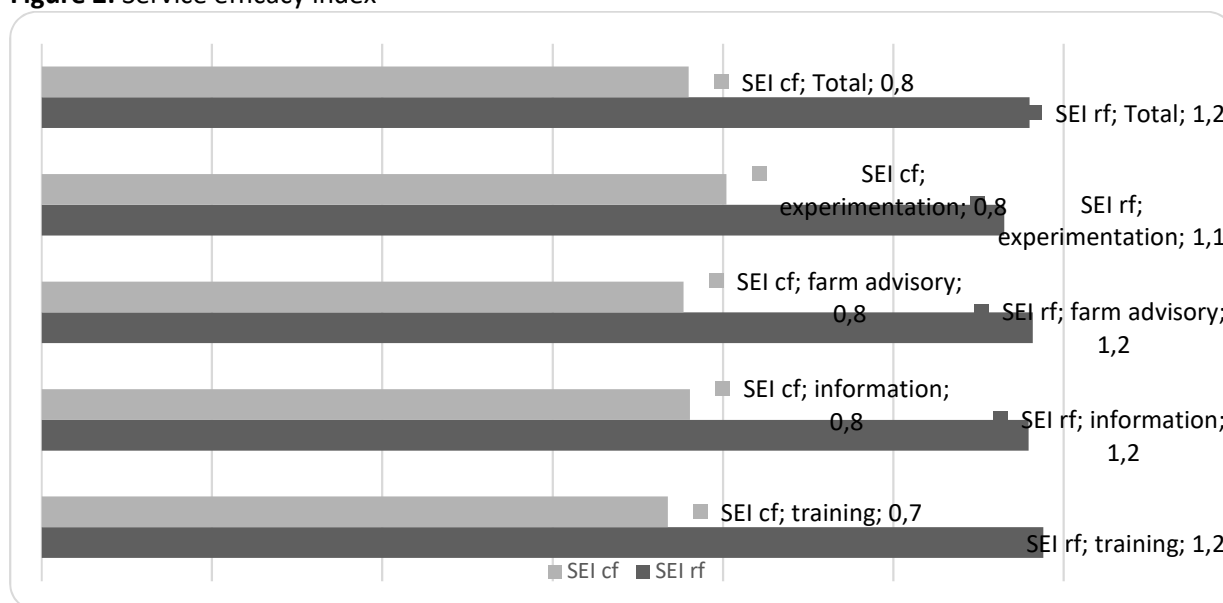
The figure points out two main aspects:

- The first one is the relatively higher resilience capability of farms getting supported by the farm advisory services, either individual or collective. The average score of farms using higher levels of services is 2.2, with respect to the ceased farms characterized by an average score of service use equal to 1.5.
- The second one is that individual services, such as farm advisory services provide stronger support to the farm's resilience, than the other services (2.7 in the resilient

farm, 0.5 more than the average score). Moreover, while information and training can play a role in securing the persistency of the farm, experimentation seems still not enough participated.

As far as the service efficacy index is concerned, Figure 2 shows the results, by evidencing higher performance of services on the impact of the farm resilience. High access to agricultural services seems correlated to higher levels of resilience.

Figure 2: Service efficacy index



4. Practical Implications

Although we cannot establish a cause-effect relation between the use of agricultural services and farm resilience, our empirical analysis reveals the effective role of farm advisory services in enhancing the farm's resilience, in that a correlation between the two emerges. Therefore, the connection of the farm with adequate agricultural knowledge and innovation systems provides it with higher potential of persistency. Among the main services, farm advisory support, as individual service, is confirmed to be the most important, as pointed out in previous studies (Labarthe, Beck, 2022). Nonetheless, our analysis reveals a worrying decreasing inefficacy in the experimentation service in both programming periods under investigation, which raises concerns about the capability of agricultural services to respond to the farmers' capacity to deal with new challenges in the competitive worldwide scenario as evidenced in previous studies (Dockès et al., 2019).

This has clear implications for enforcing the set of measures dedicated to strengthening the AKIS system. In the current programming period (2023-2027), AKIS has obtained a dedicated space and a wider set of measures, with the purpose of reaching out the maximum number of potential beneficiaries. New challenges can be faced by the young farmers thanks to a renewed set of measures, some of which are "traditional", some others are innovative, such as the back-office services for Akis (consisting of support activity for transferring specialized knowledge to farm advisors and provide them with holistic approaches to farm decision-making), or cooperation for actions supporting innovation, through which fostering listening hubs and innovation incubators. Boosting higher rates of access to these services seem the real challenge to face for improving the newly installed farms' resilience.

5. Theoretical Implications

The approach we have adopted in this paper is to consider the farm embedded in a socio-institutional context in which relational assets matter. The set of relations that the farmers assemble to support their activity empowers mostly young farmers with a basket of services aimed to improve a wide range of competences, defined by McElwee and Bosworth (2010) as professional, managerial, strategic, opportunity and networking skills. As confirmed in the recently theorized micro-AKIS (Labarthe, Sutherland, 2022), access to farm services is strategic for the farm resilience and should be encouraged in all rural contexts, with special reference to the rural marginal settings.

6. References

- Charatsari C., Michailidis A., Lioutas E.D. 2024. Do farm advisory organizations promote sustainability? A study in Greece, *Agricultural Systems*, 218: 104003, <https://doi.org/10.1016/j.agsy.2024.104003>.
- Darnhofer, I. (2021). Farming Resilience: From Maintaining State towards Shaping Transformative Change Processes. *Sustainability*, 13: 3387. <https://doi.org/10.3390/su13063387>
- De Rosa M., Olivieri G., Menna C., Gandolfi F., Del Giudice T. (2023). Multifunctional farm advisory services in promoting change in agricultural systems: The case of Campania region of Italy. *AIMS Agriculture and Food*, 2023, 8(4): 962-977. Doi: 10.3934/agrfood.2023051
- Dockès A-C., Chauvat S., Correa P., Turlot A., Nettle R. (2019); Advice and advisory roles about work on farms. A review. *Agronomy for Sustainable Development*, 39 (1), Doi: [ff10.1007/s13593-018-0547-x](https://doi.org/10.1007/s13593-018-0547-x).
- Djuric K., Kuzman B., Prodanovic R. (2019). Support to young farmers through agricultural policy measures: The experience of the EU and Serbia, *Economics of Agriculture* 66(1): 237-249. DOI:10.5937/ekoPolj1901237D.
- Eistrup M., Sanches A.R., Muñoz-Rojas J., Pinto Correia T. (2019). A “Young Farmer Problem”? Opportunities and Constraints for Generational Renewal in Farm Management: An Example from Southern Europe, *Land* 8: 70. Doi:10.3390/land8040070
- Farny, S., and D. Dentoni. 2025. Social identity and place-based dynamics in community resilience building for natural disasters: an integrative framework. *Ecology and Society* 30(2), 12. <https://doi.org/10.5751/ES-15998-300212>
- EUROPEAN COMMISSION – Directorate-General for Agriculture and Rural Development – Unit A.3 (2023): Guidelines. Evaluating the AKIS Strategic Approach in CAP Strategic Plans.
- Labarthe P., Beck M. (2022); CAP and Advisory Services: From Farm Advisory Systems to Innovation Support *EuroChoices* 21(1):5-14, DOI:10.1111/1746-692x.12354
- McElwee G., Bosworth G. (2010). Exploring the strategic skills of farmers across a typology of farm diversification approaches, *Journal of farm management* 13(12): 819-838.
- Meuwissen M.P.M., Feindt P.H., Spiegel A., Termeer C.J.A.M., Mathijs E., de Mey Y., Finger R., Balmann A., Wauters E., Urquhart J., Vigani M., Zawalińska K., Herrera H., Nicholas-Davies P., Hansson H., Paas W., Slijper T., Coopmans I., Vroege W., Ciechomska A., Accatino F., Kopainsky B., Poortvliet P.M., Candel J.J.L., Maye D., Severini S., Senni S., Soriano B., Lagerkvist C-J., Peneva M., Gavrilescu C., Reidsman P. 2019. A framework to assess the resilience of farming systems, *Agricultural Systems* 176 (2019) 102656 <https://doi.org/10.1016/j.agsy.2019.102656>
- Soriano B., Garrido A., Bertolozzi-Caredio D., Accatino F., Antonioli F., Krupin V., Meuwissen M.P.M., Ollendorf F., Rommel J., Spiegel A., Tudor M., Urquhart J., Vigani M., Bardají I. (2023); Actors and their roles for improving resilience of farming systems in Europe, *Journal of Rural Studies*, 98, 134-146, <https://doi.org/10.1016/j.jrurstud.2023.02.003>.

Mental wellbeing education in agricultural universities and colleges: understanding provision, student needs, and the potential role for peer-led initiatives

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Short abstract

Mental health education at agricultural colleges and universities may play a key role in supporting young farmers with a unique range of pressures. Though there is growing research interest in this area, particularly in New Zealand, there has been limited exploration of if and how mental health education is provided in these settings, the pressures agricultural students face, and the potential role for different forms of content, including peer-led initiatives. We explore these areas using an online survey of agricultural students, course leaders, and student support staff in the UK. Findings illustrate that agricultural students face pressures associated both with being a ‘young farmer’ and a ‘young person’, and some still face challenges in seeking help, notably with stigma. Whilst mental health content is provided in a variety of ways in these settings, it tends not to be embedded into the main curriculum, with course leaders citing time- and expertise-based challenges. Peer-led content can play an important role for some students, but it should be included sensitively; though some students felt comfortable talking about mental health with peers, others did not, and course leaders and support staff also noted concerns.

1. Purpose

There is growing evidence about the causes and effects of mental health challenges amongst young farmers^{1,2}. The “Big Farming Survey”³ in England and Wales found that 10% of young farmers aged 16-24 felt lonely ‘often or always’. There were particularly high levels of depression and anxiety in younger age groups. Research in the USA² finds similar patterns. Furthermore, despite some anecdotal evidence suggesting that young farmers may be more open to talking about mental health issues, research consistently highlights barriers to help-seeking in this demographic with reasons overlapping with other age groups – including lack of access to support services and stigma^{1,4} and the tendency for farmers to undertake self-care [including an ‘optimism bias’⁴], rather than ask for help⁵. Research has also focused on asking respondents to describe agricultural stress factors from the perspective of being on-farm, rather than asking young farmers also to account for pressures away from the farm. The wider literature on the ‘landscapes of support’⁶ for farmer mental health argues that interventions should be offered ‘where farmers they are’⁷. This means offering support in places where farmers congregate, such as auction marts⁸, agricultural shows, and in young farmers’ clubs¹. Young farmers, or prospective new entrants wishing to get into the sector, also attend agricultural colleges and universities. When young farmers in Ireland and the UK were asked about solutions, some argued strongly for more awareness and support to be offered in places of education¹.

Thus far, there has been limited investigation of how mental health education can be embedded into the curriculum (or wider network) of agricultural further and higher education institutes (post-16 education). In the UK specifically, both college education (further education, 16+) and university education (higher education, 18+) must include

provision of mental health support in some form. The research shows that agricultural students may face a unique set of pressures and required tailored support. Research is only just beginning to explore mental health education in agricultural education settings and our study is at the forefront of these efforts. Thus far, some of the leading research has been conducted by scholars in New Zealand. Winder et al.⁹ found that a workshop aimed at improving mental health literacy among agricultural students led to significant increases in knowledge and confidence. Peer-led learning was identified as a key strength of the programme's success. A similar study by Hay et al.¹⁰ also explored the effectiveness of peer-led health and wellbeing education for agricultural students, finding that peer-led discussions and real-world examples reduced stigma and increased engagement. Knook et al.¹¹ evaluated an online programme designed to improve mental health and resilience among agricultural students. The programme showed a positive increase in mental health literacy/resilience and that it had created a 'safe space'.

There remain unanswered questions, including little research exploring the perspective of university academic or support staff. Our research focuses on UK agricultural students, course leaders, and student support staff, and asks:

1. What are the set of pressures agricultural students face at colleges and universities?
2. How is mental health education offered to students and what are the delivery challenges?
3. What role, if any, should peer-led mental health education in these settings play?

2. Design

An online survey was designed. We decided that three distinct respondent groups would be targeted: agricultural students, course leaders, and support wellbeing staff. The questionnaire was divided into thematic sections for each target group, with some overlap, asking both open- and closed-ended questions aligned with the research questions. The survey was piloted and gained ethical approval from Harper Adams' Research Ethics Committee. The study employed purposive sampling, targeting students, course leaders, and support services staff directly involved in UK agricultural further and higher education. Various methods of distribution were undertaken: firstly, via significant support from Landex. Landex is a membership organisation of 36 land-based colleges and universities in the UK, capturing a high proportion of students studying agricultural courses. We also advertised the survey on social media, in the farming press, and by emailing course leaders, student unions, the Agricultural Universities Council, and student support staff. Both quantitative and qualitative methods were used to analyse survey responses. Close-ended questions were analysed using descriptive statistics to identify frequencies and percentages, while some questions were analysed using inferential testing. Open-ended responses were analysed thematically.

3. Findings

Data collection is ongoing until after the abstract submission deadline for the extended abstract, so preliminary results are presented only on the basis of the first 168 survey responses analysed on 12th April 2025 - 125 students from 16 institutions, 32 course leaders from 21 institutions, and 11 support staff from five institutions. 75% of student responses came from one institution. Amongst students, there was a gender mix (56% women, 44% men) and farming/non-farming background (61%/39%).

4. What are the set of pressures agricultural students face? (n=96)

Theme	Frequency	Description	Quote(s) (all students)
Academic pressure & workload	36	Overwhelmed by deadlines, assignments, or volume of work, lack of time	"Stress induced by the workload we are given"
Family obligations/home farm stress	23	Responsibilities at home, relating to family farm dynamics, grief	"Discussions surrounding succession when I go home"
Financial Stress	11	Finances, living costs, balancing work and study	"I am granted the minimum student loan, which doesn't cover my rent"
Health & wellbeing	11	Maintaining personal wellbeing, other health issues like ADHD, substance abuse, drinking	"I put a lot of pressure on myself to perform, especially during exams" "Substance abuse"
Uncertainty about future	11	Worry about career prospects, direction, industry future	"Dealing with the prospect of change after university"
Mental health conditions	9	Anxiety, depression, other mental health conditions	"hidden disabilities which affect my day-to-day life"
Social pressure/peer comparison	9	Comparison with peers, body image, or struggling to fit in socially – bullying.	"The expectations around alcohol consumption and studying" – "stop calling people with depression gay"
Agricultural-related issues	7	Challenges such as policy changes, climate impact, and sector instability	"Pressure, uncertainty and unreliable changes within our industry"
Isolation/Loneliness	7	Feeling socially or emotionally disconnected while studying or on placement	"University can be quite an isolating experience"
Stigma/Culture issues	6	Fear of judgement, shame, and cultural norms	"The culture and behaviour at university social settings"
Equality issues	2	Racism; Struggles with sexuality	"As an international student it's discrimination and racism by uni students."

Course leaders and student wellbeing support staff also acknowledged that agricultural students *"have a unique set of circumstances and factors...not seen in the wider student body"* (support staff). One student support staff member noted a tendency for this group to self-care, not always in helpful ways: *"It is noticeable with Agri learners that they are often less willing to engage with support and are more keen to be sent self-help information that requires little to no conversation with us."*

5. How, if at all, is mental health education offered to students in these settings and what are the delivery challenges?

77% of students believed agricultural students require tailored mental health support. Most students rated access to mental health support at university adequate, good, or excellent, although largely noted that it was not embedded into the curriculum itself. Only 25% felt that content was tailored towards agricultural students. Instead, content on mental health education tended to be delivered by external visitors, student support staff, or one-off sessions geared at supporting students on placement. Course leaders said that content was delivered in many ways, but a higher proportion said that it was embedded within the curriculum. Course leaders noted challenges in delivering content:

Theme		Frequency	Description	Quote(s)
Time		11	Struggling to fit mental health into already full teaching schedules	"It's hard to see where it would fit in directly within scientific fact-based subjects"
Uncertainty		9	Not knowing how to integrate it into curriculum	"it should be more embedded... not sure how"
Staff training/confidence		5	Concern about using incorrect language or triggering emotions	"Not everyone feels safe or comfortable delivering this"
Lack of engagement		4	Students unwilling to share emotions or take the subject seriously	"Some students may not buy into the concept of people struggling"
Conflict of interest		3	Conflict between being a teacher and offering support	"It's hard for students to swap between seeing you as an educator and a friend"
No challenges		3	A small number of staff reported no barriers	"Personally, I have not faced any barriers"

6. What role, if any, should peer-led mental health education in these settings play?

Findings on the role of peer-led mental health support revealed mixed views. All groups were asked to select who should deliver mental health education in agricultural colleges and universities – course lecturers, student support staff, external speakers like charities, and peers. All groups ranked peers the lowest. While some students highlighted benefits such as relatability (37.5%), comfort (35%), and reduced stigma (15%), only 37% indicated they would participate in such a programme, with 40% unsure. When asked if they would feel comfortable discussing mental health with peers, 31% said 'Yes', 21% said 'No', and 48% said sometimes. Students were also asked to select from a list of potential barriers to accessing mental health support and the most frequent barrier was "stigma/judgement". Course leaders and wellbeing support staff also expressed mixed views on the role of peer-led

mental health education, with specific concerns noted about lack of training, placing a burden or secondary stress on students, engagement barriers, lack of time, and the potential for some peers to bully others.

7. Practical Implications

Our research offers advice for course designers and support staff at agricultural colleges and universities. Specifically, it illustrates the unique range of pressures faced by agricultural students, suggesting that better tailoring of content will be needed. Strategies are needed to address stigma associated with poor mental health and this will involve content delivered in a variety of ways, including external experts, course lecturers, support staff. Peer-led content needs to be included sensitively, with a focus on creating a safe space for learning (e.g. using online content as delivered by Winder et al.). University and college staff will need training and support to deliver more content.

8. Theoretical Implications

Our study adds to the early literature exploring the provision of mental health education in agricultural colleges and universities. We add novel empirical data illustrating that agricultural students face pressures associated both with being a 'young farmer' and 'young person'. Our findings on the stigma and other help-seeking challenges identified by students, and the challenges of delivering content in these settings highlighted by course leaders and support staff, can help to inspire further research on sharing best practice on pedagogy and effective learning in this area.

9. References

- Billington, A., Cuthbertson, C., Iwinski, S., Hu, Y., Krishnaswamy, M., & Rudolphi, J. (2025). "Move forward": A marginalia analysis of farmers' mental health management strategies. *Journal of Rural Studies*, 117, 103649.
- Cole, D. C., & Bondy, M. C. (2020). Meeting farmers where they are—rural clinicians' views on farmers' mental health. *Journal of Agromedicine*, 25(1), 126-134.
- Hay, A., Stanley-Clarke, N., Maris, R., Winder, L., & Knook, J. (2024). Building connections in health and wellbeing education: Qualitative findings of a study with New Zealand agricultural students. *Health Education Journal*, 83(2), 161-171.
- Knook, J., Stanley-Clarke, N., Maris, R., Hay, A., Andrews, C., & Winder, L. (2025). A Mixed Methods Assessment of an Online Mental Health and Resilience Program for Agricultural Sector Students. *Journal of Agromedicine*, 30(1), 95-104.
- Nye, C., Winter, M., & Loble, M. (2022). The role of the livestock auction mart in promoting help-seeking behavior change among farmers in the UK. *BMC Public Health*, 22(1), 1581.
- RABI (2021). <https://rabi.org.uk/about/big-farming-survey/>
- Rose, D. C., Bradley, F., O'Connor, D., Hall, J., Morrison, R., Mulkerrins, M., ... & Russell, T. (2024). The mental wellbeing of young farmers in Ireland and the UK: driving factors, help-seeking, and support. *Scottish Geographical Journal*, 140(1-2), 155-175.
- Rudolphi, J. M., Berg, R. L., & Parsaik, A. (2020). Depression, anxiety and stress among young farmers and ranchers: a pilot study. *Community mental health journal*, 56(1), 126-134.
- Stanley-Clarke, N., Hay, A., Maris, R., Ryan, A., Knook, J., & Winder, L. (2024). Optimism bias as a barrier to accessing mental health support amongst tertiary students. *Higher Education Research & Development*, 43(7), 1602-1614.

Shortland, F., Hall, J., Hurley, P., Little, R., Nye, C., Lobley, M., & Rose, D. C. (2023). Landscapes of support for farming mental health: Adaptability in the face of crisis. *Sociologia ruralis*, 63, 116-140.

Winder, L., Stanley-Clarke, N., Maris, R., Hay, A., & Knook, J. (2025). Wellbeing education increases skills and knowledge among tertiary students in the agricultural sector: insights from a mixed methods study. *The Journal of Agricultural Education and Extension*, 31(2), 180-196.

Mental Health and Wellbeing Education in Tertiary Institutions: Exploring Areas for Development

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Short abstract

Those working and living on-farm are increasingly facing wellbeing challenges, with young people a particularly vulnerable group. Resilience can be built by introducing young people to aspects of wellbeing via education programmes. This study reports on a content analysis of current wellbeing education at five universities that provide agricultural degrees, located in Aotearoa New Zealand, the United Kingdom, Ireland and the United States. We use a framework developed from a comprehensive literature review on young people and mental health. The analysis involves examining course notes, learning materials, and related resources to identify key themes and content related to wellbeing. Mental health education for agricultural students is inconsistently embedded across universities, with some focusing on practical work scenarios while others integrate it throughout the curriculum. However, most programmes lack comprehensive, longitudinal approaches. The study enriches existing frameworks on youth mental health by providing insights into how wellbeing is integrated into higher education curricula, identifying key areas of focus and opportunities for improvement. Practically, the findings offer actionable recommendations for universities to enhance their wellbeing education, strengthening support systems and promoting mental health and wellbeing among students.

1. Purpose

The agricultural sector is facing a myriad of financial, environmental, social, and cultural challenges, which affect the mental health and wellbeing of those working and living on-farm [1]. Suicide rates in rural communities are higher than national rates, which is illustrated in several Western liberal democracies, such as Aotearoa New Zealand (AoNZ), Ireland, the United Kingdom, and the United States [2]. Young people appear to be particularly at risk when it comes to mental health challenges in agricultural settings. In the UK, 40% of 18–24-year-olds who live or work on farms experience anxiety or depression, significantly higher than the 12% reported by their non-farming counterparts [3]. In the United States, 34.7% of young farmers report experiencing moderate to severe anxiety symptoms [4]. Similarly, in Aotearoa New Zealand, 64% of young men and 77% of young

women involved in farming report at least one wellbeing issue that has a major negative impact on their mental health [5]. To address this concerning trend, extension and education programmes can be used to build resilience amongst young farmers [6]. These programmes can be helpful in conveying mental health concepts to future land-managers, such as university students [7]. Mental health literacy developed through wellbeing education involves the knowledge and skills to identify when a person is becoming unwell and where to direct them for further support and assistance [8]. Supporting young people to develop wellbeing skills can have long term benefits for the individual including the development of resilience into adulthood and improving mental health literacy [9]–[12]. The skills learned from mental wellbeing education programmes can also be translated into improved educational achievement and the development of healthy social behaviours [9], [10]. Previous research recommends incorporating programmes to increase mental health literacy and create empathy into education programmes [13]. Several studies have indicated successful implementation of these education programmes in agricultural studies [14], [15], but there is no research yet focusing on what content is exactly delivered and if this is tailored towards the challenges young people face.

Therefore, this study reports on a content analysis of current wellbeing education at five universities that provide agricultural degrees, located in Aotearoa New Zealand, the United Kingdom, Ireland and the United States, to identify to what extent these issues are addressed in their wellbeing programmes. It responds to calls on conducting more research on wellbeing in the agricultural sector to identify how to better support young people [16]–[18].

2. Methodology

Content analysis provides a systematic and replicable methodological framework for analysing various forms of data such as verbal and written text [19], [20]. It can be used within quantitative or qualitative research and applied either deductively and/or inductively depending on the research design [21]. The approach involves the coding and assigning of data content to categories which are either predetermined, deductive and statistical in nature or derived from data through a process of interpretation searching for meanings and codes for categorisation [22]. This study applied a qualitative content analysis approach which involved two layers of analysis; both deductive and inductive. Initially predetermined categories derived from a scoping literature review (Table 1) were used to generate a summary of content from the wellbeing programmes being delivered to agricultural students. Alongside this, data was also built up inductively through a close reading of the wellbeing content within programmes to identify categories inconsistent with the codes derived from the scoping review [23]. This inductive analysis enabled unexpected data to be collected including considerations and insights critical for informing the future development of programme content to better support young people engaged in agricultural programmes.

3. Findings

Findings indicate that mental health education for agricultural students varies significantly across institutions. In New Zealand, the researched universities generally lack specific, embedded mental health and wellbeing education tailored to the practical work component of agriculture degrees. In contrast, education at the two universities studied in Ireland and the UK focus much of their wellbeing support around the practical work experience, by for example using scenario-based discussions to address a range of student mental health challenges. In one of the universities in NZ, mental health education is integrated throughout the entire curriculum. However, the broader picture suggests that mental health content is often developed reactively, emerging from immediate, tangible challenges observed during

student placements, rather than through proactive, longitudinal curriculum design. This lack of consistent, embedded support, raises questions about the long-term impact of such training on student wellbeing, highlighting a critical need for more comprehensive, integrated approaches.

Code	List of concerns around mental health	Explanation/Definition
1.1	Access to support services	Contact with support services is often hindered by barriers in rural communities e.g. travel distance to service, lack of targeted support for rural communities, barriers to help-seeking such as stoic community attitudes and stigma.
1.2	Community attitudes, stigma	Mental health and wellbeing are looked on in a negative way, or as a disgrace, which hinders service utilisation and supports.
1.3	Suicide	Statistics identify that young people on farm or in the agricultural sector are at greater risk of taking their own lives.
1.4	Help-seeking	The farming community, including young farmers, are less likely to seek help or access support services.
1.5	Optimism bias	Young people in agriculture display a positivity or self-serving bias that as individuals they are less likely to need mental health support and are less likely to engage in self-protective behaviours.
	List of factors contributing to poor mental health	Explanation/Definition
2.1	Alcohol and smoking	Alcohol misuse, dependence or addiction. Losing control through drinking alcohol. Smoking cigarettes, cigars or pipes. Tobacco
2.2	Climate change worry	Changes in temperatures and weather patterns having adverse effects on farm. Criticism of farming in the environmental space and media negativity, and the pressure to implement systems to reduce the effects of farming on the environment.
2.3	Finances	Concerns around money, socioeconomic decline. A feeling of stress or worry about money, related to e.g. paying bills, debt, living costs.
2.4	Firearms	Access to, and exposure to, firearms on farms.
2.5	Isolation	Geographic, social and/or cultural isolation e.g. separation from family and friends, living remotely, loneliness from a reduction in socialising.
2.6	Lack of mental health knowledge	Absence of, or inadequate, knowledge or literacy around mental health and wellbeing issues e.g. knowledge around mental health issues or of coping strategies for stressful times.
2.7	Low resilience	The ability to bounce back in the face of adversity, or the capacity to withstand and recover during stressful periods.
2.8	Sexism/misogyny - young female farmers' experiences.	Prejudice or dislike of women or girls in farming. The historical patriarchy of farming is still prevalent where terms or sayings may be used by men (farmers) that are derogatory towards female workers regarding their strength, ability to work on farm, or place in society.
2.9	Time pressures	Feeling pushed for time. On-farm related to e.g. work hours, time to complete tasks, having time to take time 'off-farm'.

Table 1: The list of factors and concerns around mental health in young people used to inform the content analysis

4. Practical Implications

The practical implications of this work include the potential for more targeted, proactive mental health education within agricultural curricula, ensuring students are better prepared for mental health and wellbeing challenges of placements and professional work. It also highlights the need for universities to embed mental health support consistently across all

years of study and develop mechanisms to measure the long-term impact of this education, potentially leading to improved wellbeing and retention in the sector.

5. Theoretical Implications

The theoretical implications of this work are refining our understanding of how mental health education impacts student wellbeing and learning outcomes. It shows a need for tailored, scaffolded approaches in agricultural education. Additionally, it raises questions about the role and the effectiveness of scenario-based teaching in addressing the unique stressors faced by agricultural students.

6. References

- [1] C. Nye *et al.*, "Mental health , well-being and resilience in agricultural areas : A research agenda for the Global North," *J. Rural Stud.*, vol. 114, no. May 2024, 2025, doi: 10.1016/j.jrurstud.2024.103506.
- [2] D. C. Rose *et al.*, "Farming wellbeing through and beyond COVID-19 : Stressors , gender differences and landscapes of support," *Sociol. Ruralis*, vol. 63, no. January, pp. 3–10, 2023, doi: 10.1111/soru.12425.
- [3] R. Wheeler and M. Loble, "Health-related quality of life within agriculture in England and Wales: results from a EQ-5D-3L self-report questionnaire," *BMC Public Health*, vol. 22, no. 1, pp. 1–12, 2022, doi: 10.1186/s12889-022-13790-w.
- [4] J. M. Rudolphi, R. L. Berg, and A. Parsaik, "Depression, Anxiety and Stress Among Young Farmers and Ranchers: A Pilot Study.," *Community Ment. Health J.*, vol. 56, no. 1, pp. 126–134, Jan. 2020, doi: 10.1007/s10597-019-00480-y.
- [5] Farmstrong, "Younger farmers on their wellbeing: research summary 2018," Wellington, 2018. [Online]. Available: https://farmstrong.co.nz/wp-content/uploads/2019/01/Summary-document-YoungerFarm_Res_Sum_FINAL.pdf%0Ahttps://farmstrong.co.nz/wp-content/uploads/2019/01/Summary-document-YoungerFarm_Res_Sum_FINAL.pdf
- [6] J. Knook, C. Eastwood, K. Mitchelmore, and A. Barker, "Wellbeing, environmental sustainability, and profitability: Including plurality of logics in participatory extension programmes for enhanced farmer resilience," *Sociol. Ruralis*, vol. 63, no. 1, pp. 141–162, Nov. 2022, doi: 10.1111/soru.12413.
- [7] H. M. Stallman and I. Shochet, "Prevalence of mental health problems in Australian university health services," *Aust. Psychol.*, vol. 44, no. 2, pp. 122–127, 2009, doi: 10.1080/00050060902733727.
- [8] K. Morgaine, L. Thompson, K. Jahnke, and R. Llewellyn, "GoodYarn: building mental health literacy in New Zealand's rural workforce," *J. Public Ment. Health*, vol. 16, no. 4, pp. 180–190, Jan. 2017, doi: 10.1108/JPMH-07-2017-0027.
- [9] J. Ashwood *et al.*, "Payoffs for California College Students and Taxpayers from Investing in Student Mental Health," *Rand Corp.*, 2015, doi: 10.7249/rr1370.
- [10] A. Ferris *et al.*, "Evidence-based health promotion for youth, farmers and families of the gore community: A focus on mental health and family violence," *Scope (Kalamazoo)*, vol. 2019, no. 4, pp. 96–110, 2019, doi: 10.34074/SCOP.3004019.
- [11] R. Winzer, L. Lindberg, K. Guldbrandsson, and A. Sidorchuk, "Effects of mental health interventions for students in higher education are sustainable over time: A systematic review and meta-analysis of randomized controlled trials," vol. 2018, no. 4, 2018, doi: 10.7717/peerj.4598.
- [12] T. Young, S. Macinnes, A. Jarden, and R. Colla, "The impact of a wellbeing program imbedded in university classes: the importance of valuing happiness, baseline wellbeing and practice frequency," *Stud. High. Educ.*, pp. 1–20, 2020, doi:

-
- 10.1080/03075079.2020.1793932.
- [13] D. Wynaden *et al.*, "The silence of mental health issues within university environments: A quantitative study," *Arch. Psychiatr. Nurs.*, vol. 28, no. 5, pp. 339–344, 2014, doi: 10.1016/j.apnu.2014.08.003.
 - [14] L. Winder, N. Stanley-Clarke, R. Maris, A. Hay, and J. Knook, "Wellbeing education increases skills and knowledge among tertiary students in the agricultural sector: insights from a mixed methods study," *J. Agric. Educ. Ext.*, 2024, doi: <https://doi.org/10.1080/1389224X.2024.2351545>.
 - [15] J. Knook, N. Stanley-Clarke, R. Maris, A. Hay, C. Andrews, and L. Winder, "A Mixed Methods Assessment of an Online Mental Health and Resilience Program for Agricultural Sector Students," *J. Agromedicine*, vol. 00, no. 00, pp. 1–10, 2024, doi: 10.1080/1059924X.2024.2421982.
 - [16] B. G. Hansen, C. T. Bugge, and P. K. Skibrek, "Automatic milking systems and farmer wellbeing—exploring the effects of automation and digitalization in dairy farming," *J. Rural Stud.*, no. October, 2020, doi: 10.1016/j.jrurstud.2020.10.028.
 - [17] M. S. Haugen and A. Blekesaune, "Farm and Off-farm Work and Life Satisfaction among Norwegian Farm Women," *Sociol. Ruralis*, vol. 45, no. 2, 2005.
 - [18] D. Peel, H. L. Berry, and J. Schirmer, "Farm exit intention and wellbeing: A study of Australian farmers," *J. Rural Stud.*, vol. 47, pp. 41–51, 2016, doi: 10.1016/j.jrurstud.2016.07.006.
 - [19] L. Haggarty, "What is ... content analysis?," *Med. Teach.*, vol. 18, no. 2, pp. 99–101, 1996, doi: 10.3109/01421599609034141.
 - [20] M. D. White and E. E. Marsh, "Content analysis: A flexible methodology," *Libr. Trends*, vol. 55, no. 1, pp. 22–45, 2006, doi: 10.1353/lib.2006.0053.
 - [21] L. Khirfan, M. Peck, and N. Mohtat, "Systematic content analysis: A combined method to analyze the literature on the daylighting (de-culverting) of urban streams," *MethodsX*, vol. 7, p. 100984, 2020, doi: 10.1016/j.mex.2020.100984.
 - [22] L. Forman and L. Damshroder, "Qualitative content analysis," in *Empirical methods for bioethics: A primer*, L. Jacoby and L. A. Siminoff, Eds., Emerald Group Publishing Limited, 2007, pp. 39–62.
 - [23] D. F. Vears and L. Gillam, "Inductive content analysis: A guide for beginning qualitative researchers," *Focus Heal. Prof. Educ. A Multi-Professional J.*, vol. 23, no. 1, pp. 111–127, 2022, doi: 10.11157/fohpe.v23i1.544.

Trusted Voices in Farming: Identifying Credible Mental Health Speakers to Support Irish Farmers

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Short abstract

Mental health is an urgent and growing concern within the Irish agricultural sector, where farmers face elevated risks of psychological distress, burnout, and suicide. This study investigates who the farming community perceives as credible mental health speakers and how the tone of mental health messaging influences this perception. A between-groups experimental survey involving 193 participants assessed believability, trustworthiness, and credibility of speakers delivering varied mental health narratives. Results show that licensed mental health providers, family members, and general practitioners are considered the most credible sources, while agricultural advisors—though well-positioned—ranked lower. Messages that downplayed mental health concerns were perceived as significantly less credible than those adopting a balanced or overemphasised tone. The study underscores the importance of culturally sensitive, trusted messengers and one-on-one communication channels in addressing stigma and improving mental health literacy. Practical implications include training advisors as “health connectors” and embedding mental health topics within discussion groups. Theoretically, the findings contribute to health communication and stigma research, affirming the critical role of source credibility and cultural alignment. The study also highlights the potential of leveraging existing agricultural networks to deliver mental health interventions in a trusted and effective manner.

1. Purpose

Mental health has become a pressing concern within the agricultural sector, with farmers experiencing disproportionate levels of psychological distress, anxiety, and burnout. These mental health challenges are exacerbated by factors such as occupational isolation, erratic income, regulatory complexity, and deeply rooted social expectations. The unique cultural landscape of farming often valorises stoicism, independence, and self-reliance, traits which can deter help-seeking behaviours. Male farmers in particular frequently avoid engaging with mental health services due to traditional notions of masculinity, where vulnerability is associated with weakness (Hammersley et al., 2021). As policy attention and scholarly research converge on improving mental health supports for farming communities, a critical question remains: who do farmers trust to speak credibly about mental health?

Understanding the role of credibility in mental health communication can help inform more effective outreach strategies, leading to improved mental health literacy, reduced stigma, and ultimately, better mental health outcomes for farmers. This study aims to identify who the Irish farming community perceives as credible mental health speakers, investigate the stigma surrounding mental health in the agricultural sector, and provide evidence-based

recommendations for delivering mental health messages that resonate with this population. This research also seeks to advance understanding of how perceived speaker characteristics influence the acceptance of health messages, especially in communities marked by cultural conservatism and occupational insularity.

2. Methodology

This research employed a quantitative, between-groups experimental survey design, informed by previous studies in rural health and credibility assessment (Donovan et al., 2024; Rudolphi et al., 2019). A total of 193 participants, aged between 19 and 73, were recruited from across the Republic of Ireland through purposive and snowball sampling strategies. The sample included a mix of full-time farmers, part-time farmers, students in agricultural programs, and agriculturally affiliated workers. The survey was disseminated both online and in paper format, utilizing platforms such as agricultural discussion groups, marts, colleges, and digital channels (e.g., WhatsApp, Facebook, LinkedIn).

Participants were randomly assigned to read one of three short vignettes, each portraying a fictional speaker discussing mental health in farming. The vignettes differed only in tone: one speaker downplayed mental health concerns, another overemphasised them, and the third adopted a balanced, middle-ground approach. Following the vignette, participants rated the speaker on multiple dimensions using validated scales measuring believability, trustworthiness, and overall credibility (Connolly et al., 2008). Additional scales assessed openness to receiving mental health information from various sources and perceived stigma (Docksey et al., 2022).

Data cleaning involved correcting minor typographical errors and coding open-ended responses into thematic categories. The dataset was imported into SPSS (Version 29) for statistical analysis. Hypotheses were tested through one-way ANOVA followed by Tukey's HSD post hoc comparisons to assess between-group differences in speaker credibility. Descriptive statistics were used to examine the most and least trusted sources and preferred channels for receiving mental health messages.

3. Findings

Results revealed that licensed mental health providers (mean = 3.25), family members (mean = 3.18), and general medical practitioners (mean = 3.16) were the most credible sources for mental health information. These were closely followed by friends and mental health organisations. Agricultural advisors were ranked eighth (mean = 2.60), indicating potential but underutilised influence in this area. The study also identified a clear preference among farmers for receiving mental health information through personalised and relational means, rather than impersonal or institutional channels.

Regarding the tone of mental health messaging, participants rated speakers who downplayed mental health concerns as significantly less credible, trustworthy, and believable than those who either overemphasised or presented a balanced perspective. There was no statistically significant difference in perceived credibility between the middle-ground and overemphasised speakers, suggesting that farmers are receptive to messages that confront mental health issues directly, provided they are presented with authenticity and empathy.

The findings also highlight a generational nuance: younger respondents (under 35) were more open to digital channels and peer-led messages, while older respondents preferred face-to-face conversations and advice from family doctors. This suggests the need for age-sensitive tailoring of mental health outreach strategies.

4. Practical Implications

This study has significant implications for mental health policy, advisory services, and rural health outreach. Firstly, the relatively low credibility ranking of agricultural advisors—despite their close working relationships with farmers—points to a training gap. Integrating basic mental health literacy and communication modules into advisory training programmes could empower advisors to serve as “health connectors,” capable of recognising signs of distress and referring farmers to appropriate supports.

Secondly, initiatives should leverage the trust placed in family members and medical professionals. Community-based interventions could incorporate family-focused mental health education, encouraging open dialogue within farm households. Collaborations between health professionals and agricultural networks may facilitate cross-sectoral approaches to outreach.

Thirdly, programme designers should prioritise delivery through familiar and trusted communication environments. Discussion groups, KT meetings, and farm walks could incorporate short, peer-led segments on mental wellbeing. Simultaneously, tailored campaigns on agricultural radio or in farming publications may reach those who are less engaged with formal events. Importantly, large group settings were among the least preferred channels, reinforcing the value of privacy, informality, and directness.

5. Theoretical Implications

The findings of this study extend the Elaboration Likelihood Model (ELM) by demonstrating that, in the context of farming, message acceptance is not solely driven by cognitive elaboration but is profoundly shaped by cultural congruence and interpersonal trust. Source credibility operates not only through perceived expertise and trustworthiness but also through shared social identity and familiarity.

This research also contributes to stigma theory by showing how occupational culture and social norms act as gatekeepers to help-seeking behaviours. In farming, where stoicism and resilience are culturally embedded, mental health stigma is both personal and structural. The study underscores the importance of designing interventions that respect these cultural dynamics rather than simply challenging them.

Moreover, the study reinforces the relevance of the Agricultural Knowledge and Information System (AKIS) as a framework for understanding how information flows in farming contexts. By positioning mental health communication within AKIS structures—through advisors, discussion groups, and peer-to-peer exchanges—stakeholders can build on existing networks of trust and information exchange. This systemic approach aligns with recent policy calls for integrated rural health strategies that go beyond service provision to encompass education, culture, and community.

6. References

- Brennan, M. et al. (2021) ‘Weather, workload and money: Determining and evaluating sources of stress for farmers in Ireland’, *Journal of Agromedicine*.
- Connolly, D. A., Price, H. L., Lavoie, J. A. A., & Gordon, H. M. (2008). Perceptions and predictors of children's credibility of a unique event and an instance of a repeated event. *Law and Human Behavior*, 32(1), 92–112. <https://doi.org/10.1007/s10979-006-9083-3>
- Docksey, A.E. et al. (2022) ‘The stigma and self-stigma scales for attitudes to mental health problems: Psychometric Properties and its relationship to mental health problems and absenteeism.’, *Health Psychology Research*, 10(2). doi:10.52965/001c.35630.
- Donovan, R.J., Jalleh, G. and Drane, C. (2024) ‘Impact of source credibility on behavioural responses to a mental health promotion social marketing campaign’, *Journal of Social Marketing*, 14(2), pp. 250–263. doi:10.1108/jsocm-07-2023-0159.

-
- Hammersley, C., Meredith, D., et al. (2022) 'Mental health, societal expectations and changes to the governance of farming: Reshaping what it means to be a "man" and "good farmer" in rural Ireland', *Sociologia Ruralis*, 63(S1), pp. 57–81. doi:10.1111/soru.12411.
- Hammersley, C. et al. (2021) "'That's me, I am the farmer of the land": Exploring identities, masculinities, and health among male farmers in Ireland', *American Journal of Men's Health*, 15(4), p. 155798832110352. doi:10.1177/15579883211035241.
- O'Shaughnessy, B. R. et al. (2022) 'The prevalence of Farmer Burnout: Systematic Review and narrative synthesis', *Journal of Rural Studies*, 96, pp. 282–292. doi:10.1016/j.jrurstud.2022.11.002.
- Rudolphi, J.M., Berg, R. and Marlenga, B. (2019) 'Who and how: Exploring the preferred senders and channels of mental health information for Wisconsin Farmers', *International Journal of Environmental Research and Public Health*, 16(20), p. 3836. doi:10.3390/ijerph16203836.

Session 3D

HELP-SEEKING AND 'ACCIDENTAL COUNSELLORS'

Farmer Mental Health Help Seeking: Developing Knowledge for Policy and Extension Use

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Short abstract

Purpose | Farming is associated with mental health risks. The *FarMHealth* project aimed to implement an intervention to improve farmer mental health help-seeking and literacy. This abstract provides key outcomes and their impact on farmer mental health policy and practice.

Design | The project consisted of 1. A quantitative survey, 2. Qualitative semi-structured interviews and focus groups and 3. A tailored intervention

Findings | Farmers were willing to seek help, but had low literacy, poor knowledge of available services (Firnhaber et al., 2023), high burnout (O'Connor et al., 2024b), stigma toward help-seeking (Firnhaber et al., 2024a), and advocated strongly for farmer-oriented services (Malone et al., 2025). Following the intervention, increased knowledge of service access, increased help-seeking intention, and confidence in managing mental health was observed, alongside decreased stigma around discussing mental health (O'Connor et al, under review).

Practical and theoretical implications | Farmer-oriented methods for accessing mental health services are essential for increasing engagement. *FarMHealth* demonstrated farmers were willing to improve mental health literacy skills, and seek help if they were supported to do so. Policy and practice was influenced through eight publications, collaboration with key farming bodies, engagement with national media outlets, and public outreach through social media. Funding is needed to facilitate national rollout.

1. Purpose

Farmers globally can experience mental health issues at higher rates than the general population (Daghagh-Yazd et al., 2019; Klingelschmidt et al., 2019; Jones-Bitton et al., 2020) and are a crucial high-risk target population for preventative interventions (Younker & Radunovich, 2021). Younger (≤ 35 years) and older (≥ 55 years) farmers experience higher rates of suicide compared to non-farmers (Arnautovska et al., 2014), and farmers experience higher rates of both suicide and depression worldwide than any other occupation (Arif et al., 2021; Herron et al., 2020; Fraser et al., 2005). Long working hours in isolation, frequently without support, and managing financial and regulatory demands are likely to contribute to the experience of mental health issues (Furey et al., 2016; Lunner Kolstrup et al., 2013). In addition, the high levels of uncertainty inherent in farming, such as alterations to

regulations, disease outbreak and unpredictable weather, is a factor which contributes to poor mental health in farmers (Fraser et al., 2005; Deary et al., 1997). In Ireland, it was found that from 2014 to 2020, higher mortality rates from suicide were experienced by Irish farmers than from farm accident fatalities, which has been attributed to farm-specific stressors such as succession, isolation, financial hardship, bureaucracy, and climate change (Russell et al., 2023). These high rates of poor mental health and suicide demonstrate the urgent need for mental health interventions tailored toward Irish farmers. However, despite the inherent risk factors present in this cohort, farmers often have low levels of help-seeking and mental health literacy compared to other high risk groups for poor mental health, such as members of the LGBT community, racial minority groups, and university students (Shabrina et al., 2022; Pickenpaugh et al., 2022; Spengler et al., 2023). The DCU-led *FarMHealth* project, funded by the Department of Agriculture, Food and the Marine (DAFM), aimed to design and evaluate an intervention to improve farmer mental health help-seeking and literacy by surveying prevailing attitudes and identifying community and stakeholder perspectives and preferences for this intervention. This abstract provides key project outcomes and indicates how they have impacted farmer mental health policy and practice.

2. Design

The *FarMHealth* project addressed mental health help-seeking and literacy in Irish farmers across two studies followed by an intervention:

1. Irish adult farmers (n=351) completed a cross-sectional quantitative survey online or in-person at farming events. The Multicomponent Mental Health Literacy scale, Mental Help-Seeking Intention Scale and Attitudes Toward Seeking Professional Psychological Help Short Form were used. Prevalence assessments and descriptive analyses were completed and non-parametric tests were used to examine the differences between age, gender, education, income and health issues.
2. Seventeen qualitative interviews were conducted with Irish farmers, and 3 focus groups and 1 interview were conducted with stakeholders from key organisations supporting Irish farmers. Data were recorded and transcribed verbatim and were analysed using reflexive thematic analysis.
3. A tailored intervention designed to increase mental health help-seeking and literacy in farmers was carried out based upon the results of the survey and qualitative data collection. Seventy-two farmers (intervention n=37; control n=35) participated across a parallel mixed methods intervention. A quasi-experimental between (group: intervention and control) and within-group design was used (time: baseline [T1], immediately post-intervention [T2], and ≥ 1 month post-intervention [T3]). A facilitator with a farming background and qualifications in mental health delivered a discussion on mental health literacy during Teagasc discussion groups. Five intervention participants also participated in a qualitative interview after T3.

3. Findings

1. The survey found that many farmers did not know how to contact a local clinic (53.8%), obtain a suicide prevention hotline number (24.2%), where to get services (24.8%) or useful information on mental illness (21.8%). Farmers had low literacy (M=17.8) and intentions to seek help (M=4.3), with females displaying higher literacy ($p < .001$, $r = .17$). Third level education was associated with higher literacy ($p = .007$, $r = -.18$) and positive attitudes to help-seeking ($p = .024$, $r = -.12$). Past help-seeking was associated with higher literacy ($p = .043$, $r = .11$) positive attitudes ($p = .022$, $r = .12$) and greater help-seeking intention ($p = .028$, $r = .12$). Those with mental health ($p = .036$, $r = -.11$) or substance use issues ($p = .023$, $r = -.12$) had lower help-seeking intention. These results indicate farmers were willing to seek help for their mental health but having low literacy and poor knowledge of how to access services

(Firnhaber et al., 2023; O'Connor et al., 2024a), and had high levels of burnout (O'Shaughnessy et al., 2022; O'Connor et al., 2024b).

2. Results from the interviews and focus groups added context to the survey findings. Analysis of sociocultural barriers and facilitators to help seeking among Irish farmers and stakeholders found three central barriers to farmers' help-seeking: resilience, pride in being a 'good farmer' and help-seeking stigma. One central barrier/facilitator, slowly increasing mental health awareness, was also found. Regarding prevailing opinions of mental health services and preferences, four themes were identified: 1) reliance on informal support, 2) negative perceptions of available mental health services, 3) preferences for tailored mental health support, and 4) farm-centric logistics. Overall, the qualitative phase indicated a prevailing culture of self-reliance and stigma surrounding seeking mental health support (Firnhaber et al., 2024a; Firnhaber et al., 2024b), and a strong community identity and desire to see mental health services that understood the needs of farmers (Malone et al., 2025).

3. A once-off, farmer specific intervention, created based upon the preceding research phases, showed participants' mental health literacy increased significantly at T2 and T3 compared to both T1 and the control at all time points. Both help-seeking intentions and self-efficacy in seeking mental healthcare also increased significantly at T2 compared to T1. The intervention addressed stigma against mental health (Theme 1) and provided important resources for participants' present and future coping (Theme 2), identified using reflexive thematic analysis. 100% of participants enjoyed the discussion and would recommend it to other farmers (O'Connor et al, under review).

4. Practical Implications

FarMHealth demonstrated farmers were willing to develop their mental health literacy skills, and seek help from services and their community if they were supported to do so. The project has influenced policy and practice through the publishing of eight papers across all phases of the research. Furthermore, public dissemination of the research was achieved through collaboration with key farming bodies such as the DAFM, the Minister for Agriculture Food and the Marine, and Teagasc, who provided opportunities to directly engage with stakeholders outside of included participants in the form of publicly available articles in the Teagasc newsletter, talks, and meetings. This was further compounded through engagement with national media outlets such as RTÉ Brainstorm, articles in national newspapers such as The Irish Times, Irish Independent, and Irish Farmers Journal, and public outreach through social media. Its publications were cited in the recent mental health report by the European Agency for Safety and Health at Work (Donohue et al., 2024). Further funding is vital to enable this intervention to be rolled out nationally in order to continue to increase its impact on the farming community.

5. Theoretical Implications

The overall success of the project provides strong evidence for tailoring mental health literacy

interventions to the specific cultural and social context of the group for whom it is designed. Indeed, considering farmers' nearly universally positive attitude to the intent of the project in the beginning, culminating in their enthusiastic participation in the intervention, these results indicate how much using a farmer-centric and community-based approach can impact farmers' willingness to engage with mental health services and content. Therefore, future initiatives for farmer's mental health must collaborate directly with farming communities and seek to challenge rather than reinforce stigma. Hard to reach populations must be included in the design of any interventions designed to improve aspects of their daily lives in order to ensure maximum engagement.

6. References

- Arif, A. A., Adeyemi, O., Laditka, S. B., Laditka, J. N., & Borders, T. (2021). Suicide mortality rates in farm-related occupations and the agriculture industry in the United States. *American journal of industrial medicine*, 64(11), 960-968.
- Arnautovska, U., McPhedran, S., & De Leo, D. (2014). A regional approach to understanding farmer suicide rates in Queensland. *Social psychiatry and psychiatric epidemiology*, 49, 593-599.
- Daghagh Yazd, S., Wheeler, S. A., & Zuo, A. (2019). Key risk factors affecting farmers' mental health: A systematic review. *International journal of environmental research and public health*, 16(23), 4849.
- Deary, I. J., Willock, J., & McGregor, M. (1997). Stress in farming. *Stress Medicine*, 13(2), 131-136.
- Donohue, E., Camonita, F., Tageo, V., Guey, C.; Zejerman, I., Todaro, L., Godderis, L., & Boone, A. (2024). Mental health in agriculture: preventing and managing psychosocial risks for farmers and farmworkers. European Agency for Safety and Health at Work. <https://osha.europa.eu/en/publications/mental-health-agriculture-preventing-and-managing-psychosocial-risks-farmers-and-farm-workers>
- Firnhaber, J., O'Connor, S., Malone, S., O'Shaughnessy, B., McNamara, J., & Breslin, G. (2023). Mental health knowledge and help-seeking intention in Irish farmers. *European Journal of Public Health*, 33(Supplement_2), ckad160-1401.
- Firnhaber, J., Malone, S. M., O'Hagan, A. D., O'Keefe, S., McNamara, J., & O'Connor, S. (2024). 'You don't want to be seen to be struggling'; identifying sociocultural barriers and facilitators for Irish farmers' mental health help-seeking. *Sociologia Ruralis*, 64(2), 353–375. <https://doi.org/10.1111/soru.12469>
- Fraser, C. E., Smith, K. B., Judd, F., Humphreys, J. S., Fragar, L. J., & Henderson, A. (2005). Farming and mental health problems and mental illness. *International Journal of Social Furey, E. M., O'Hara, D., McNamara, J., Kinsella, S., & Noone, C. (2016). The roles of financial threat, social support, work stress, and mental distress in dairy farmers' expectations of injury. Frontiers in public health*, 4, 126.
- Herron, R. V., Ahmadu, M., Allan, J. A., Waddell, C. M., & Roger, K. (2020). "Talk about it:" changing masculinities and mental health in rural places?. *Social Science & Medicine*, 258, 113099.
- Jones-Bitton, A., Best, C., MacTavish, J., Fleming, S., & Hoy, S. (2020). Stress, anxiety, depression, and resilience in Canadian farmers. *Social psychiatry and psychiatric epidemiology*, 55, 229-236.
- Klingelschmidt, J., Chastang, J. F., Khireddine-Medouni, I., Chérié-Challine, L., & Niedhammer, I. (2019). Occupational factors associated with suicide among French employees from the special agricultural social security scheme (MSA) working between 2007 and 2013. *Revue d'epidemiologie et de sante publique*.
- Lunner Kolstrup, C., Kallioniemi, M., Lundqvist, P., Kymäläinen, H. R., Stallones, L., & Brumby, S. (2013). International perspectives on psychosocial working conditions, mental health, and stress of dairy farm operators. *Journal of agromedicine*, 18(3), 244-255.
- Malone, S. M., Firnhaber, J., O'Hagan, A. D., O'Keefe, S., McNamara, J., & O'Connor, S. (2025). "Lacking the rural empathy"; Irish farmers' and stakeholders' opinions on current mental health services and preferences for support. *Journal of Rural Studies*, 114, 103508. <https://doi.org/10.1016/j.jrurstud.2024.103508>
- O'Connor, S., Malone, S.M., Firnhaber, J., O'Keefe, S., McNamara, J. & O'Hagan, D. "Skills for Resilience in Farming"; an evidence-based, theory driven educational intervention to

-
- increase mental health literacy and help-seeking intentions among Irish farmers. (under review)
- Pickenpaugh, E. N. (2022). The Role of Perceived Racial Discrimination on Help-Seeking Intention and Psychological Distress. University of Northern Colorado.
- Russell, T., Stapleton, A., Markey, A., & McHugh, L. (2023). Dying to farm: developing a suicide prevention intervention for farmers in Ireland. HSE National Office for Suicide Prevention.
- Shabrina, A., Siswadi, A. G. P., & Ninin, R. H. (2022). Mental health help-seeking intentions: The role of personality traits in a sample of college students. *Psikohumaniora: Jurnal Penelitian Psikologi*, 7(2), 169-182.
- Spengler, E. S., Tierney, D., Elledge, L. C., & Grzanka, P. R. (2023). Beyond the individual: Sexual minority help-seeking and the consequences of structural barriers. *Journal of Counseling Psychology*, 70(2), 133.
- Younker, T., & Radunovich, H. L. (2021). Farmer mental health interventions: a systematic review. *International journal of environmental research and public health*, 19(1), 244.
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‘Accidental counsellor’ or ‘accidental confidant’: exploring the role of land agents, agronomists, health and safety consultants, and contractors in supporting farmer mental wellbeing

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Short abstract

Research suggests that so-called ‘accidental counsellors’ – individuals who come into contact with farmers on a regular basis, such as agronomists, veterinarians, hauliers, etc. – could play a key role in supporting farmer mental health. There has been limited critical evaluation of if and how such individuals could support farmers with their mental health and whether these individuals feel supported themselves to offer support. Using a mixed methods study involving a survey, training event, and interviews focusing on contractors, agronomists, health and safety consultants, and land agents, we explore these issues and critically evaluate what role, if any, they could play in the ‘landscapes of support’. We find that many of these individuals are already supporting farmers with their mental health, primarily by listening to worries. Knowledge of how to support farmers and where to signpost them towards resources may be limited without training and, unlike professional mental health supporters, individuals in the informal landscape tend not to have clearly defined networks of support. Informal support for mental health should not be a substitute for a well-resourced professional landscape. We find also that the ability to act as an ‘accidental counsellor’ can be impacted by their professional relationship with the farmer and power dynamics.

1. Purpose

Research on farmer mental health has identified a diverse ‘landscape of support’¹, comprising of formal support (e.g. primary healthcare by doctors or mental health specialists, specialist mental health charities) and informal help (e.g. from peers, friends, rural communities, and advisers). Formal/professional support can be inaccessible in rural areas² or lacking in ‘rural empathy’³. Due to the lack of access to professional care, combined with the stigma around help-seeking^{4,5,6} and worries about lack of confidentiality⁷, farmers utilise trusted social ties or informal sources of support³. For some farmers, there is also a reluctance to engage anyone for support⁸. Though there has been limited research evaluation of support strategies for farmer mental health⁹, some studies recommend widening the ‘safety net’, including utilising the extension network^{10,11}. This body of nascent research argues that, despite the relative isolation of some, there are many people that farmers engage with on a regular basis; such as veterinarians, agronomists, environmental advisers; land agents; bank managers; farm inspectors; hauliers; etc. These individuals regularly travel up the farm drive to see farmers and discuss business and technical issues. Some research spots an opportunity to engage these individuals in widening the safety net for farmer mental health. If these individuals could be equipped with the knowledge, skills, and confidence to have sensitive conversations around mental health with farmers, spotting signs of distress, helping with tasks, and signposting them towards support, this could provide help to those who may not actively seek it. In the literature, these individuals have been termed ‘accidental counsellors’¹². This has inspired efforts to provide targeted resources for so-called ‘accidental counsellors’ and to provide mental health first aid training to a wide variety of people who come into contact with farmers. As an example, the ‘Accidental Counsellor Hub’ (Farming Health Hub/University of Exeter¹³) provides resources for accidental counsellors to “*confidently assist a farmer in a moment of need*”. However, there has been little critical engagement with the concept of individuals travelling up the farm drive acting in a role as ‘accidental counsellor’. The potential risks, both to the farmer and to the supporter, of individuals acting as a ‘counsellor’ have not yet been examined. This paper asks:

- (a) How, if at all, do current individuals who travel up the farm drive (‘supporters’) support farmers with their mental health?
- (b) What effect, if any, does partaking in difficult conversations around mental health with farmers have on the ‘accidental counsellors’, and what support mechanisms do these supporters have around them?
- (c) What specific role/s should these so-called ‘accidental counsellors’ play, if any, in supporting farmers with mental health, and does this vary by type of supporter?

2. Design

We explored the literature related to ‘accidental counsellors’ outside of agriculture. In the UK context, we acknowledge that professional mental healthcare for the general population involves individuals with varying levels of qualifications and competencies; from the most highly qualified and certified psychologists dealing with the most severe cases, requiring high levels of qualification and oversight, to ‘counsellors’ who tend to receive less training and do not have certified titles. Across this spectrum, clinical psychologists, social workers, and counsellors, tend to suffer negative mental health impacts of their work themselves [secondary victimisation¹⁴ or secondary traumatic stress¹⁵], and some are required to maintain a level of self-care and have a support network in place¹⁶. Certified professionals are generally not able to support individuals with whom there may be a conflict of interest (e.g. holding a position of ‘power’ or external influence over them). This literature review

added important context to our agriculture-specific study. In agriculture, there are serious problems of poor mental health for some farmers, including suicidal ideation and clinical depression¹, and there is evidence that this causes stress to advisers¹⁷. There is limited reference in the literature to rural support organisations helping their own staff who face difficult circumstances on farm¹⁷.

Primary data was collected in various ways. Firstly, we conducted an online survey (December 2024-January 2025) of various groups of people who travel up the farm drive to meet farmers; agronomists, contractors, land agents, and health/safety consultants. The survey contained closed- and open-ended questions and focused on if and how these individuals support farmers with their worries, and the effect it has on them. In total, 162 people responded to this survey, including 53 agronomists, 30 contractors, 25 land agents, 28 health and safety consultants, and others with broader or mixed roles (26). Secondly, the research team were asked to evaluate the impact of a mental health training day for 32 people, primarily aimed at land or managing agents (28), but also including small numbers of contractors (2) and agronomists (2). The training was delivered by a specialist mental health charity, covering topics such as 'having difficult conversations', 'dealing with serious incidents (e.g. suicidal ideation)', and signposting towards helpful resources for those in the agricultural sector. A pre-workshop survey (Feb-March 2025, n=26) and post-workshop survey (n=15, March 2025) asked close- and open-ended questions of these 'supporters' related to knowledge required to have conversations with farmers around worries, awareness of supporting resources, and level of help available to the 'supporters' themselves (both before and after the training). It also asked them to reflect in open-ended answers about their role, if any, in supporting farmers with their worries. We consciously did not include stories shared during the training so that a 'safe space' was created. Thirdly, we followed up with six individuals (land agents and contractors) from this workshop with in-depth interviews. The interview focused in more detail on the four main research questions in the paper, also asking them to reflect on the impact of the training in the preceding weeks. Quantitative data from the surveys were analysed using descriptive statistics, whilst the qualitative data from both surveys and interviews were thematically analysed using Nvivo.

3. Findings

The qualitative interviews were not complete at the time of writing so are not included below.

How, if at all, do current individuals who travel up the farm drive ('supporters') support farmers with their mental health?

99% of advisers in the main survey (n=162) reported that farmers shared worries with them. A variety of different strategies were used by these advisers to support farmers with their worries, including more passive helping methods like listening (the most used strategy) and sharing own experiences towards more active helping methods like support with tasks or signpost to support. Passive methods were most commonly used. Advisers also categorised a large range of worries farmers share; including business-related, policy-related, weather-related, and social concerns.

What effect, if any, does partaking in difficult conversations around mental health with farmers have on the 'accidental counsellors', and what support mechanisms do these supporters have around them?

In total, 7% of advisers (n=162) were 'very confident' in supporting farmers with their concerns and 10% were 'not at all confident'. Other answers ranged from 'a little bit confident' (38%) to 'fairly confident' (33%) to 'mostly confident' (12%). 96% of advisers

(n=162) said that conversations with farmers about worries stayed with them afterwards at least some of the time, illustrating the potential for it to affect their own mental health. 93% of respondents to the post-training survey (n=15) found the training very useful or useful and cited the following main take-home messages:

How to be supportive	Benefit/importance of listening
	How to create opportunities to converse/listen about wellbeing
	Need for vigilance around struggling farmers
Gained new knowledge	Difference between mental illness and mental health/wellbeing
	FarmWell Green Zone Checklist
	Understanding available support/signposting for farmers
A need for change	More work to be done

In the post-training survey (n=15) compared to the pre-training survey (n=26), a greater proportion (93% v 35%) of respondents reported having at least a fair amount of the knowledge they needed to support farmers. A higher proportion of post-training respondents (n=15) reported feeling at least fairly knowledgeable about where to find resources (87%), compared to pre-training (n=26, 23%). Little change was noted in the extent to which advisers themselves felt supported after the training. One comment said, *"how involved we can be without risk to ourselves?"*.

What specific role/s should these so-called 'accidental counsellors' play, if any, in supporting farmers with mental health and does this vary by type of supporter?

Comments in all surveys illustrated the potential tension associated with performing an 'accidental counsellor' role, perhaps for some type of adviser more than others. In the main survey, two advisers noted that *"we are not professionals and there are several organisations ... who are better geared up to give advice"* and *"it is outside the scope of visit and my competence"*. Some land agents and landlords in the pre- and post-workshop training wrestled with a conflict of interest:

"Where we, as landlord [or agent] are part of the cause of the worry, as rent will form a part of the overall financial challenges a farmer has, how do I deal with that where we cannot remove or reduce that worry?"

"How do you avoid putting yourself in a position of conflict of interest professionally, personally, morally?"

"as a Landlord's agent we are being asked to provide comfort and support to farmers one week and then in two week's time we have to act on the instructions of the landlord and serve a rent review. There is no support or guidance for acting on both sides and in the job there needs to be a clear line of separation between the roles and...as agent we should only be signposting them in the direction of professional help and not advising."

4. Practical Implications

Advisers and other individuals who visit farms could play a role in supporting farmer mental health with increased mental health literacy. Involving trusted others can be a key component of mental care, beyond professional contexts. Listening to worries with a sympathetic ear and knowing how to signpost towards support is important^{18,19}. If individuals visiting farms are to be asked to play an 'accidental counsellor' role, there should be clarity on what this means for them, and a support network is needed, as secondary traumatic stress can occur. Employers or the self-employed will need to be mindful about what supporting role they can play for farmer well-being, as this is likely to be impacted by professional relationships and power dynamics. If an accidental counsellor were to hold power over the livelihoods of farmers, there is potential this could violate ethical principles

in mental health care surrounding beneficence and impartial care²⁰. Policy-makers designing the landscapes of support for farmer mental health should not forget professional mental health support, which can be a crucial component of person-centred care for depression and anxiety.

5. Theoretical Implications

This is one of the first papers to undertake a critical analysis of the potential role of so-called ‘accidental counsellors’ in supporting farmer mental health. Our paper makes a number of important theoretical contributions to the ‘landscapes of support’¹ concept: (1) articulating that different types of individual interacting with farmers are supporting, and have the potential to support, farmers with their mental health in different ways, affected by their professional relationship and training level, (2) illustrating the importance of a ‘landscape of support’ for those who support farmers, particularly those without professional training and professional support networks, (3) showing the potential limitations of neoliberal attempts to place duties of care onto market actors, rather than the state funding adequate professional mental health support.

6. References

1. Shortland, F., Hall, J., Hurley, P., Little, R., Nye, C., Lobley, M., & Rose, D. C. (2023). Landscapes of support for farming mental health: Adaptability in the face of crisis. *Sociologia ruralis*, 63, 116-140.
2. Hull, M. J., Gunn, K. M., Smith, A. E., Jones, M., & Dollman, J. (2022). “We’re lucky to have doctors at all”; A qualitative exploration of Australian farmers’ barriers and facilitators to health-related help-seeking. *International Journal of Environmental Research and Public Health*, 19(17), 11075.
3. Malone, S. M., Firnhaber, J., O’Hagan, A. D., O’Keeffe, S., Mcnamara, J., & O’Connor, S. (2025). “Lacking the rural empathy”; Irish farmers’ and stakeholders’ opinions on current mental health services and preferences for support. *Journal of Rural Studies*, 114, 103508.
4. Adam, J., Messely, L., Prové, C., & Sanders, A. (2024). Wellbeing and collective grievances among farmers: The case of Flanders, Belgium. *Journal of Rural Studies*, 108, 103278.
5. Hammersley, C., Richardson, N., Meredith, D., McNamara, J., Carroll, P., & Jenkins, P. (2025). On Feirm ground, supporting farmer mental health: analysing the effectiveness of a bespoke farmer mental health training programme targeted at farm advisors in Ireland. *The Journal of Agricultural Education and Extension*, 31(1), 90-118.
6. O’Connor, S., O’Hagan, A. D., Firnhaber, J., O’Shaughnessy, B. R., McNamara, J., Breslin, G., ... & Malone, S. M. (2024). Sowing seeds of awareness: a cross-sectional analysis of mental health literacy and help-seeking in Irish farmers. *Journal of Occupational Medicine and Toxicology*, 19(1), 47.
7. Riethmuller, M. L., McEvoy, P. M., & Newnham, E. A. (2025). Farmers’ access to mental health services and community supports: A mixed methods analysis of service preferences, barriers and attitudes. *Journal of Rural Studies*, 117, 103657.
8. Billington, A., Cuthbertson, C., Iwinski, S., Hu, Y., Krishnaswamy, M., & Rudolphi, J. (2025). “Move forward”: A marginalia analysis of farmers’ mental health management strategies. *Journal of Rural Studies*, 117, 103649.
9. Younker, T., & Radunovich, H. L. (2021). Farmer mental health interventions: a systematic review. *International journal of environmental research and public health*, 19(1), 244.
10. Molgaard, V. K. (1997). The extension service as key mechanism for research and services delivery for prevention of mental health disorders in rural areas. *American Journal of Community Psychology*, 25(4), 515-544.

11. Robertson, M. N., DeShong, H. L., Steen, J. K. S., Buys, D. R., & Nadorff, M. R. (2021). Mental health first aid training for Extension agents in rural communities. *Suicide and Life-Threatening Behavior*, 51(2), 301-307.
12. Perceval, M., Ross, V., Kölves, K., Reddy, P., & De Leo, D. (2018). Social factors and Australian farmer suicide: a qualitative study. *BMC public health*, 18(1), 1367.
13. Farming Health Hub/University of Exeter. Accidental Counsellors. <https://www.accidentalcounsellors.co.uk/>
14. Figley, C. R. (1988). Victimization, trauma, and traumatic stress. *The Counseling Psychologist*, 16(4), 635-641.
15. Figley, C. R. (2013). *Compassion fatigue: Coping with secondary traumatic stress disorder in those who treat the traumatized*. Routledge.
16. Birkett, L., Hagan, A. J., & Verity, S. J. (2025). Well, or Well Enough? An exploration of the need for guidance addressing clinician wellbeing and fitness to practice in UK Clinical Psychologists. *medRxiv*, 2025-02.
17. Hossain, D., Eley, R., Coutts, J., & Gorman, D. (2008). Mental health of farmers in Southern Queensland: Issues and support. *Australian Journal of Rural Health*, 16(6), 343-348.
18. Swinkels, L. T. A., Hoeve, M., Ter Harmsel, J. F., Schoonmade, L. J., Dekker, J. J. M., Popma, A., & van der Pol, T. M. (2023). The effectiveness of social network interventions for psychiatric patients: A systematic review and meta-analysis. *Clinical Psychology Review*, 104, 102321.
19. George, L. K., Blazer, D. G., Hughes, D. C., & Fowler, N. (1989). Social support and the outcome of major depression. *The British Journal of Psychiatry*, 154(4), 478-485.

Building on Solid Foundations: Reflecting on the key learnings from the 'On Firm Ground' training model and the implications for mental health promotion targeting farmers.

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1. Purpose

Good mental health is integral to the wellbeing and overall prosperity of any population. In Ireland the government is committed to a broad vision for a 'Healthy Ireland', whereby wellbeing is valued, and citizens are supported to enjoy physical and mental health (Department of Taoiseach, 2024). Farmers are a sizeable and distinct but underserved occupational group in Ireland, who experience elevated levels of physical and mental health challenges (Cox et al., 2025; Hammersley et al., 2021). This is, in part, related to the nature of their work e.g. long working hours, few breaks, isolation (Furey et al. 2016; Hammersley, 2022). Structural issues associated with financial precarity, farm compliance pressure, and negative perceptions of farmers in relation to climate change, have been identified as confounding factors that impact farmer mental health (Chiswell, 2023; Hammersley, 2022). Adopting a more targeted response to support farmer mental health has been identified as a critical component of social sustainability in Irish agricultural circles. In response to this

context, the 'On Feirm Ground' (OFG) programme, funded by the Department of Agriculture, Food and Marine (DAFM), the Department of Health (DoH) and the Health Service Executive (HSE) in Ireland was developed. On Feirm Ground has been purposively designed with the twin aims of; training agricultural advisors, a key relational resource in agricultural networks, in how to intervene with and signpost farmer in distress; and to mainstream health promotion in farming environments (Hammersley, 2022). A primary objective for OFG was to respond to the call for more critical, evidence-based, and targeted supports for farmers' mental health and wellbeing (Powell et al., 2024) This study had two objectives: (1) to examine the effectiveness, sustainability and scalability of the OFG programme, focusing on the training pedagogy and adaptability/flexibility of the model to respond to the ever-changing contexts of mental health in contemporary farming, and (2) to ascertain the key learnings from the delivery of Phase 1, to inform future interventions for the promotion of farmer wellbeing, nationally and internationally.

2. Methodology

Research approach and background:

The study was funded by the DAFM, and comprised research team members from University College Dublin (UCD) Agri Mental Health Group (UCDAMHG) and South East Technological University's (SETU) National Centre for Men's Health (NCMH). The study was overseen by an 'Advisory Group', who offered guidance on the research process and assisted in the recruitment of research participants. This study is part of the wider 'Farming Minds' (FM) project, commissioned to develop and test the feasibility and effectiveness of a scalable psychological intervention for farmers to target the key areas of mental health, stress, and resilience, in terms of prevention and early intervention. Building on the existing framework and key learnings from the OFG training programme, the FM team sought to develop evidence-based interventions that went beyond signposting to support development of key psychological skills.

Design/Method/Approach:

Following ethical approval from the 'UCD Research Ethics Committee', qualitative interviews (n=15) were conducted online, to openly explore participants perspectives and experiences of the OFG training model, contemporary contexts impacting on farming and farmers, and potential learning from Phase 1 delivery of OFG to inform future initiatives to support farmer mental health. Purposive sampling was used to select interview participants from the different ecological levels of engagement with OFG. This included policy developers involved in mental health and agriculture (x 3), OFG programme governance co-ordinators (x 2), Advisory Oversight group members (x 3), Mentors (x 2) and Agricultural advisors/OFG facilitators (x 5). A semi-structured, qualitative interview schedule was developed based on the aims of the 'Farming Minds' project; to better understand the key principles underpinning the development of the pedagogical approach adopted for the OFG programme, and to assess whether the programme perceived by participants to be acceptable, viable and efficacious. The interview schedule was used to guide the interview process and was continually revised based on reflection and consultation between the paper authors, to best capture the perspectives and experiences of the participants. Inductive thematic analysis was utilized to analyse the data. All interviews were transcribed verbatim, anonymized and gleaned of any identifying information. Broad initial codes were generated to develop an emergent coding framework, linked to the research aims. The first and second authors explored interrater reliability, by coding a portion of transcripts, line by line, to cross check coding strategies, negotiate interpretation of the data, collapse codes and agree on a coding framework. Transcripts were coded iteratively using open and comparative

techniques. Codes were then assigned to potential themes aligned with the associated data extract and cross-checked by the research authors, who worked collaboratively to capture important elements and to reach consensus about theme content (Braun and Clarke, 2006).

3. Preliminary findings

While analysis is ongoing, preliminary findings reveal that the OFG programme has effectively responded to its twin aims of providing strategic, practical support for agricultural advisors in the context of farmer mental health as well as contributing positively to a broader health promotion ethos within farming in Ireland.

Is the problem with the farmer or with farming?

Data indicate how OFG provoked critical debate among participants on the interaction of structure and agency in farmers' lives and whether 'the problem' with farmer mental health lay with the farmer or with farming. Framing how farmers mental health is perceived, and the need to look beyond seeing farmers as 'the problem' was framed against a backdrop of identifying and understanding broader structural issues as well as the wider socio-cultural context within farming. This lens shifts the conceptualisation of farmer as a stable individualised figure, to 'farming', as a continuous process of becoming, composed of heterogeneous interactions at different levels in agriculture, that are continuously being made and remade. In this way the approach disrupts the presumption of self-determination in farming contexts and presents 'farming' as an open process of becoming. This also positions farming within heterogenous relations that are continuously being made and remade, opening-up possibilities for change. Within this debate, the influence of agency and structure on farmer mental health and acknowledgement of the dissonance that may be generated within this discussion, is fundamental for understanding both the complexity of the issue and how to move forward to address these issues in ways that are culturally and positionally effective. The data demonstrates how many of the participants looked beyond seeing farmers themselves as the problem, albeit coming from different perspectives, to acknowledge other contributing factors within farming more generally. Findings in the 'OFG' data oscillate between the macro and micro perspectives of farmer mental health, such as resistance to seeking help within the context of masculinities, the resilience of stigma in relation to mental health in rural settings and contemporary transitions in the nature and status of farming. In the short term, recognising the breath of the impact these challenges have on farmers' health - exacerbating stress, anxiety, and low mood, that in the longer-term impacts on farmer's identities, sense of self, and willingness to stay in farming (Hammersley et al., 2022).

Enabling 'magic in the room'

Faith in the model came across very strongly in the data. Findings reveal the benefits of the OFG collaborative and co-productive training methodology, to provide a culturally sensitive and adaptive training model to support farmers in distress (Powell et al. 2024). In this way, the programme was seen as building on the key learnings from previous successful mental health initiatives and training programmes developed within the context of Ireland's National Men's Health Policy. The model was experienced, not so much a 'set of instructions' to be learned, rather it drew on the expert knowledge of the advisors, sharpening their skills and showing how engagement with mental health issues, can be done safely. The model design affirms the advisors' own ability; (i) to lean into their skills, (ii) reflect on what they have learned in the programme, namely structural and cultural determinants impacting on farmer mental health, (iii) to build trust in their competency to engage farmers and respond to the conditions they find themselves in, in the field. By 'joining the dots' for participants,

as one mentor explained, the programme expands understanding of cultural contexts, such as more traditional farming masculinities, rural isolation, and stigma around mental health, that shape farmer mental health behaviours. A core aspect of the collaborative and participatory approach was to integrate the significant knowledge base of agricultural advisors, their relational skills and connections, to draw out the learning from those who regularly meet and converse with farmers (Hammersley et al., 2023). Findings show how the upskilling of advisors as 'health connectors' was grounded in their inherently pastoral role, emotional intelligence and based on trusted relationships with farmers. 'OFG's' strength lay in its ability to create transformative learning environments through 'learning in circles'. Participants from each of the ecological levels, who participated in the training, commented on the dynamic processes or 'magic in the room', created by this pedagogical approach. The processes identified were: (i) creating a relaxed, non-hierarchical, collaborative atmosphere, (ii) fostering a safe trusting 'working in circles' format, and (iii) foregrounding the expertise and experience of the advisors in the room.

Ripple effects and wider implications

Findings show how OFG consolidated and informed the integral contribution provided by many agricultural advisors to a 'health connector' role and affirms their expressed need for further training and skills to support farmers on how to manage the stressors they encounter (MacAuliffe et al, 2019; Kuehne and Lewellyn, 2017). In the context of future directions and learning from phase 1 of the OFG training, there were calls for additional training that would directly equip farmers with the skills to manage stress and to safeguard their own mental health. As participants responded to and integrated the training into their own life experiences and subsequently their advisory practice, (as per the design), they move through what Kolb (1984), describes as the 'Active Experimentation' stage. Applying new strategies in their professional roles, increasing the potential for a shift in attitudes in relation to mental health in the wider agricultural culture. These ripple effects illustrate praxis in action; reflection and action intertwined to effect real-world change (Freire, 1970). The data also highlight the flexibility and sustainability of the model to respond to dynamic agricultural settings, denoting its suitability for scaling out both nationally and internationally. In particular, findings reinforce the suitability of OFG for scale-out to other agricultural professionals and for positively impacting the culture around help-seeking and mental health in farming. Learning from the OFG model moves beyond the interactional impact of the training for agricultural advisors and their engagement with farmers, in particular farmers in distress. OFG's impact on the culture around normalizing help-seeking and mainstreaming mental health in agriculture was recognised, promoting the idea of 'talking about it when no one needs to hear about it'. Thus, the programme was seen as serving as a catalyst for a systemic shift in rural mental health. Recommendations to integrate mental health and wellbeing into third level agricultural courses/policy discourses, positioning mental health as a core element of farm management, were also noted.

4. Practical and theoretical implications

OFG provides a robust collaborative and culturally sensitive model for training agricultural personnel (Powell et al, 2024). The programme responds to calls for genderresponsive services and systemic approaches that support the diverse and complex needs of farmers, by addressing the complex interplay of factors that influence farmer mental health, such as gender norms, stigma, social support and life stressors (King et al., 2024). The model aligns with calls for synthesis within research and draws on previous intervention models, and the vast knowledge, expertise and skills of agricultural advisors to both support farmers in in distress, on the ground, and to facilitate a space for opening up or normalising discussions

about mental health in agricultural spaces, e.g. in agricultural colleges, knowledge transfer meetings, agricultural shows. With reference to the contribution of the pedagogical processes underpinning in the model, it draws on Freire's (1970) concept of praxis; the union of reflection and action toward transformative change. In 'OFG', praxis is achieved by encouraging advisors to interrogate the structural roots of farmer distress (e.g. masculinities, isolation, policy pressures (Hammersley et al, 2022), to reflect critically on possible applications of their learning from the training, with farmers on the ground, as well as the importance of maintaining boundaries in relation to their role as health connectors (Hammersley, 2024). Freire's ideas on adult education and training as a means of liberation through dialogue, cultural contextualisation and empowerment, also resonates well with 'OFG's wider commitment to challenging stigma and normalizing mental health discourses within farming and rural communities. Thus, findings are discussed with reference to the importance of resourcing underserved groups like farmers and agricultural advisors, to advocate for themselves and their wider population in the context of mental health. In the context of scaling out the program to other agricultural professionals, this should be seen as developing a community of practitioners, taking into account their skills and enthusiasm for the role, while acknowledging their ongoing need for a wider scaffold of training, mentoring and safeguarding, going forward.

*Note: 'Feirm' is the word for farm, in the Irish language.

Keywords: Farmer mental health, Advisor, Collaborative Training, Evaluation

5. References

- Braun, V., Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*. 3(2), 77-101.
- Chiswell, Hannah. 2023. Psychological morbidity in the farming community: A literature review. *Journal of Agromedicine* 28 (2): 151–176. <http://doi.org/10.1080/1059924X.2022.2089419>.
- Gemma Cox, Alison Stapleton, Tomás Russell, Louise McHugh & Katerina Kavalidou (06 May 2025): Probable Suicide Among Men in Farming and Agricultural-Related Occupations in the Republic of Ireland: Exploring Coronal Data, *Journal of Agromedicine*, DOI: 10.1080/1059924X.2025.2498339
- Dept. of the Taoiseach (2024). Vision for Ireland Wellbeing Framework. www.gov.ie/en/campaigns/1fb9b-a-well-being-framework-for-ireland-join-the-conversation/
- Freire, P. (1970) *Pedagogy of the oppressed*. London, UK: Penguin Modern Classics
- Hammersley, C., Richardson, N., Meredith, D., McNamara, J., Carroll, P., & Jenkins, P. (2024). On Feirm Ground, Supporting Farmer Mental Health: Analysing the effectiveness of a bespoke farmer mental health training programme targeted at farm advisors in Ireland. *The Journal of Agricultural Education and Extension*, 31(1), 90–118. <https://doi.org/10.1080/1389224X.2024.2339801>
- Hammersley, C., Richardson, N., Meredith, D., Carroll, P., & McNamara, J. G. (2023). Supporting farmer wellbeing: exploring a potential role for advisors. *The Journal of Agricultural Education and Extension*, 29(4), 511–538. <https://doi.org/10.1080/1389224X.2022.2082498>
- Hammersley, C., Meredith, D., Richardson, N., Carroll, P. (2022). Mental health, societal expectations and changes to the governance of farming: Reshaping what it means to be a 'man' and 'good farmer' in rural Ireland. *Sociologia Ruralis* 63(1), 57-81 <https://doi-org.ucd.idm.oclc.org/10.1111/soru.12411>

- Hammersley, C., Richardson, N., Meredith, D., Carroll, P., & McNamara, J. (2021). "That's me I am the farmer of the land": Exploring identities, masculinities, and health among male farmers' in Ireland. *American Journal of Men's Health* 15(4). <https://psycnet.apa.org/record/2021-82595-001>
- Kennedy, A., J. Adams, J. Dwyer, M. A. Rahman, and S. Brumby. 2020. "Suicide in Rural Australia: Are Farming-Related Suicides Different?" *International Journal of Environmental Research and Public Health* 17: 6. doi:10.3390/ijerph17062010
- King, K., Burley, A., Seidler, Z., Armstrong, G., & Vijayakumar, L. (2024). What psychologists need to know about men and suicide. *Australian Psychologist*, 59(6), 487–495. <https://doi.org/10.1080/00050067.2024.2404116>
- Kolb, D.A., (1984). *Experiential learning: Experience as a source of learning and development*. Upper Saddle River, NJ: Prentice Hall.
- Kuehne, G., and R. Lewellyn. 2017. "The Wisdom of Farm Advisors: Knowing Who and Knowing Why." *SSRN Electronic Journal* 1–25. doi:10.2139/ssrn.2897232.
- McAuliffe, C., D. O'Connor, and T. Kelly. 2019. "The Role of Agricultural Advisors in Dealing with Farmer Stress – A Case Study in the Teagasc Kerry/Limerick Region of Ireland." 24th European Seminar on Extension and Education, 18-21 June 2019, Acireale, Italy. teagasc.ie/media/website/about/research-and-innovation/Claire-McAuliffe-Thesis.pdf
- Ní Laoire, Caitriona. 2005. "You're not a man at all!": Masculinity, Responsibility, and Staying on the Land in Contemporary Ireland." *Irish Journal of Sociology* 14 (2): 94–114. doi:10.1177/079160350501400206
- Powell, N., Dalton, H., Laurence-Bourne, J., Perkins, D., (2024). Co-creating community wellbeing initiatives: what is the evidence and how do they work? *International Journal of Mental Health Systems* <https://doi.org/10.1186/s13033-024-00645-7>
- Richardson, N., & Carroll, P. (2009). "National Men's Health Policy 2008–2013: Working with Men in Ireland to Achieve Optimum Health and Well-being." Department of Health and Children. Dublin, Ireland. ISBN 0-7557-7621-6
- Stapleton, A., Russell, T., Markey, A. & McHugh, L. (under review). "Exploring Farmer Mental Health and Suicide on the Island of Ireland. *Sociologica*.

Trusted Voices in Farming: Identifying Credible Mental Health Speakers to Support Irish Farmers

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Short abstract

Mental health is an urgent and growing concern within the Irish agricultural sector, where farmers face elevated risks of psychological distress, burnout, and suicide. This study investigates who the farming community perceives as credible mental health speakers and how the tone of mental health messaging influences this perception. A between-groups experimental survey involving 193 participants assessed believability, trustworthiness, and

credibility of speakers delivering varied mental health narratives. Results show that licensed mental health providers, family members, and general practitioners are considered the most credible sources, while agricultural advisors—though well-positioned—ranked lower. Messages that downplayed mental health concerns were perceived as significantly less credible than those adopting a balanced or overemphasised tone. The study underscores the importance of culturally sensitive, trusted messengers and one-on-one communication channels in addressing stigma and improving mental health literacy. Practical implications include training advisors as “health connectors” and embedding mental health topics within discussion groups. Theoretically, the findings contribute to health communication and stigma research, affirming the critical role of source credibility and cultural alignment. The study also highlights the potential of leveraging existing agricultural networks to deliver mental health interventions in a trusted and effective manner.

1. Purpose

Mental health has become a pressing concern within the agricultural sector, with farmers experiencing disproportionate levels of psychological distress, anxiety, and burnout. These mental health challenges are exacerbated by factors such as occupational isolation, erratic income, regulatory complexity, and deeply rooted social expectations. The unique cultural landscape of farming often valorises stoicism, independence, and self-reliance, traits which can deter help-seeking behaviours. Male farmers in particular frequently avoid engaging with mental health services due to traditional notions of masculinity, where vulnerability is associated with weakness (Hammersley et al., 2021). As policy attention and scholarly research converge on improving mental health supports for farming communities, a critical question remains: who do farmers trust to speak credibly about mental health?

Understanding the role of credibility in mental health communication can help inform more effective outreach strategies, leading to improved mental health literacy, reduced stigma, and ultimately, better mental health outcomes for farmers. This study aims to identify who the Irish farming community perceives as credible mental health speakers, investigate the stigma surrounding mental health in the agricultural sector, and provide evidence-based recommendations for delivering mental health messages that resonate with this population. This research also seeks to advance understanding of how perceived speaker characteristics influence the acceptance of health messages, especially in communities marked by cultural conservatism and occupational insularity.

2. Design

This research employed a quantitative, between-groups experimental survey design, informed by previous studies in rural health and credibility assessment (Donovan et al., 2024; Rudolphi et al., 2019). A total of 193 participants, aged between 19 and 73, were recruited from across the Republic of Ireland through purposive and snowball sampling strategies. The sample included a mix of full-time farmers, part-time farmers, students in agricultural programs, and agriculturally affiliated workers. The survey was disseminated both online and in paper format, utilizing platforms such as agricultural discussion groups, marts, colleges, and digital channels (e.g., WhatsApp, Facebook, LinkedIn).

Participants were randomly assigned to read one of three short vignettes, each portraying a fictional speaker discussing mental health in farming. The vignettes differed only in tone: one speaker downplayed mental health concerns, another overemphasised them, and the third adopted a balanced, middle-ground approach. Following the vignette, participants rated the speaker on multiple dimensions using validated scales measuring believability, trustworthiness, and overall credibility (Connolly et al., 2008). Additional scales assessed

openness to receiving mental health information from various sources and perceived stigma (Docksey et al., 2022).

Data cleaning involved correcting minor typographical errors and coding open-ended responses into thematic categories. The dataset was imported into SPSS (Version 29) for statistical analysis. Hypotheses were tested through one-way ANOVA followed by Tukey's HSD post hoc comparisons to assess between-group differences in speaker credibility. Descriptive statistics were used to examine the most and least trusted sources and preferred channels for receiving mental health messages.

3. Findings

Results revealed that licensed mental health providers (mean = 3.25), family members (mean = 3.18), and general medical practitioners (mean = 3.16) were the most credible sources for mental health information. These were closely followed by friends and mental health organisations. Agricultural advisors were ranked eighth (mean = 2.60), indicating potential but underutilised influence in this area. The study also identified a clear preference among farmers for receiving mental health information through personalised and relational means, rather than impersonal or institutional channels.

Regarding the tone of mental health messaging, participants rated speakers who downplayed mental health concerns as significantly less credible, trustworthy, and believable than those who either overemphasised or presented a balanced perspective. There was no statistically significant difference in perceived credibility between the middle-ground and overemphasised speakers, suggesting that farmers are receptive to messages that confront mental health issues directly, provided they are presented with authenticity and empathy.

The findings also highlight a generational nuance: younger respondents (under 35) were more open to digital channels and peer-led messages, while older respondents preferred face-to-face conversations and advice from family doctors. This suggests the need for age-sensitive tailoring of mental health outreach strategies.

4. Practical Implications

This study has significant implications for mental health policy, advisory services, and rural health outreach. Firstly, the relatively low credibility ranking of agricultural advisors—despite their close working relationships with farmers—points to a training gap. Integrating basic mental health literacy and communication modules into advisory training programmes could empower advisors to serve as “health connectors,” capable of recognising signs of distress and referring farmers to appropriate supports.

Secondly, initiatives should leverage the trust placed in family members and medical professionals. Community-based interventions could incorporate family-focused mental health education, encouraging open dialogue within farm households. Collaborations between health professionals and agricultural networks may facilitate cross-sectoral approaches to outreach.

Thirdly, programme designers should prioritise delivery through familiar and trusted communication environments. Discussion groups, KT meetings, and farm walks could incorporate short, peer-led segments on mental wellbeing. Simultaneously, tailored campaigns on agricultural radio or in farming publications may reach those who are less engaged with formal events. Importantly, large group settings were among the least preferred channels, reinforcing the value of privacy, informality, and directness.

5. Theoretical Implications

The findings of this study extend the Elaboration Likelihood Model (ELM) by demonstrating that, in the context of farming, message acceptance is not solely driven by cognitive elaboration but is profoundly shaped by cultural congruence and interpersonal trust. Source credibility operates not only through perceived expertise and trustworthiness but also through shared social identity and familiarity.

This research also contributes to stigma theory by showing how occupational culture and social norms act as gatekeepers to help-seeking behaviours. In farming, where stoicism and resilience are culturally embedded, mental health stigma is both personal and structural. The study underscores the importance of designing interventions that respect these cultural dynamics rather than simply challenging them.

Moreover, the study reinforces the relevance of the Agricultural Knowledge and Information System (AKIS) as a framework for understanding how information flows in farming contexts. By positioning mental health communication within AKIS structures—through advisors, discussion groups, and peer-to-peer exchanges—stakeholders can build on existing networks of trust and information exchange. This systemic approach aligns with recent policy calls for integrated rural health strategies that go beyond service provision to encompass education, culture, and community.

6. References

- Brennan, M. et al. (2021) 'Weather, workload and money: Determining and evaluating sources of stress for farmers in Ireland', *Journal of Agromedicine*.
- Connolly, D. A., Price, H. L., Lavoie, J. A. A., & Gordon, H. M. (2008). Perceptions and predictors of children's credibility of a unique event and an instance of a repeated event. *Law and Human Behavior*, 32(1), 92–112. <https://doi.org/10.1007/s10979-006-9083-3>
- Docksey, A.E. et al. (2022) 'The stigma and self-stigma scales for attitudes to mental health problems: Psychometric Properties and its relationship to mental health problems and absenteeism.', *Health Psychology Research*, 10(2). doi:10.52965/001c.35630.
- Donovan, R.J., Jalleh, G. and Drane, C. (2024) 'Impact of source credibility on behavioural responses to a mental health promotion social marketing campaign', *Journal of Social Marketing*, 14(2), pp. 250–263. doi:10.1108/jsocm-07-2023-0159.
- Hammersley, C., Meredith, D., et al. (2022) 'Mental health, societal expectations and changes to the governance of farming: Reshaping what it means to be a "man" and "good farmer" in rural Ireland', *Sociologia Ruralis*, 63(S1), pp. 57–81. doi:10.1111/soru.12411.
- Hammersley, C. et al. (2021) "'That's me, I am the farmer of the land": Exploring identities, masculinities, and health among male farmers in Ireland', *American Journal of Men's Health*, 15(4), p. 155798832110352. doi:10.1177/15579883211035241.
- O'Shaughnessy, B. R. et al. (2022) 'The prevalence of Farmer Burnout: Systematic Review and narrative synthesis', *Journal of Rural Studies*, 96, pp. 282–292. doi:10.1016/j.jrurstud.2022.11.002.
- Rudolphi, J.M., Berg, R. and Marlena, B. (2019) 'Who and how: Exploring the preferred senders and channels of mental health information for Wisconsin Farmers', *International Journal of Environmental Research and Public Health*, 16(20), p. 3836. doi:10.3390/ijerph16203836.

Session 4D

Online

Whole Farm Planning for the 21st Century: Integrating Childcare into Your Whole Farm Plan

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Short abstract

Over a decade of research in the U.S. and Europe has established that accessing affordable quality childcare poses major challenges for farmers, by preventing individuals from entering agriculture and constraining existing farmers ability to grow their operations (Budge and Shortall 2023; Rissing et al. 2020; Becot et al. 2022). Specifically, access to childcare affects farm production and marketing systems, labor needs, farm safety, farm profitability, family economics, farm mental health, and quality of life. These issues especially affect small and medium farmers, beginning farmers, women, and young farmers. Childcare is an everyday ordinary stressor with the power to amplify extraordinary stressors, such as extreme weather and market volatility. Even though childcare can affect the viability of farms and farm families across production systems, scales, and geographic regions, it is rarely systematically addressed in farm programs.

To address this gap, this session will provide an overview of the recently released "*Whole Farm Planning for the 21st Century: Integrating Childcare, Healthcare, and Health Insurance into Your Whole Farm Plan*" curriculum. Using a train-the-trainer model and drawing on the best practices of adult learning and problem based learning the curriculum includes two module with 42 new learning and evaluation tools. Materials are designed to be accessible to visual, auditory, and experiential learners, including: facilitator guides, ppts, activity sheets, case studies, comic books, and comic images.

This session will describe the curriculum, and the approaches used to recruit and train extension educators. Educators from across the Midwestern region of the U.S. were encouraged to apply to the training as a team with complimentary skill sets - one partner with expertise in agriculture and one with expertise in community development or family and consumer science. Results of a pre-post survey demonstrate the positive impact of the training. Educators attending the training significantly increased their knowledge about how childcare, health care, and health insurance impact farms (mean: Before 2.99, After 4.64), their ability to assist clients with integrating these topics into whole farm planning (mean: Before 2.14, After 4.13), and their confidence in their own skill and abilities to teach these topics and in their ability to find resources on both childcare (mean: Before 2.43, After 3.51) and health care/health insurance (mean: Before 2.38, After 4.25). This open-access curriculum is one approach to providing educators with the knowledge, confidence, ability, and pedagogical materials to offer programs that address social sustainability and quality of life in agriculture.

Keywords: Educator confidence, social sustainability, childcare, training educators,

References

- Becot, F., Inwood, S., and Rissing, A. (2022). Childcare for farm families: A key strategy to keep children safe yet largely absent from farm programming. *Frontiers in Public Health*. <https://doi.org/10.3389/fpubh.2022.1043774>
- Budge, H. & Shortall, S. (2023) Agriculture, COVID-19 and mental health: Does gender matter? *Sociologia Ruralis*, 63(S1), 82–94. <https://doi.org/10.1111/soru.12408>
- Rissing, A., Inwood, S.M. and E. Stengel. 2020. "Farming Parents Are Working Parents: Tracing the Impact of Childcare on Agriculture and Food System Development." *Agriculture and Human Values*. <https://doi.org/10.1007/s10460-020-10162-1>

The Creation of an Accident Causation Model Specific to Agriculture

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Short abstract

Purpose | The development of evidence-informed industry-specific accident causation models can support the analysis and understanding of factors causing or contributing to safety incidents in specific industries. The dynamic relationship between the farmer, the farm environment, farm tools and equipment give rise to complex hazards present on Irish farms. Due to the uniqueness of the agricultural sector, current accident causation theories cannot be applied. This research presents a bespoke accident causation model titled the Irish Farm Accident Causation Model (IFACM), specifically tailored to Irish farms' needs which represents a pioneering approach to understanding and preventing accidents in the agricultural sector.

Design/Methodology/Approach | The accident causation factors within the IFACM were validated by means of a 3-round e-Delphi study using 17 international experts.

Findings | The IFACM is a theoretical and practical model of accident causation that arranges the causal factors into a graphic representation of originating, shaping and contributory factors that lead to accidents when unsafe acts and conditions are created that are not rectified by control measures.

Practical and theoretical implications | Ultimately, the IFACM serves as a powerful, dynamic tool that brings both theoretical insight and practical solutions to the forefront of farm safety. It bridges the gap between academic research and real-world application, ensuring that safety measures are not only based on evidence but also aligned with the unique needs and conditions of the Irish agricultural sector.

1. Purpose

Significant academic and professional efforts have been made to understand how and why accidents are caused. Understanding how and why accidents happen is integral to their prevention (Jia et al., 2024). By learning from accidents, accident prevention work can be more targeted towards what causes accidents, including the formulation of regulations, risk management, and training to specifically target these (Benner, 2019; Li et al., 2017).

The complexity surrounding accident events has made understanding how accidents occur problematic. For the last century, following the seminal work by Heinrich, (1941) there have been considerable efforts toward investigating accident causation, beginning with simplistic domino models that focus on individual behaviour as the precursor to accidents, developing into more complex models that consider the temporal dimension of accidents, moving to complex non-linear models that are grounded in understanding the system. This has resulted in the creation of several accident causation models, generally with the overall aim of providing tools for better industrial accident prevention. As researchers recognise the complexity of accident causation, more recent accident models have the characteristics of being complex and non-linear. Understanding accident causation is central to establishing effective defences and preventative mechanisms, ultimately with the ability to reduce accidents, injuries and fatalities.

Accident causation models attempt to explain how accidents occur and analyse their causes to prevent future accidents (Wu et al., 2024) and help those working within the safety field to analyse why accidents occur and how to prevent similar accidents in the future (Ge et al., 2022). Despite this, there is limited research in applying accident causation models to the field of agriculture. The unique management structure of Irish farms makes it difficult to apply traditional accident causation models that may be used in other industries like aviation or construction. The development of evidence-informed industry-specific accident causation models can support the analysis and understanding of factors causing or contributing to safety incidents in specific industries. This research has identified the need for an accident causation model that encompasses the complex sociotechnical systems that exist on farms.

2. Design

The next stage of research involved the testing and validation of the accident causation factors developed through a literature review. The factors were validated by means of a Delphi study. The Delphi method was chosen because of its emphasis on a focused group of experts in a specific area of interest. To validate the accident causation factors, the Delphi panellists were required to have extensive experience in their field of practice. A general overview of the Delphi study conducted is presented in Table 1 below.

Table 1: Summary of Basic Information about the Delphi Study

Type of Delphi Method	Modified e-Delphi
The term of the Delphi Study	April 2023 – December 2023
Scope of the Study	The research method was used to: (1) verify the list of accident causation factors as components of the Irish Farm Accident Causation Model (2) assess the layout, practicality and usefulness of the model
Number of Rounds	3
Panel Size	23 experts in Round 1, 22 experts in Round 2 and 17 experts in Round 3

The IFACM was validated using the modified electronic Delphi (e-Delphi) technique in which communication with experts and questionnaire design, delivery and administration were accomplished using the Internet. Version 1 of the IFACM was sent out to participants in April 2023 and the final version of the IFACM was confirmed in December 2023.

A literature review was carried out to create an exhaustive list of farm accident causes in Ireland. These accident causes were then developed into a graphical model called the IFACM (Version 1). Each accident causation factor was defined in the Farm Accident Causation Explanation Table. An e-Delphi was chosen as the preferred delivery method because it did not require the physical presence of participants, which would have been too time-consuming and cost-ineffective, affecting the feasibility of the study. This made it possible to use international experts. A deliberate approach was used to select a panel of experts because of the relatively small research field of farm safety, meaning that the pool of theorists to select from was limited, because of the depth and specificity of the required specialist knowledge. A modified e-Delphi methodology was chosen as it is a widely used systematic process for achieving consensus among a group of experts. It consisted of a series of three rounds that took place over a nine-month period. The Delphi study aimed to validate the IFACM, whereby validation was understood as examining the suitability, accuracy and the content of the model as well as obtaining confirmation that it is fit for its intended use.

3. Findings

To address the limitations of existing accident causation models, the IFACM was developed, a model specifically tailored to the agricultural context and aims to integrate both the individual and family-operating structure of farms. The IFACM is divided into sections, some of which are unique to agriculture and are outlined below.

- **Farm Site Factors** - The physical layout of a farm plays a significant role in accident causation. Factors such as the design and organisation of the farmyard, roadways, farm buildings and machinery storage areas directly impact the risk of accidents. The natural features of the farm site can also play a major role in causing accidents such as rivers or gradients.
- **Task Activity Factors** – The IFACM considers the diversity of hazardous tasks that farmers regularly undertake. Tasks such as working with slurry, electricity, chemicals and lone working each present unique risks and challenge, which contribute to a more robust understanding of the factors that lead to accidents on farms and the actual conditions faced by agricultural workers. By explicitly addressing these high-risk activities the model becomes a more powerful tool for understanding farm accidents and creating effective safety strategies.
- **Equipment Factors** - The design and availability of farming equipment are critical factors in accident causation. Poorly designed machinery that is difficult to operate or lacks safety features can increase the likelihood of accidents. The condition and maintenance of farming equipment are critical in reducing the risk of mechanical failures and are often a direct cause of accidents. Improper use or unsafe operation of equipment is one of the most common causes of farm accidents. The presence (or lack) of safety features on farm equipment is an essential factor in reducing the severity of accidents.
- **Worker and Human Factors** - One of the core distinctions of the IFACM is the way it conceptualises the farmer's role. As both the individual and the operator, the farmer is not simply a worker carrying out tasks but is involved in decision-making that influences both safety protocols and the overall culture of the farm. The model takes into account personal decision-making, culture of risk taking and control measures that impact safety on a small farm.

- **Safety Management Factors** – One of the key components of this model is the inclusion of safety management factors, which address the systems, procedures and organisational strategies employed to prevent accidents, manage risks and ensure the overall safety of farm workers and operators.
- **Shaping Factors** – In addition to contributing factors that occur directly prior to an accident, shaping factors are also included. There are contextual or broader elements that influence how safety risks are manifested and managed on farms.
- **Originating Factors** – these are structural or systemic perspective, setting the broader context in which farms operate. Although they may not be immediate triggers of farm accidents, they can create conditions that increase the likelihood of accidents occurring.

By considering these elements, many of which are specific to the agricultural sector, the IFACM provides a more holistic and realistic view of the factors influencing farm accidents, which is lacking in existing models. This model also allows for enables contextual understanding of farm accidents, moving away from one-size-fits-all solutions to a model that can be adapted to diverse farm types, sizes and locations. The final structure of the IFACM includes 49 accident causation factors.

4. Practical Implications and Theoretical Implications

In this research, the e-Delphi method was employed as an invaluable tool to validate the IFACM by utilising expert opinions to ensure that the model accurately represented the diverse and complex factors contributing to farm accidents in Ireland. In this study, the participants evaluated and confirmed 49 causes of farm accidents in Ireland through three rounds of the Delphi process. The findings emphasise the uniqueness of the IFACM due to the novelty of an accident causation model that is specific to agriculture and the poor accident statistics highlight the need for a thorough understanding of accident causes. It is hoped that this work will facilitate stakeholders in their efforts to reduce farm accidents, injuries and fatalities.

The IFACM is a versatile tool that can significantly contribute to improving farm safety in multiple ways:

1. The model has the potential to guide farm safety incident investigation. It can be used to as a structured approach to identify the contributory factors that surround a farm safety accident and trace these back through the shaping factors and originating factors that lie at the 'root cause'. This includes not only the immediate factors involved in the accident but also the broader, underlying influences that may have contributed to the event. The model may also provide a basis for the quantification and weighting of accident causation factors in the future using incident data, although this is outside the current scope of research. If incident data were systematically collected, the model could be used to rank causation factors based on their frequency and severity, which would further aid prioritisation of safety improvements.
2. It is intended that the model could be used to inform an analysis of risk factors that result in a farm accident. In this way, the model could be considered when planning agricultural tasks. By incorporating the IFACM into planned agricultural tasks, farmers can have a more structured approach to identifying potential hazards and assessing risks associated with various tasks. The model has the potential to improve the quality of risk identification and management, ensuring appropriate controls are identified for agricultural activities. By considering the broader factors that contribute to farm accidents, such as environmental conditions, human factors and machinery safety, the model helps to ensure that risk assessments are more holistic. This can improve the overall quality of risk management and help create more robust safety protocols.

3. Finally, the model has the potential to be used to develop safety interventions. The dynamic relationship between the farmer, farm environment, farm tools and equipment gives rise to complex hazards that are present on Irish farms. An understanding of these complex hazards and risk factors will allow for the creation of interventions to target these risks.

The IFACM represents a pioneering approach to farm accident causality that can significantly improve farm safety in Ireland and beyond. Its tailored, dynamic framework provides a clear, evidence-based pathway to risk identification, safety culture enhancement and more effective policymaking. As a practical tool for safety interventions, the IFACM helps farm owners, workers and policymakers make informed decisions that will lead to safer working environments. The model's application extends beyond agriculture, offering a blueprint for the creation of similar safety frameworks in other high-risk industries. Through its comprehensive and versatile approach, the IFACM is a vital contributor to the ongoing effort to reduce accidents and ensure the sustainability of farming and other high-risk industries for generations to come.

5. References

- Benner, L. (2019). Accident investigation data: Users' unrecognized challenges. *Safety Science*, 118, 309–315. <https://doi.org/10.1016/j.ssci.2019.05.021>
- Ge, J., Zhang, Y., Xu, K., Li, J., Yao, X., Wu, C., Li, S., Yan, F., Zhang, J., & Xu, Q. (2022). A new accident causation theory based on systems thinking and its systemic accident analysis method of work systems. *Process Safety and Environmental Protection*, 158, 644–660. <https://doi.org/10.1016/j.psep.2021.12.036>
- Heinrich, H. (1941). *Industrial Accident Prevention: A Scientific Approach*. https://books.google.co.uk/books/about/Industrial_Accident_Prevention.html?id=mPZAAAAIAAJ&redir_esc=y
- Jia, Q., Fu, G., Xie, X., Xue, Y., & Hu, S. (2024). Enhancing accident cause analysis through text classification and accident causation theory: A case study of coal mine gas explosion accidents. *Process Safety and Environmental Protection*, 185, 989–1002. <https://doi.org/10.1016/j.psep.2024.03.066>
- Li, W., Zhang, L., & Liang, W. (2017). An Accident Causation Analysis and Taxonomy (ACAT) model of complex industrial system from both system safety and control theory perspectives. *Safety Science*, 92, 94–103. <https://doi.org/10.1016/j.ssci.2016.10.001>
- Wu, B., Wang, J., Cai, H., Shen, Y., Qu, B., & Fu, Y. (2024). Research on the Analysis Method of Production Safety Accidents Based on Accident Event Causal Association Diagram. *Mining, Metallurgy and Exploration*. <https://doi.org/10.1007/s42461-024-01088-x>

TOPIC 5 – How education and advice drive agrifood systems transformations

Convenors: Artur Cristóvão; Hanna Tamsalu; Livia Madureira

Session 1E

FARMING ADVISORY & RURAL EXTENSION: SUPPORTING NEW TRENDS IN AGRICULTURE

Evolving Media Spotlight on Agriculture and its Influence on Farm Advisory Services. Trends and transformations in Irish newspapers since 1970

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Short abstract

This study examines agriculture as a media subject in Ireland across time and its relevance for farm advisory services. It analysed 2,805 articles published in Irish mainstream and farming newspapers between 1970 and 2019. Informed by communication theories, it broadly compared the frequency, prominence, topics, framing, sentiment, and sourcing reported in both media types to disclose how long-term changes in media attention to agricultural information may affect agricultural and non-agricultural audiences and trigger ripple effects for agricultural extensionists and communicators. We found evidence to suggest that mainstream reporting on agriculture reduced across time, with a slight revival of interest in the subject in 2019. We also found that mainstream newspapers shifted focus from economic and industry topics associated with agriculture to prioritising environmental, consumer, and political aspects of the subject. At the same time, farming newspapers stayed consistently focused on the sector's economic, production, and industry matters through the decades. While this study has limitations, the overall patterns suggest that mainstream newspapers lessened the frequency and broadened the scope of their agricultural reporting across time, while farming newspapers remained aligned to more traditional agricultural journalism. Theoretically, these diverse reporting approaches could present difficulties for public and farmer perceptions of the sector, and societal discussion on future farm and food policy directions—a looming challenge that agricultural extension experts would be wise to recognise, monitor, reflect on, and address appropriately.

1. Purpose

This presentation aims to examine the role of both mainstream and agricultural media in highlighting how agricultural educators and rural extensionists can lead communications on the transformation of agrifood systems. Taking Ireland as a case study, the presentation will explore the evolution of media attention to agriculture across different outlets over time, highlighting emerging gaps and identified challenges in coverage characteristics. In understanding how agri-related messages are shaped and communicated, this presentation will also explain what differing approaches to agricultural reporting can mean in terms of possible effects on agricultural and non-agricultural audiences (Cartmell & Evans, 2013; Evans & Salcedo, 1976; Frick et al., 1995; Strömberg & Snyder, 2008; Thomson & Kelvin, 1996). It will also propose ways for agricultural educators and rural extensionists to bridge

communication shortcomings, ensuring that all actors—both agricultural and non-agricultural—participate in a cohesive and constructive societal dialogue towards sustainable agricultural food systems. Furthermore, it will discuss future research pathways for improving agricultural communications from farm to fork which should be of interest to other countries or regions with significant agriculture sectors. It comes as there is limited research that compares how agriculture as a media subject is handled across different media types in Ireland, Europe, and indeed the United States where scholars have devoted far more research attention to the field of agricultural journalism and communications (Miller et al., 2020). This study and presentation aims to address that gap.

2. Methodology

Guided by communication theories, this presentation first draws on a mixed-methods content analysis of 2,805 articles published in leading Irish newspapers (both mainstream and farming) at six sample points between 1970 and 2019. This approach combines quantitative content measurements to identify overall coverage trends (frequency of coverage and presentation of coverage) with qualitative analysis also applied to reveal deeper content insights (topics, framing, sentiment, and sourcing). Similar methods have been used in previous studies examining newspaper data in relation to agenda-setting, quantity of coverage, and framing theories (Alföldi & Tutkun-Tikir, 2007; Mc Cormack & Wims, 2022; Semetko & Valkenburg, 2000; van Dooremalen & Uitermark, 2021). We quantified the data to provide scientific grounding on comparative patterns in the frequency and prominence of articles published between different outlets over the study period. We continued with a manual thematic analysis, as developed by Braun and Clarke (2006), to illustrate how newspaper reports dealt with topics that emerged from the dataset. This was followed by qualitative frame analysis to determine the list of frames, sources, and sentiment guided by the approach of Tankard Jr (2001). This study applied an early approach to quantitative and qualitative content analysis conducted through traditional human coding, because this method allows the coder to develop a strong ability to combine categories, achieve a better understanding of how to organise data, and greatly facilitates a deep emergence into the content.

We selected data from the highest-selling mainstream and agricultural newspapers in Ireland, namely, *Irish Independent*, *The Irish Times*, *Sunday Independent*, *The Irish Press*, *Evening Herald*, *Evening Echo*, the *Farming Independent*, and the *Irish Farmers Journal*. To ensure the capture of a broad and manageable dataset, we sought to collect articles from the first and second halves of each year under analysis (1970, 1980, 1990, 2000, 2010, 2019); therefore, January and July were selected. The criteria for article selection included reference to at least one of a detailed string of multiple keywords associated with agriculture and agri-food production. To add important rigor and transparency, this study developed a living codebook guided by Reyes et al. (2024) to reveal the decision-making and conceptualisation processes behind the study's coding frame, the primary instrument for data collection. The coding frame facilitated the recording of 28 items including: article number, year of publication, month of publication, date of publication, day of publication, title of newspaper, target audience, type of newspaper, page of publication, section of publication, type of article, word count, article placement, headline of the article, and lead of the article, news frame, headline sentiment, first source, type of journalist. Intercoder reliability tests were undertaken too. Random samples of articles were selected from the total dataset and shared with an independent coder who received basic training on the coding scheme, key terms, and definitions for variables. The independent coder's results

were compared with the lead author's codes and were repeatedly found to have consistent and unanimous levels of agreement. All content analysis data was initially recorded in Microsoft Excel before being imported to SPSS statistical software for deeper quantitative analysis.

Against the background of fast-evolving differences between mainstream and farming media coverage of agriculture as a subject, it appeared logical to supplement the content analysis with qualitative interviews from key informants involved in the academic field of agricultural journalism and communications to help gain further insights to inform and understand the phenomenon under investigation (Tremblay, 1957). Participants were purposively selected to provide a representative sample of researchers and educators of the specialised agricultural communications discipline (Bryman, 2012; Patton, 2015). The interviews began with an account of each informant's career, and their experience, research, and teaching in agricultural communications and journalism. Questions then focused on their assessment of the field, changes witnessed over time, the challenges posed, and their thoughts on future research directions. The interviews ranged from 45 to 70 minutes. Each interview was audio-recorded, transcribed verbatim, and imported into NVivo 10.0. Thematic analysis (Byrne, 2022; Clarke & Braun, 2017) was used to analyse the data to discover themes regarding the academics perceptions, opinions, and outlook for the role of agricultural journalism and communications research, key changes and challenges for agricultural communicators, and future research prospects for the field.

3. Findings

We found that mainstream newspapers published a larger number of articles relevant to agriculture during the earlier periods of analysis compared to the later stages examined, although a slight revival in coverage emerged in mainstream coverage in 2019. In comparison, we found that farming newspapers published fewer articles relevant to agriculture in the earlier periods of analysis and a larger number of articles during the later intervals. Figure 1 shows the contrast in the frequency of articles relevant to agriculture published by mainstream newspapers and farming newspapers during the timeline under analysis.

Figure 1: Frequency of total articles on agriculture in mainstream and farming newspapers 1970 to 2019 (n = 2,805)



Second, our results indicate that the prominence of agriculture as a media subject changed more substantially within the general pagination of mainstream newspapers—in terms of section of publication, article type, and page of publication—compared to farming newspapers over the timeframe. We also found evidence that the level of attention given to different agricultural topics changed more substantially in mainstream newspapers than in farming newspapers across time. The results suggest mainstream newspapers mainly prioritised traditional ‘Economic’ and ‘Industry’ topics relevant to agriculture in the early years of analysis but shifted attention to ‘Environment’, ‘Politics’, and ‘Consumer’ topics by 2019. Conversely, farming newspaper coverage continued to prioritise traditional ‘Economic’, ‘Industry’, and ‘Production’ topics over the timeframe, with less attention on ‘Environment’, ‘Politics’, and ‘Consumer’ matters. Additionally, the key informant interview findings illuminate strategies to overcome communication challenges and explore opportunities for engaging both agricultural and non-agricultural audiences from an education and research perspective, as the global farm and food sector advances toward more sustainable agricultural food systems.

4. Practical Implications

While this study is not without limitations, we contend that the contribution of the study in terms of providing a broad baseline perspective on the development of media reporting on agriculture in different media types across time in a country where agriculture remains a major industry surpasses these limitations. The findings outlined in this presentation raise awareness of differences in agricultural information being shared to agricultural and non-agricultural audiences and implies the need for agricultural extension professionals to be more strategic in communication approaches to farmers and the wider public now and into the future. The findings of the research can also guide practice in terms of encouraging agricultural educators and rural extensionists to build and enhance relationships with media organisations that engage both with farmers and the wider public on agricultural information.

5. Theoretical Implications

The findings may suggest that agricultural educators and rural extensionists need to adapt their communication strategies to play a more active role in agenda-setting. This could involve influencing both agricultural and non-agricultural audiences, as well as policymakers, to facilitate a successful transition toward transformative agri-food systems. Given the expanding interpersonal gap between agricultural and non-agricultural populations, and projected growth in media influence on society, these diverse journalistic approaches could be problematic for public perception, policy discussion, farmer decision-making, and extension efforts in progressing towards more sustainable agri-food systems. Media and agricultural organisations, agencies, and institutions must consider these differences to ensure a consistent approach to communication about agriculture because media effects are vital for the sector’s position in society and vital in influencing awareness and action on more sustainable agri-food systems. The results may also positively influence associated university-level curricula, degree, and research programmes that include agricultural communication and journalism components in Ireland, Europe, and the US, with respect to providing graduates with the necessary communication skills to keep the sector’s diverse audiences informed while maintaining public trust in the agricultural food system. Finally, we believe this study provides important precedent for similar research to be conducted in other countries where agriculture is a major industry and where the academic field of agricultural communications is not yet fully acknowledged or prioritised.

6. References

- Alföldi, T., & Tutkun-Tikir, A. (2007). Agriculture in the media - which issues are addressed and how are they represented? *Agrarforschung*, 14, 200-205.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Bryman, A. (2012). *Social research methods* (4th ed.). Oxford University Press. <https://go.exlibris.link/Nm3Jxz1z>
- Byrne, D. (2022). A worked example of Braun and Clarke's approach to reflexive thematic analysis. *Quality & quantity*, 56(3), 1391-1412. <https://doi.org/10.1007/s11135-021-01182-y>
- Cartmell, D. D., & Evans, J. F. (2013). Understanding Whence We Came: Role of the Association for Communication Excellence in the Development of Agricultural Communications during the Past Century - and Future Implications. *Journal of applied communications*, 97(2), 50. <https://doi.org/10.4148/1051-0834.1120>
- Clarke, V., & Braun, V. (2017). Thematic analysis. *The journal of positive psychology*, 12(3), 297-298.
- Evans, J. F., & Salcedo, R. N. (1976). Communications in Agriculture: The American Farm Press. *Journal of extension*, 14(3), 29. <https://go.exlibris.link/Yyg8DPns>
- Frick, M. J., Birkenholz, R. J., & Machtmes, K. (1995). Rural and urban adult knowledge and perceptions of agriculture. *Journal of agricultural education*, 36(2), 44. <https://go.exlibris.link/krwzqnLF>
- Mc Cormack, C., & Wims, P. (2022). Reporting on Vital Agricultural News in Ireland – a Comparison between Mainstream Print Media and the Farming Press. *Journal of applied communications*, 106(2), 1. <https://doi.org/10.4148/1051-0834.2422>
- Miller, J. D., Maples Bell, S., Rucker, J., Buck, E., & Parks, A. (2020). Introducing the Academic Discipline of Agricultural Communications to the United Kingdom. *Journal of applied communications*, 104(4), COV8. <https://doi.org/10.4148/1051-0834.2364>
- Patton, M. Q. (2015). *Qualitative research & evaluation methods: integrating theory and practice* (Fourth ed.). SAGE. <https://go.exlibris.link/XW8Bk1fm>
- Reyes, V., Bogumil, E., & Welch, L. E. (2024). The Living Codebook: Documenting the Process of Qualitative Data Analysis. *Sociological methods & research*, 53(1), 89-120. <https://doi.org/10.1177/0049124120986185>
- Semetko, H. A., & Valkenburg, P. M. (2000). Framing European politics: a content analysis of press and television news. *Journal of communication*, 50(2), 93-109. <https://doi.org/10.1111/j.1460-2466.2000.tb02843.x>
- Strömberg, D., & Snyder, J. J. M. (2008). The Media's Influence on Public Policy Decisions. In *Information and Public Choice*. World Bank Publications. <https://go.exlibris.link/V1Hjbt6n>
- Tankard Jr, J. W. (2001). The empirical approach to the study of media framing. In *Framing public life* (pp. 111-121). Routledge.
- Thomson, J. S., & Kelvin, R. E. (1996). Suburbanites' Perceptions About Agriculture: The Challenge for Media. *Journal of applied communications*, 80(3). <https://doi.org/10.4148/1051-0834.1339>
- Tremblay, M.-A. (1957). The Key Informant Technique: A Nonethnographic Application. *American Anthropologist*, 59(4), 688-701. <http://www.jstor.org.ucd.idm.oclc.org/stable/666104>
- van Dooremalen, T., & Uitermark, J. (2021). The framing of 9/11 in American, French, and Dutch national newspapers (2001–2015): An inductive approach to studying events. *International sociology*, 36(3), 464-488. <https://doi.org/10.1177/0268580920966829>

Supporting the implementation of an “alternative” agricultural project in the Basque Country, the role of agricultural education

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Short abstract

While the dominant model of industrial agriculture has failed to effectively address global food insecurity (FAO, 2022) and has contributed significantly to ecosystem degradation, an agroecological transition could help address challenges such as climate change, biodiversity loss and natural resource depletion. However, agricultural training systems are not necessarily aligned and advisory institutions cannot do everything. This is because the implementation of agroecological principles in agricultural system projects often faces several obstacles: the integration of farmers into the professional and social fabric and access to land and other (im)material resources.

Our objective is to better identify the individual, social and environmental factors that contribute to the sustainability of alternative agricultural projects in the Basque Country by 1) equipping individuals with technical skills and integrated socio-behavioural skills (or soft skills), 2) facilitating access to resources such as land, and 3) promoting the integration of newcomers into the professional and social fabric.

Our results highlight the importance of developing analyses that are more based on a systemic approach, where individuals are considered in all their human complexity and are seen as interacting and interdependent with individuals in their social environment and with the living and non-living entities that make up natural ecosystems.

1. Purpose

Since the second half of the 20th century, the industrialization of agriculture, driven by farm size growth, mechanization and specialization, has become the dominant model. This agricultural ‘modernization’, stemming from technological innovations in agricultural machinery, plant breeding and genetic selection, as well as agricultural chemicals, has led to a dramatic increase in yields. However, these practices have also contributed to the degradation of natural ecosystems: soil erosion and depletion, water pollution, loss of biodiversity and significant greenhouse gas (GHG) emissions (Foley et al., 2011; IPBES, 2019). According to the FAO (2021), current agricultural systems are responsible for more than a third of global GHG emissions, including deforestation linked to agricultural expansion, methane from livestock, and emissions from nitrogen fertilizers. This dominant agricultural model is now revealing profound limitations that threaten the sustainability of agricultural and food systems themselves (Duojiang et al., 2022).

An agroecological transition could help address challenges such as climate change adaptation and mitigation, the preservation of biodiversity and natural resources. Agroecology-based systems involve agricultural practices and value chains that harness the

ecological, economic, and social potentials of a territories.¹³ In other words, agroecology frames a radical overhaul of agricultural practices based on the principles of ecology, social justice and economic resilience. It thus stands in opposition to the dominant models of agriculture, described as ‘conventional’, ‘industrial’ or ‘productivist’ (Altieri, 1986, Scorsino et al., 2023; Deverre, 2011; Ansaloni and Fouilleux, 2006; Leméry, 2003) and thus constitutes an alternative path.

However, alternative forms of agriculture such as agroecological practices require the acquisition of skills (e.g., in biology and ecology) necessary for a better understanding of ecosystem dynamics than those required for the so-called conventional practices: ‘the diversity of work situations in agroecological practices involves complex cognitive activities that are not required by more conventional agricultural practices, or at least not to the same degree’ (Mayen, 2016). Training is therefore essential for acquiring these new skills, especially for farmers originating from a family without an agricultural background (NIMA) and wishing to retrain after a professional experience in another sector. In this context, the French agricultural education system offers a Professional Certificate in Farm Management (BPREA). The BPREA (Brevet Professionnel Responsable d'Entreprise Agricole) is the French Ministry of Agriculture's flagship training program for new rural dwellers wishing to take up farming.

Starting an agricultural business is similar to entering the job market. It starts at a point of departure – usually after graduation – and continues until a point of arrival is reached, when the individual subjectively considers itself to be stable in its professional activity (Vincens, 1997). This process can be approached through Amartya Sen's concept of capability, which he defines as the space of real freedoms to choose a life that one wishes to value. Thus, ‘a person's life can be seen as a combination of “modes of functioning” or “ways of acting”’ (Sen, 2009: 218). These modes of functioning correspond to the actual achievements, over the course of a lifetime, chosen by the individual from among all those that they are capable of achieving. The availability of resources does not necessarily imply their translation into modes of functioning. Several factors, which Sen defines as conversion factors, must be in place or exist for resources (goods or services) to be transformed into capabilities, i.e. into possibilities for action.

‘Capability theory approaches education from the perspective of the power that individuals have over their own lives, and is therefore the opposite of a theory of education-culture, which seeks to domesticate students and instill in them a specific set of norms and values. Indeed, this culture-based education reduces individuals' freedom of choice, which is the opposite of the objective of education (Callens, 2002).

He thus defines three types of conversion factors:

- individual factors, strictly personal characteristics such as age, genetic characteristics, and incorporated skills (technical but also socio-behavioural (Algan and Huillery, 2022))
- social factors that are part of the socio-cultural heritage linked to the environments in which the individual has evolved
- environmental factors, which correspond to geographical and institutional constraints/opportunities (normative and cultural context, etc.).

In this context, we wonder to what extent the learning environment (training centers, advisory services, peer groups) supports the start-up of alternative farms. The study was conducted in the Basque Country where one can find a unique institutional ecosystem characterized by the coexistence of organizations from the dominant model with institutionalized alternative organizations). The aim is to better identify the individual, social and environmental factors that contribute to the viability of alternative agricultural projects.

¹³ <http://dicoagroecologie.fr/encyclopedia/agroecologie/>

We assume that they contribute to the viability of agricultural projects by 1) equipping individuals with technical skills as well as embedded socio-behavioural skills (or soft skills), 2) facilitating access to resources such as land, and 3) promoting the integration of newcomers into the professional and social fabric.

2. Methodological approach

We used a qualitative methodology that allows to better consider the uniqueness of each individual's journey. The objective was to determine the socio-professional trajectories of Ostabat BPREA graduates, to assess the role of this training in the agricultural settlement project by evaluating the skills acquired to be operational in the field, as well as its shortcomings; and to explore alternatives to remedy these shortcomings. We also explored the links that these farmers have with support structures for setting up their business, and how these contribute to the success of their establishment in the short, medium and long term.

Two main sources were used to identify these profiles: the CFPPA in Ostabat, which acted as an intermediary to identify former graduates willing to participate in the survey, and our network of local actors, which facilitated our meetings at the markets in Saint-Palais and Mauléon.

In the end, we interviewed 12 learners, most of whom had recently settled in the Basque Country (8 men, 4 women) and were graduates of the CFPPA in Ostabat, with diverse profiles: most did not come from an agricultural background, with the exception of three who had taken over the family farm.

Semi-structured interviews lasting approximately one and a half hours were conducted in June 2024. These interviews allowed us to guide the conversation while giving the interviewees the freedom to express their ideas and experiences in depth (Combessie 2007). This method seems the most appropriate for our study since the interviewer is not limited to the questions asked, but can express themselves freely with answers that they can elaborate on and clarify. The interviews were recorded and then transcribed for analysis.

To better understand their meaning, the following questions were asked:

<ul style="list-style-type: none"> - What type of previous training did they receive and in what year? - Why did they change careers? - After obtaining the BPREA, did they take any additional training? - Were they satisfied with their training? - Did they receive any support in setting up their business? - Did they encounter any difficulties? 	<ul style="list-style-type: none"> - Are they involved in community organisations? - Do they feel integrated? - What strategy should be implemented to give their profession more credibility? - Do they feel fulfilled in their social and professional life? - Have they seen a return on their investment? - What obstacles have they encountered?
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3. Results

The Basque Country appears to be a special territory where the importance of culture is symbolized by the practice of the Basque language - belonging to the Basque people is achieved through the practice of the language. These specificities are also found at the level of agriculture: importance of the peasantry with small farms (nearly 2,900 farms representing 77% of the total farms in 2020)¹⁴, importance of livestock farming (3,180 farms

¹⁴ <https://zabal-agriculture.opendata-paysbasque.fr/pages/fermes-pays-basques/?flg=fr-fr>

had livestock in 2020, or 84% of farms in the Basque Country), particularly sheep which contribute to shaping the landscapes (1,912 farms in 2020 for 564,029 heads, or 60% of livestock farms).

Here is a summary of the profiles of the 12 interviewees:

Respondent	Specialisation	Academic background	Business model	Human resources	Objective	Level of integration	Profitability
1	Organic sheep farmer	Agricultural baccalaureate, state-recognised teaching qualification, specialised	Production of 60 sheep, direct sales to consumers	Her partner	Personal consumption, food self-sufficiency and sale of surplus	high	medium
2	Berries producer	Licence agricole, BP REA.	Production of berries and sorbets, sale at local markets, delivery to suppliers	Seasonal help	profitability, expansion of distribution,	Acceptable	good
3	Arborist	Mechanical engineer BP REA	Fruit production on 2 ha, direct sales and future plans for a shop		Diversification of income and promotion of local agriculture, development of eco-tourism	Acceptable	None, as the farm is not yet productive
4	Sheep farmer	BEP in agricultural production management in Saint Palais and BP REA	Production: Flock of more than 200 sheep, sale of organic cheese, small processing unit for sheep's cheese, sale to a network of suppliers		increased profitability and maintenance of family stability,	high	good
5	Fruit processor	DEUG in Sociology, Master's in Land Use Planning, DESS in Operational Urban Planning	Artisanal fruit jam with a small processing unit, direct sales and sales at local markets		Seeking profitability and good social integration	Acceptable	medium
6	Vegetable plant producer	Agricultural engineer (AgroParisTech)	Vegetable plants available year-round in a double greenhouse of	partners, employees, seasonal workers	Increased profitability, creation of social ties and regional recognition	high	Very good

			approximately 1,500 m ² . Direct sales and large-scale distribution to the Pau market				
7	Sarsi Ardia sheep farmer	BP REA, degree in business and development specialising in sports management	production of more than 250 sheep, direct sales and local markets		perpetuating the ancient Basque breed of Sarcy Ardia sheep	high	good
8	market gardener	BP REA. Master's degree in biology and plant technology in Bordeaux,	Market gardening		successful start-up project currently underway	acceptable	
9	Mechanic	Mechanical engineering, studies BP REA			Remains a mechanic as he was unable to access funding and land for his start-up project	acceptable.	
10	Layer hen and pigeon farmer	BTS in construction studies and economics BP REA	Short supply chain sales		to grow his business and strengthen his community involvement	high	Very good
11	Chilli pepper producer	BTS in production engineering BP REA	short supply chain sales		protect his farm, organic farming, contamination,	high	medium
12	market gardener	BTS in economics, BP REA	short circuit sales		grow his business, protect his farm, organic farming, contamination	low	low

We focus specifically on individual and social conversion factors. The results show that the BP REA provides a solid foundation of technical and entrepreneurial skills, but lacks relevance on agroecological issues. It should be noted that socio-behavioral skills, particularly those relating to perseverance and a sense of individual effectiveness, are crucial for setting up a business, which can be a long and difficult process. This is illustrated by respondent 9, who abandoned their project, and by a graduate who had to wait eight years to gain access to land. Although the effectiveness of learning organizations varies considerably from one

individual to another, they remain essential for skills development while contributing to the emergence of mutual support and social networks after graduation.

The practice of the Basque language – or lack thereof – can also appear to be a strong factor in conversion. However, the case of one of the non-Basque speakers who settled in the area and who preserves Basque heritage through his practice shows that it is more broadly the voluntary commitment to promoting Basque heritage (surveyed 7 with the production of Sarsi Ardia sheep) that has a very positive influence on social integration in this particular area.

Environmental conversion factors, including the soil and climate, play a major role for all farmers, and the institutional ecosystem, particularly in terms of start-up aid for young farmers, is crucial for successful establishment.

4. Practical implications

In terms of training systems, it is necessary to take greater account of the individual as a whole. Setting up in so-called alternative agriculture is a life project that requires the acquisition of technical and psychosocial skills – the ability to build and rely on networks for a successful establishment.

The BP REA could also evolve:

- Towards more modules related to agroecology – technical aspects
- Through the integration of more internship periods (ten weeks is not enough)
- Through the incorporation of a module on Basque culture and heritage
- With more dedication paid on behavioral skills (self-confidence, encouraging collaborative project work, if possible with local stakeholders to promote the creation of communities and mutual support networks, with the corollary that training should be as close as possible to the place of installation)

Strengthening synergies between training and support would also facilitate access to land and cultural integration (e.g. learning the Basque language), which remain real challenges.

5. Theoretical implications

The results underline the importance of developing analyses based more on a systems approach in which the individual is considered in all his human complexity. This complexity is based in particular on interactions and interdependencies with individuals in the social environment and with the living and non-living entities that make up natural ecosystems.

6. References

- Algan, Y., & Huillery, É. (2022). *Économie du savoir-être. Presses de Sciences Po.*
- Altieri, M. A. et Anderson, M. K. (1986). An ecological basis for the development of alternative agricultural systems for small farmers in the Third World (Une base écologique pour le développement de systèmes agricoles alternatifs pour les petits agriculteurs du tiers monde). *American Journal of Alternative Agriculture*, 1(1), 30-38.
- Ansaloni, M. et Fouilleux, E. (2006). Changement de pratiques agricoles. Acteurs et modalités d'hybridation technique des exploitations laitières bretonnes. *Économie rurale*, 292(2), 3-17.
- Barral, S., & Pinaud, S. (2017). Accès à la terre et reproduction de la profession agricole : Influence des circuits d'échange sur la transformation des modes de production. *Revue française de socio-économie*, (1), 77-99.
- Becker, G. 1964. Human capital : A theoretical and empirical analysis, with special reference to Education.
- Benet Rivière, J. (2024). Introduction : la place des savoirs agroécologiques dans l'enseignement agricole, entre avancées et obstacles. *Noroi*, n° 271(2), 7-23.

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- Lémery, B. (2003). Les agriculteurs dans la fabrique d'une nouvelle agriculture. *Sociologie du travail*, 45(1), 9-25.
- Bonnel, G. (2020). S'installer comme agriculteur bio sans hériter de terres. *Métropolitiques*
- Bonvin, J.-M. et Farvaque, N. (2007). L'accès à l'emploi au prisme des capacités, enjeux théoriques et méthodologiques. *Formation emploi*, 98(2), 9-22.
- Combessie, J. C. (2007). La méthode en sociologie. *La découverte*.
- Deverre, C. (2011). Agricultures alternatives et transformation des systèmes alimentaires. *Pour*, (5), 39-50.
- Mayen, P. (2016). Apprendre à produire autrement : quelques conséquences pour former à produire autrement. *Pour*, (4), 97-116.
- Sen, A. (2003). Un nouveau modèle économique Développement, justice, liberté. *Odile Jacob*
- Sen, A. (2009). 4ème édition. Ethique et économie. Quadrige. Grand Textes. Paris PUF
- Vincens, J. (1997). L'insertion professionnelle des jeunes. À la recherche d'une définition conventionnelle. *Formation emploi*, 60(1), 21-36.
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How Do Advisory Services Translate into Improved Performance and Impact of Short Food Supply Chains? An Analysis of “Golden Cases” identified in the COREnet project

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Short abstract

Short Food Supply Chains (SFSCs) are gaining traction as pathways to more sustainable and resilient food systems. However, their expansion is often hindered by knowledge gaps and the limitations of conventional advisory services. The Horizon Europe COREnet project addresses this challenge by investigating how advisory services influence SFSC performance and impact through a novel “Golden case” methodology. This paper presents a comparative analysis of three Golden Cases from Poland, the Netherlands, and Sweden, applying the Nonaka and Takeuchi knowledge conversion model to examine the mobilisation of tacit and explicit knowledge. The findings underscore the evolving role of advisors—from technical experts to facilitators of peer learning, knowledge brokers, and co-creators of innovation ecosystems. SFSC advising is portrayed as a dynamic, iterative process involving multiple actors and knowledge flows, rather than a one-way transfer of information. The link between advisory activities and SFSC performance and impact is non-linear. The Golden Case approach is not a means of showcasing best practices, but a practical framework for generating reflective practice and peer learning. These insights call for a rethinking of policies for advisory training and support systems, to better prepare advisors for their expanded roles within knowledge ecosystems.

1. Purpose

Short Food Supply Chains (SFSCs) are growing in popularity globally, particularly within the EU, where they are promoted by governments and civil society as a means of building more inclusive, resilient, and sustainable food systems (Enthoven and Van den Broeck, 2021). Yet despite these developments, SFSCs remain marginal within the food system as a whole. A key barrier to scaling SFSCs lies in farmers' knowledge gaps across all phases—from farm to fork—and in the disconnection between production and marketing, which are often treated as separate domains. Consequently, SFSC farmers and entrepreneurs cannot rely on traditional agricultural advisory systems that focus solely on production, nor on technical institutes or accounting advisors that address steps in the food value chain in isolation. This highlights the need to more clearly define the types of advisory and support services required for the development and scaling of SFSCs.

The COREnet project aims to better understand the relationship between advisory services and improved SFSC performance and impact. The assumption is that shared experiences and mutual learning drive the innovation essential for improving SFSC performance and impact. Acknowledging that the relationship between advising and SFSC operations is non-linear and context-dependent, the project has developed a “Golden Case” approach. This involves identifying various types of operational SFSCs across Europe to explore how advisory services influence performance within specific contexts.

One of COREnet's central assumptions is that formal or explicit knowledge alone is insufficient to bring about significant improvement in SFSC performance and impact. This view builds on earlier findings, such as those from the SKIN project (n.d.), which highlighted the importance of informal or tacit knowledge relating to e.g., farming practices, market insight, and collaboration. This recognition led to an interest in how tacit and explicit knowledge are converted and interrelated, and to the adoption of Nonaka and Takeuchi's (1995) knowledge conversion framework. This paper aims to explore how the Golden Case approach and the Knowledge Conversion framework can deepen understanding of the relationship between advisory services and SFSC development. It is structured around two questions:

1. How is the Golden Case approach applied in COREnet?
2. What is the relevance and what are the implications of applying the Knowledge Conversion framework to the Golden Cases, in the context of SFSC advising?

The following sections present initial findings from analyses of Golden Cases in three countries and discuss their implications for SFSC advisory services.

2. Design

In seeking nominations for Golden Cases, COREnet aimed to identify cases that could generate valuable insights into SFSC advising, particularly with regard to accessing informal or tacit knowledge (Serafin et al., 2023). The intent was to compile a Golden Case portfolio as a set of learning resources, to understand the relationship between advising and impact, rather than collecting exemplary cases or “best practices.” To support case selection, ten criteria were developed and used to identify Golden Cases (Serafin et al., 2023). These criteria served as reference points for comparing different types of SFSCs tied to diverse advisory regimes across borders. The ten criteria included, for example, that the SFSC is market-oriented and can be sustained—that is, operating in accordance with a business model that seeks to generate a financial surplus by covering costs from revenues.

In the Knowledge Conversion framework (Nonaka and Takeuchi, 1995), knowledge is built by successive transformations between explicit and tacit forms of knowledge (see Figure 1).

According to this model, the key to understanding the relationship between advising and SFSC performance lies in appreciating the dynamics of knowledge conversion in each Golden Case, and recognizing that different forms of tacit and explicit knowledge are active in different contexts. The framework provides a useful lens for analysing the roles of SFSC advisors and advisory services as part of an ongoing knowledge conversion process.

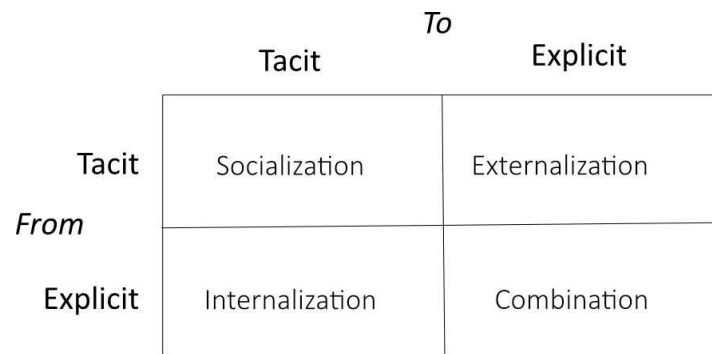


Figure 1: The Knowledge Conversion Model by Nonaka and Takeuchi (1995, p. 72)

For the purpose of this extended abstract, three Golden Cases were analysed using the Knowledge Conversion framework and the ten criteria as reference points:

1. A network of four SFSCs in *Poland*, which organises producers and consumers in specific geographical areas through an IT-enabled local market for locally produced, processed, and unprocessed food.
2. A mobile cheese-making facility in *the Netherlands*, where cheese is produced directly on the dairy farm using milk supplied by the farmer. This enables dairy farmers to sell their cheese directly to consumers without investing capital and time in cheese-making themselves.
3. An initiative in *Sweden* that supports farmers and food entrepreneurs in developing plant-based beverages by providing access to processing equipment and advisory services.

Data were collected through review of the Golden Case nomination forms and interviewing the nominators (COREnet partners) to gain deeper knowledge of each case. This data provided a basis for comparative analysis across the three cases, conducted during two online workshops focused on identifying similarities and differences in knowledge conversion processes. A narrative approach was employed, consistent with the view that complex insights can be derived from case-based experiences (Flyvbjerg, 2006).

3. Findings

Q1: How is the Golden Case approach applied in COREnet? The Golden Case approach provided an empirical basis for posing common questions across diverse situations, treating each case as a narrative—unfinished, evolving, and continuously retold. By interrogating each case with new questions and tentative answers, the approach created opportunities to reframe the SFSC narrative and engage participants in COREnet’s broader ambition of networking SFSC advisors across Europe. Rather than selecting exemplary or ideal cases, the approach prioritise cases that offer insights into how the dynamics of advising and knowledge exchange translate into SFSC impact across different contexts. This enabled a comparative, cross-contextual analysis that respects local specificities while identifying transferable principles. For example, we compared the types of advising and support provided in each case, the nature and mechanisms of performance improvements, and the

impacts on the SFSC ecosystem, stakeholder engagement, sustainability, and replicability. While the comparative analysis illustrated how advising practices differ across SFSC contexts, it also revealed that such comparisons alone are insufficient for gaining a deeper understanding of the complex relationship between advising, performance, and impact.

Q2: What are the relevance and implications of applying the Knowledge Conversion framework to the Golden Cases, for SFSC advising? Applying the Knowledge Conversion framework highlighted that SFSC advising is not merely about transmitting information. Instead, it involves actively facilitating the transformation of knowledge, treating the SFSC as a co-created knowledge ecosystem, as illustrated in the three cases.

In the *Polish* case, the digital ecosystem framed a model of advising in which all actors operate as peers. Advisors facilitated the externalization of farmers' tacit knowledge into explicit protocols embedded in an IT platform, and vice versa—translating these protocols back into practical applications. This iterative conversion process enhanced operational efficiency and scalability. Farmers' feedback directly informed platform design, ensuring alignment with real-world needs. This example illustrates how **advisors play a crucial role in translating tacit knowledge into shareable, explicit formats** that support SFSC scaling.

In the *Dutch* case, the advisor helped surface and challenge limiting tacit assumptions about pricing, enabling the development of a more sustainable business model. A formal training and mentoring program supported this tacit–explicit–tacit knowledge cycle. The advisor helped the mobile cheesemaker articulate an implicit belief—that farmers would not accept a price increase—and facilitated a process of collective problem-solving by organizing a meeting with farmers. This intervention made it possible to scrutinize and revise the pricing strategy. Thus, the **advisor facilitated the explication of tacit beliefs that can be discussed and questioned**. Across all three cases, advisors were found to play a central role in supporting business model clarity and improvement.

The *Swedish* case portrayed the advisor not only as a technical and organisational expert, but also as a professional knowledge broker. The advisor facilitated access to a network of specialists, enabling **the combination of diverse forms of explicit knowledge** to support innovation. This capacity to mobilize explicit knowledge from various domains benefited both farmers and advisors by reinforcing the credibility and depth of the advisory process. The case exemplifies the advisor's role in creating and maintaining knowledge networks, a theme echoed in the Polish and Dutch cases as well.

4. Practical Implications

The Golden Case approach was developed to explore the complex and context-dependent relationship between advisory services and the performance and impact of SFSCs. The Knowledge Conversion model provided a framework for tracing how knowledge—both tacit and explicit—is mobilised, transformed, and shared within SFSCs. By emphasising learning resources over best practices, the approach supported reflective practice, peer-to-peer learning, and policy development.

The findings underscore the evolving role of advisors—from technical experts to facilitators of knowledge conversion and innovation. At the same time, farmers and other actors are increasingly becoming active participants in advisory processes. Advisors coming from tacit knowledge contexts (e.g., farmers, consumers) and those from formal knowledge domains (e.g., consultants, public service advisors, academics) must become adept at navigating the

tacit–explicit knowledge interface. They must support one another in articulating, validating, and applying experiential and codified knowledge.

This also requires a mutual recognition of value: those grounded in formal knowledge must appreciate that informal or tacit knowledge is not inferior, but different; and those operating informally must likewise recognize the contribution of formal, codified knowledge. The role of the advisor or support service often involves facilitating the explication, examination, improvement, or enabling of practices across each of the ten criteria.

Furthermore, advising should be understood as a dynamic, iterative process involving multiple actors and knowledge flows, rather than as a one-way transfer of information. It is a dynamic and evolving process. The link between advising activities and SFSC performance and impact is non-linear. These insights call for a rethinking of policies for advisory training and support systems, to better prepare advisors for their expanded roles within knowledge ecosystems.

5. Theoretical Implications

An emerging insight from applying the Knowledge Conversion model is that it illuminates some often-overlooked dynamics within SFSCs. For example, farmers and small-scale food producers typically possess substantial informal, tacit knowledge related to their production processes and artisanal practices. Establishing an SFSC often requires transforming this tacit knowledge into more concrete, explicit forms—such as written documentation or software code. This translation process is demanding and often undervalued, but it is something a skilled advisor can recognize and support effectively. This highlights the value of theoretical frameworks in analysing the effects of advisory services on SFSCs; they can bring new understanding and fresh perspectives on familiar cases.

The COREnet project will enable the examination of additional Golden Cases, facilitating a more nuanced understanding of the links between advisory services, SFSC performance and impact within their specific contexts. Sharing and reflecting on these insights are not only outcomes of the process but also a basis for peer-to-peer learning and mutual support systems. These systems can foster mutual benefits for both SFSC initiatives and those who advise them.

Acknowledgement

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6. References

- Enthoven, L., and Van den Broeck, G. (2021). Local food systems: Reviewing two decades of research. *Agricultural Systems*, 193, 103226. <https://doi.org/10.1016/j.agsy.2021.103226>
- Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative Inquiry*, 12(2), 219–245. <https://doi.org/10.1177/1077800405284363>
- Nonaka, I., and Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford University Press.
- Serafin, R., Gorlich, K., Gwynne, B., Serafin, M. (2023) COREnet handbook & SFSC evaluation form. COREnet Deliverable 3.1. Available at <https://shortfoodchain.eu/general-resources/>
- SKIN project (n.d.). *SKIN Good practices collection*. Available at: <https://shortfoodchain.eu/wp-content/uploads/2023/03/SKIN-good-practices-collection.pdf>

A new dynamics in extension privatisation: exploring “linked suppliers” in Australia and Europe

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Short abstract

The aim of this communication is to feed the academic debate on extension privatization with novel empirical data. Our research is grounded on the idea that the main trend in the economics of extension services could be associated with the growing importance of “linked” advisory providers. By linked advice, we understand organisations that provide professional advisory services jointly with other commercial activities with farmers, e.g. trading inputs or machinery. This paper provides a comparison of two samples derived from original surveys with advisory organisations, one in Europe (n=240) and one in Australia (n=365). Our data enable to understand a mechanism by which linked suppliers are gaining traction with farmers. In both contexts, it appears that linked suppliers offer services with a same level of interactions with farmers than independent advisors (in Europe), or even a higher degree of personalisation (in Australia). This investments in the personalisation of advice could be the basis of the settlement of trusted relations between farmers and linked advisors. This potential substitution of independent suppliers by linked ones is not without consequences at the scale of Agricultural Knowledge and Innovation Systems (AKIS). Linked suppliers appear to be disconnected from public research in both contexts. Hence, the development of linked advice could lead to a form of segmentation within AKIS.

1. Purpose

The aim of this communication is to feed the academic debate on extension privatization with novel empirical data. Our research is grounded on the idea that the main trend in the economics of extension services could be associated with the growing importance of “linked” advisory providers (Sutherland et Labarthe 2022). These actors have been largely overlooked by former studies on the pluralism of farm advice based on surveys of suppliers (Prager et al. 2016, Knierim et al. 2017). However, few researches, based on surveys about farmers’ actual sources of services, reveal the importance of linked advisors (Kvam et al. 2022, Madureira et al. 2022, Paulus et al. 2024), and the effects they may have on the content of advice and on farmers’ decisions regarding sustainability issues (Boulestreau et al. 2021, Jin et al. 2022, Wuepper et al. 2021). However, little is actually known about the nature of services delivered by “linked” advisors. This communication aims to fill this knowledge gap by providing a quantitative analysis of the features of advice provided by “linked” and “independent” advisors in Australia and Europe.

2. Design

In this research, we have defined independent advice in contrast with “linked advice”. By linked advice, we understand organisations that provide professional advisory services jointly with other commercial activities with farmers: selling inputs to farmers (seeds, fertilisers, pesticides, etc.), selling machinery to farmers, purchasing and trading farms’ commodities (cereals, milk, fruits, etc.), or providing services to farmers on a commercial

basis (bookkeeping, insurance, etc.). In contrast, we refer as “independent” all organisation that provide only advisory services without being linked to farmers through any other form of commercial interest. This includes the traditional actors of advisory landscape, including historical public extension organisations or more recent private consultants that sell only advice for a fee to farmers.

Linked advisors are of course not new in farmers’ environment. What might be new is the extent to which such organisations actually provide extension services to farmers, and the modalities of provision of these services. We built on two recent streams of literature: a first one that documents farmers’ sources of advice and knowledge (Madureira et al. 2022, Laurent et al. 2022, Kvam et al. 2022, Zarokosta et Koutsouris 2022, Nettle et al. 2022, Coffré-Bravo et al. 2019); a second one that documents the differences between various types of suppliers of services (Prager et al. 2016, Knierim et al. 2017). Based on this literature, we draw three hypotheses on the dynamics and effects of linked suppliers on the provision of farm advice.

H1 – The importance of linked suppliers relates to their capacity to build trust with farmers by investing in face-to-face and personal relations

Recent empirical investigations in Europe have shown that “linked suppliers” seem to be a major source of advice for farmers in many contexts and innovation areas (Madureira et al. 2022). Farmers’ choices for advisory sources is a complex issue, where trust is a main factor. Sutherland et al. (2012) show that trust relates both to farmers’ perspectives on the organisation that provides advice (that relates to opinion on government, on regulation, on the impartiality of suppliers) but also to their perceptions on individual advisors (that relates to their experience, belonging to same social groups, etc.). Our proposition here is that this trust is also built on the supply side. It is dependant on the resources allocated by different suppliers to engage directly in relations with farmers and personalise advice for them and with them. Hence our hypothesis is that the importance of linked suppliers in the advisory landscape could be linked to the fact that these organisations now provide services with the same methods and levels of interactions than independent suppliers. To do so, we compared the “front-office” features of advisory services of linked and independent suppliers of advice.

H2 – Linked advisors increase a form of disconnection within AKIS between private extension services and public actors of research and higher education

Former quantitative studies have already shown a form of disconnection between private extension and public research (Prager et al. 2016, Knierim et al. 2017). However, these studies have focused on independent advisors only, and have demonstrated that private consultancy cabinets are less connected to public research than other forms of independent advice. This is often due to the small size and limited back-office resources of agricultural consultancy cabinets. Qualitative researches have confirmed that private consultants have specific networks and strategies to update their knowledge (Klerkx and Proctor 2013, Knuth and Knierim 2023). Our hypothesis is that such findings could also be true for linked suppliers of advice, even though there are very few evidences about the actual resources, strategies and networks of linked suppliers. To fill this gap, we compare the “back-office” features of advisory services of linked versus independent suppliers of advice.

H3 – The importance of linked suppliers could induce new gaps in extension policies aiming at supporting a sustainable development of agriculture

Advisory services are more and more expected to contribute to the three dimensions, social, economic and environmental, of a more sustainable development in agriculture. This relates

to debates about which providers should be considered or integrated in public policies to support sustainability objectives. These debates are particularly strong in Europe, where article 13 of the current Common Agricultural Policy (CAP) specifically states that advisory services suppliers should be “impartial” and “independent” to benefit from European subsidies. In France, the legislation goes one step further and forbids pesticides dealers to provide farmers advice on pesticide use. Such regulation seems to be supported by some empirical evidence that showed that farmers who rely more on linked advisors would be less incline to explore and adopt environmentally friendly solutions (Wueppert et al. 2022). However, the effects of such measures are still uncertain and debated among experts (Labarthe and Sutherland 2022). To test this hypothesis, we compared the theme, content and approach of advice provided by linked versus independent suppliers of advice, as well as their integration in policy frameworks.

Sample and tests

This paper provides a comparison of two samples derived from two original surveys with advisory organisations, one in Europe (n=240) and one in Australia (n=365). Our methodology then consisted in comparing the independent and linked advisors in the two contexts on a series of variables that enable to answer to the three hypotheses formulated above. Our analysis is based on a simple statistical analysis to compare the distribution of answer in each context, by the mean of Chi-square tests. We considered that there is a significant difference between the distribution of answers of independent and linked advisers when the p-value of the Pearson’s Chi-square test is lower than 5%. We then performed a Post-Hoc Chi-square test, which enable to understand which interval of the distribution is significant in the differences, using the same threshold for the p-value.

3. Findings

The comparison between Europe and Australia reveals a same trend about how linked providers are transforming farm advice. Before answering to the three research hypotheses formulated above, we compared the profiles of advisors. In both contexts, independent organisations tend to have advisors with higher education degree. In Australia, independent organisations tend to have more experienced advisors whereas no significative differences could be found in Europe in that respect.

Hypothesis H1 – The importance of linked suppliers relates to their capacity to build trust with farmers by investing in face-to-face and personal relations

Our different tests tend to confirm our hypothesis H1. A first striking result stems in the level of personalisation of the services supplied by linked advisors. We found no significant differences in Europe in terms of size of advisors’ clients portfolio between linked and independent advisors. In Australia, there is a significant difference: independent advisors work less personally with farmers and linked advisors work more with intermediate numbers of farmers in their clients’ portfolio. Still in Australia, there is significant difference in the intensity of services proposed by linked versus independent advisors: linked advisors display more visits to farmers than independent ones. In terms of methods chosen by advisors to interact with farmers, no significant difference could be found in Europe. In Australia, linked advisors used more one-to-one advice than independent who provide advice based on farmers’ groups. In total, it appears that in Europe, no significant difference can be found in the front-office features of linked advisors versus independent ones. In Australia, the situation is even more advanced: linked suppliers tend to offer more personalised advice than independent suppliers. Linked suppliers invest in advisory services with the same (or

even higher) degree of personalisation in front-office. This dynamic could increase their trusted relations with farmers.

Hypothesis H2 – Linked advisors increase a form of disconnexion within AKIS between private extension services and public actors of research and higher education

Our different tests regarding the back-office dimension of services tend to confirm our hypothesis H2. We found significant differences between independent and linked advisors, at different levels. These differences are less differences in levels of investments in back-office (e.g. no significant differences in the share of human resources dedicated to back-office could be identified in Europe between linked and independent organisations) than differences in the sources of knowledge and training mobilised.

Only one variable was collected with similar questions in the two contexts. It deals with the main sources of knowledge of the advisors. The results are very similar in both contexts and highlight different sources between independent and linked advisors. In both contexts, linked advisors have almost no relations with public research, universities or public authorities. In Europe, they are connected to downstream industries. In the European survey, we also collected information about how advisors are trained. Here again, we found no significant difference in the amount of training followed by linked versus independent advisors in Europe. However, there are significative differences in the sources of training in Europe. Independent advisors are more trained by public research institutes, universities and NGOs whereas linked ones are more trained by upstream and downstream industries. In Australia, some questions were dedicated to understand the nature of engagement of advisors with research. Significant differences between independent and linked advisors could also be found at two levels: advisors contributing to setting research agenda or to translating research for farmers. For both levels, we evidenced less engagement of linked advisors vis-à-vis independent. In total, we evidence strong and clear differences in the back-office of linked versus independent advisors: linked advisors are not connected or engaged with public research and university but rather with upstream or downstream industries.

H3 – The importance of linked suppliers could induce new gaps in extension policies aiming at supporting a sustainable development of agriculture

In both contexts, we evidence a strong difference in the relative contributions (or potential contributions) of linked versus independent advice to sustainability. Various researches or political documents have highlighted the need for farm advice to embrace more holistic approaches that enable to support farmers implementing broader changes of their production systems and account for the various dimensions of sustainability. In that respect, the results of the survey in Australia reveals that only independent suppliers provide advisory services that deal with topics such as whole farm management, rural community, environment and natural resources, etc. In the European survey, our results confirm that only independent advisors are accredited by the government in the frame of Common Agricultural Policy (Farm Advisory Systems targeted to sustainable development).

4. Implications

Our data enable to understand a mechanism by which linked suppliers are gaining traction with farmers. In both contexts, it appears that linked suppliers offer services with a same level of interactions with farmers than independent advisors (in Europe), or even a higher degree of personalisation (in Australia). This investments in the personalisation of advice could be the basis of the settlement of trusted relations between farmers and linked advisors. This potential substitution of independent suppliers by linked ones is not without

consequences when we zoom out at the scale of Agricultural Knowledge and Innovation Systems (AKIS). Linked suppliers appear to be disconnected from public research in both contexts. Hence, the development of linked advice could lead to a form of segmentation within AKIS: public research work mostly with independent advisors while linked advisors cooperate with industries. Such a situation could reduce the impact of public research within AKIS. Furthermore, we can question whether this situation is visible or not to public policies, which hardly engage in any form of regulation of the services provided by linked suppliers.

5. References

- Boulestreau, Y., Casagrande, M., & Navarrete, M. (2021). Analyzing barriers and levers for practice change: a new framework applied to vegetables' soil pest management. *Agronomy for Sustainable Development*, 41(3), 44.
- Jin, S., Li, W., Cao, Y., Jones, G., Chen, J., Li, Z., ... & Frewer, L. J. (2022). Identifying barriers to sustainable apple production: A stakeholder perspective. *Journal of environmental management*, 302, 114082.
- Knierim, A., Labarthe, P., Laurent, C., Prager, K., Kania, J., Madureira, L., & Ndah, T. H. (2017). Pluralism of agricultural advisory service providers—Facts and insights from Europe. *Journal of rural studies*, 55, 45-58.
- Kvam, G. T., Hårstad, R. M. B., & Stræte, E. P. (2022). The role of farmers' microAKIS at different stages of uptake of digital technology. *The Journal of Agricultural Education and Extension*, 28(5), 671-688.
- Madureira, L., Labarthe, P., Marques, C. S., & Santos, G. (2022). Exploring microAKIS: farmer-centric evidence on the role of advice in agricultural innovation in Europe. *The Journal of Agricultural Education and Extension*, 28(5), 549-575.
- Paulus, M., Herrera, B., & Knierim, A. (2024). Who do German farmers trust when making decisions about digital technologies? An analysis of the trustworthiness of innovation actors. *Studies in Agricultural Economics*, 126(3).
- Prager, K., Labarthe, P., Caggiano, M., & Lorenzo-Arribas, A. (2016). How does commercialisation impact on the provision of farm advisory services? Evidence from Belgium, Italy, Ireland and the UK. *Land Use Policy*, 52, 329-344.
- Sutherland, L. A., & Labarthe, P. (2022). Should 'Impartial' Advice be a Priority of European Agricultural and Rural Policies?. *EuroChoices*, 21(1), 15-22.
- Wuepper, D., Roleff, N., & Finger, R. (2021). Does it matter who advises farmers? Pest management choices with public and private extension. *Food Policy*, 99, 101995.

Agricultural advisors' perceptions of the "good farmer" and their role in promoting biodiversity-friendly farming

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Short abstract

While advisors are increasingly recognised as key actors in agri-environmental policy implementation, their values and perceptions remain under-examined. This study addresses this gap by exploring how agricultural advisors perceive the figure of the "good farmer" and

how these perceptions shape their engagement with biodiversity conservation. Drawing on 20 in-depth interviews with Slovenian public advisors, the findings reveal that advisors predominantly associate the “good farmer” with food production, care for cultivated land, financial stability, and preserving the farm for future generations. These views reflect advisors’ deep embeddedness in farming communities and contribute to their credibility in advisory relationships. However, this closeness also limits their capacity to promote biodiversity-friendly practices, especially when conservation goals conflict with farmers’ realities and prevailing agricultural norms. Advisors often adopt pragmatic strategies, emphasising financial benefits and measures that require minimal change. Despite these constraints, the study identifies entry points for change, particularly among advisors with greater exposure to conservation topics through formal education or collaborative project work. By examining these dynamics in the Slovenian context—a post-socialist country with a strong public advisory service and small-scale farm structure—this research offers new insights into the sociocultural and institutional conditions shaping sustainability transitions within the advisory field.

1. Purpose

Agricultural advisors are increasingly expected to facilitate sustainability transitions in farming by promoting biodiversity-friendly practices and supporting the implementation of agri-environmental measures (Pe’er et al., 2022; Clement et al., 2024). While a growing body of literature has examined farmers’ values and behaviours concerning these practices and policies (e.g. R. J. F. Burton, 2004; Riley, 2016; Westerink et al., 2024), advisors’ cultural perspectives, professional norms, and practical constraints remain under-researched. Limited attention has also been paid to how their perceptions influence how they interpret, communicate, and enact nature conservation goals in everyday advisory work (Herrera et al., 2019; Ingram & Mills, 2019). This gap is especially relevant in Central and Eastern European contexts, where advisory systems have developed along different historical and institutional trajectories compared to their Western European counterparts (Farkas & Kovács, 2021; Knierim et al., 2017). Slovenia thus provides a unique case: it has a strong, centralised public advisory system, a predominantly small-scale farming structure, and a post-socialist policy environment shaped by both EU-level greening and deeply rooted agricultural traditions (Hočevár & Slovenc Grasselli, 2023; Slovenc Grasselli, 2019). To address these gaps, the study investigates farming values and cultural norms held by Slovenian agricultural advisors by using the “good farmer” concept to understand how these perceptions influence their engagement with biodiversity conservation.

2. Methodology

This study builds on the concept of the “good farmer”, grounded in Bourdieu’s theory of habitus, capital, and field (Bourdieu, 1984). The concept refers to a culturally constructed figure whose traits, behaviours, and symbols reflect what is considered legitimate and desirable within a given farming community (R. Burton et al., 2020). In this study, it serves as an entry point for examining the values and professional identities of agricultural advisors and how these shape their engagement with biodiversity conservation.

Empirically, the research is based on 20 in-depth interviews with public agricultural advisors employed by the Slovenian Chamber of Agriculture and Forestry. Participants were selected to reflect diversity in regional contexts, advisory specialisations, and years of experience. Interviews were conducted in 2024 and analysed thematically using Atlas.ti. The coding process was informed by the interview guide and followed Saldana’s (2015) approach, combining inductive and deductive strategies to explore both explicit narratives and

underlying symbolic associations related to the “good farmer” and biodiversity-friendly farming.

3. Findings

Interviewed advisors largely defined the “good farmer” through a set of traditional farming values and symbols embedded in a productivist paradigm. Across interviews, the most frequently mentioned characteristics included focus on food production, responsible land management, long-term financial stability, and the preservation of the farm for future generations. In contrast to some findings from Western Europe (e.g., Sutherland, 2013; Westerink et al., 2021), Slovenian advisors placed particular emphasis on intergenerational continuity and the relational dimension of farming. Many advisors regarded harmonious family relationships and the presence of a successor as integral to successful farming. These elements were not merely seen as personal achievements but as symbolic indicators of long-term farm viability and responsible farm management. Interviewees also highlighted visual aspects of farming, such as well-maintained fields or neat farmyards, as signals of care and professionalism, echoing Burton’s (2004) concept of “roadside farming”.

Most advisors expressed a strong emotional connection to nature, often rooted in their personal histories and daily experiences with the land. However, their understanding of it was typically framed through its agricultural utility. Nature was described as something to be managed and cared for, often to sustain soil quality, ensure productive grasslands, or aesthetic values of the landscape. Biodiversity was rarely valued for its intrinsic properties. Instead, it was appreciated when directly linked to farm productivity or landscape aesthetics and appreciated when it served functions compatible with farming (e.g., pest control, pollination).

Nature conservation and agri-environmental measures (AEM) were widely recognised as part of advisors’ responsibilities, especially given the increasing emphasis on environmental compliance in CAP-related advisory work. Yet, advisors frequently described these obligations as administratively burdensome and disconnected from farming realities. Many felt that the top-down design and implementation of AEM failed to consider local contexts or farmers’ knowledge, making it difficult to justify to clients. In their advisory practice, most advisors adopted pragmatic strategies. Rather than persuading farmers of the ecological importance of biodiversity, they promoted AEM by highlighting financial benefits and identifying those that aligned with what farmers were already doing. Although this approach facilitates uptake in the short term, it reinforces a narrow instrumental logic and risks limiting deeper engagement with conservation values. Nonetheless, some advisors reported more transformative experiences where conservation measures were implemented through collaborative projects that allowed for flexibility, dialogue, and on-farm demonstration. These settings were perceived as more conducive to learning and more respectful of farmers’ and advisors’ knowledge.

The findings suggest that advisors operate within a field shaped by tensions between their embeddedness in traditional agricultural values and their role in promoting policy-driven transformations. Most advisors themselves grew up in rural areas, were educated in agricultural topics, and share similar life experiences with the farmers they work with. On one hand, this proximity fosters a sense of mutual understanding and trust, reinforcing their professional credibility. Their symbolic capital in the farming field derives from their shared worldview with farmers and their ability to represent practical, locally grounded knowledge. On the other hand, their institutional role increasingly casts them as “interface bureaucrats” (Clement et al., 2024), responsible for implementing top-down regulations and ensuring compliance with environmental standards. This dual position creates a structural tension. Advisors often reported a sense of role conflict, describing themselves as “administrative

workers” who no longer have time or space to provide meaningful, relational advice. Their legitimacy depends on maintaining trust with farmers, yet their tasks require them to promote measures that are sometimes perceived as disconnected or even threatening to traditional farming identities.

Despite these constraints, the research identifies potential mechanisms for gradual change. Advisors who had been exposed to biodiversity-related topics during their formal education, or who participated in interdisciplinary conservation projects, exhibited greater openness to integrating environmental concerns into their advisory work. These experiences appeared to expand their professional habitus and facilitate the internalisation of alternative framings of good farming. Such findings point to the relevance of long-term professional development and cross-sectoral collaboration in reconfiguring advisory roles. While advisors may not currently act as drivers of systemic transformation, their strategic position at the intersection of policy and practice makes them important agents for negotiating change, particularly if their knowledge, experience, and social capital are better integrated into the design and implementation of nature conservation initiatives.

4. Practical Implications

The study offers several practical implications for policymakers, advisory institutions, and practitioners working at the interface of agriculture and conservation governance. First, the strong alignment between advisors’ values and those of farmers reinforces their potential as trusted intermediaries. However, this same embeddedness may constrain their ability to promote more transformative environmental practices, especially when perceived as misaligned with local farming realities. It is therefore essential to frame biodiversity conservation in ways that resonate with advisors’ and farmers’ values, such as care for land, intergenerational continuity, and quality food production, rather than relying solely on abstract ecological targets. Second, the predominance of pragmatic, compliance-driven advisory strategies points to a need for more participatory approaches in the design and implementation of agri-environmental measures. Advisors should not be seen merely as policy implementers, but as locally embedded actors whose practical knowledge and social credibility can improve both the relevance and the uptake of conservation initiatives. Finally, professional development and continuous education are key to expanding advisors’ capacity to engage with biodiversity-related topics. This includes the integration of environmental content in formal agricultural curricula, as well as providing opportunities for cross-sectoral collaboration and experiential learning through project-based work.

5. Theoretical Implications

This study contributes to the “good farmer” literature by extending the concept beyond its conventional focus on farmers to include agricultural advisors as a novel and under-researched actor group. By doing so, it reveals how advisors, much like farmers, operate within culturally embedded value systems that shape their professional identities and everyday practices. Drawing on Bourdieu’s theory of habitus, capital, and field, the study demonstrates how advisors’ dispositions are formed through their life trajectories, educational experiences, and professional embeddedness in the agricultural field. The study further underscores the potential for gradual shifts in habitus, particularly through educational exposure and interdisciplinary collaboration. It suggests that professional fields like agricultural advice are not static but can evolve through reflective practice, cross-sectoral dialogue, and policy frameworks that support learning and transformation. Finally, in addition to expanding the actor focus, the study also contributes a novel geographical and institutional context to the literature. While much of the existing research has centred on

Western and Northern Europe, this study introduces findings from Slovenia—a post-socialist country with a strong public advisory system and predominantly small-scale farming structure. This context offers a distinct perspective on how advisory habitus, institutional history, and local farming cultures intersect to shape environmental engagement.

6. References

- Bourdieu, P. (1984). *Distinction: A social critique of the judgement of taste* (R. Nice, Trans.; 11. print). Harvard University Press.
- Burton, R., Forney, J., Stock, P., & Sutherland, L.-A. (2020). *The Good Farmer: Culture and Identity in Food and Agriculture*. <https://doi.org/10.4324/9781315190655>
- Burton, R. J. F. (2004). Reconceptualising the ‘behavioural approach’ in agricultural studies: A socio-psychological perspective. *Journal of Rural Studies*, 20(3), 359–371. <https://doi.org/10.1016/j.jrurstud.2003.12.001>
- Clement, F., Labarthe, P., & Plumecocq, G. (2024). The everyday work of farm advisors as interface bureaucrats in greening French agricultural policies. *Journal of Political Ecology*, 30(1), Article 1. <https://doi.org/10.2458/jpe.5450>
- Farkas, J. Z., & Kovács, A. D. (2021). Nature conservation versus agriculture in the light of socio-economic changes over the last half-century—Case study from a Hungarian national park. *Land Use Policy*, 101, 105131. <https://doi.org/10.1016/j.landusepol.2020.105131>
- Herrera, B., Gerster-Bentaya, M., Tzouramani, I., & Knierim, A. (2019). Advisory services and farm-level sustainability profiles: An exploration in nine European countries. *The Journal of Agricultural Education and Extension*, 25(2), 117–137. <https://doi.org/10.1080/1389224X.2019.1583817>
- Hočevár, D., & Slovenc Grasselli, M. (2023). Farmers on the reasons for their embodied anxieties in post-1991 Slovenia. *Anthropological Notebooks*, 29, 101–127. <https://doi.org/10.5281/zenodo.10471596>
- Ingram, J., & Mills, J. (2019). Are advisory services ‘fit for purpose’ to support sustainable soil management? An assessment of advice in Europe. *Soil Use and Management*, 35(1), 21–31. <https://doi.org/10.1111/sum.12452>
- Knierim, A., Labarthe, P., Laurent, C., Prager, K., Kania, J., Madureira, L., & Ndah, T. H. (2017). Pluralism of agricultural advisory service providers – Facts and insights from Europe. *Journal of Rural Studies*, 55, 45–58. <https://doi.org/10.1016/j.jrurstud.2017.07.018>
- Pe’er, G., Finn, J. A., Díaz, M., Birkenstock, M., Lakner, S., Röder, N., Kazakova, Y., Šumrada, T., Bezák, P., Concepción, E. D., Dänhardt, J., Morales, M. B., Rac, I., Špuleroová, J., Schindler, S., Stavrinides, M., Targetti, S., Viaggi, D., Vogiatzakis, I. N., & Guyomard, H. (2022). How can the European Common Agricultural Policy help halt biodiversity loss? Recommendations by over 300 experts. *Conservation Letters*, n/a(n/a), e12901. <https://doi.org/10.1111/conl.12901>
- Riley, M. (2016). How does longer term participation in agri-environment schemes [re]shape farmers’ environmental dispositions and identities? *Land Use Policy*, 52, 62–75. <https://doi.org/10.1016/j.landusepol.2015.12.010>
- Saldana, J. (2015). *The Coding Manual for Qualitative Researchers*. SAGE.
- Slovenc Grasselli, M. (2019). Can a “Good Farmer” and a “Bad Farmer” Cooperate?: An Examination of Conventional and Organic Farmers’ Perceptions of Production and Environmental Protection. In *Intertwining of Diverse Minds in(to) Political Ecology* (pp. 111–129).
- Westerink, J., Hassink, J., Plomp, M., & van Os, J. (2024). Towards more biodiverse agricultural landscapes: How to make species-rich grassland a desirable and feasible option for dairy farmers. *Journal of Rural Studies*, 105, 103195. <https://doi.org/10.1016/j.jrurstud.2023.103195>

Session 2E

KNOWLEDGE & ADVICE FOR SUSTAINABLE TRANSITIONS IN AGRICULTURE AND AGRIFOOD SYSTEM

Sources of Information on Organic Agriculture and Good Agricultural Practices of Citrus Producers in Muğla Province of Türkiye

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Short abstract

The main material of the research consists of producers who are engaged in organic farming and good agricultural practices in citrus production in Muğla province. The questionnaires of the research were carried out in Bodrum, Fethiye, Köyceğiz, Ortaca and Ula districts of Muğla province between 2017 December and 2018 February with the producers who cultivated citrus fruits according to both organic and good agricultural practices. In the research, 25 producers from 5 districts were determined by purposive sampling method to represent the region. The survey was conducted by face-to-face interviews with the identified producers. According to the results of the research, it was determined that farmers needed information on many issues. In the research, it was found out that farmers applied to different units to get information. Also the research revealed that the most consulted information source of the producers was provincial and district directorates of agriculture with a rate of 84%. The subject that the producers consulted the information sources the most was citrus cultivation with a rate of 40%. It was set down that health factors (protecting the health of themselves, their families, workers and consumers) and environmental protection factors (protection of soil, animals, plants and water) were the most effective factors for producers to adopt organic farming/good agricultural practices. Besides producers' the most needed information was related to marketing issues.

1. Purpose

The agricultural sector makes significant contributions to employment, production, the nutrition of the country's population, the industrial sector, national income, and exports. Therefore, it is a vital sector for all countries. Producers are primary decision-makers and implementers in agricultural production. The factors that determine producer practices are significantly influenced by the level of knowledge and skills they possess, the education they have received, and their utilization of extension services. Agricultural extension, when used correctly, has the function of promoting development by aiming to raise the living standards of those living in rural areas through educational services. Accordingly, it is necessary to

prioritize agricultural extension as an important policy tool for the efficient and proper use of resources (Özçatalbaş ve Gürgen, 1998).

The concept of information has been generally or universally viewed as a basic resource which all people use to improve their condition of living and to develop the process. Agricultural information interacts with and influences agricultural productivity in a variety of ways. It can help to inform decisions regarding land, labour, livestock, capital and management. Agricultural productivity can arguably be improved by relevant, reliable and useful information and knowledge (Çukur and Saner, 2013). Information is a necessary input at every stage of the decision-making process, including goal formulation, problem identification, determining the causes of problems, identifying alternative actions in advance, and more generally, reducing uncertainty (Solano et al., 2003; Duhan and Singh, 2017). Knowledge is a critical resource in the operation and management of agricultural enterprises. Effective agricultural preparation and dissemination of information materials requires recognizing farmers' needs and determining the best ways to provide them with the information they require (Opara, 2008). Agricultural information is central to the agricultural system and serves as a fundamental supporter of agricultural development (Yaseen et al., 2016)

Türkiye has a great potential in terms of fruit production. This is based on the fact that ecological conditions and climate are suitable for fruit production. Citrus fruits have an important place especially in fruit production in Türkiye. Citrus products include lemon, orange, mandarin and grapefruit. The aim of the research is to determine the information sources of citrus producers engaged in organic farming and good agricultural practices.

In Türkiye, in the year 2023, a total of 7 million 847 thousand tons of citrus fruit were produced in an area of 1 million 800 thousand decares (TUIK, 2024). This included the production of 398 tons of grapefruit on 138 decares, 3,490 tons of lemon on 1,183 decares, 5,658 tons of mandarin on 2,130 decares, and 8,075 tons of orange on 2,692 decares, resulting in a total of 17,621 tons of organic citrus produced on 6,143 decares (including transitional production). In terms of good agricultural practices, a total of 1 million 636 thousand tons of citrus fruits were produced in an area of 407 thousand decares, consisting of 145 thousand tons of grapefruit over 28 thousand decares, 372 thousand tons of lemon over 115 thousand decares, 797 thousand tons of mandarin over 197 thousand decares, and 322 thousand tons of orange over 68 thousand decares (Anonymous, 2025). It is estimated that nearly all of these gap products are also GLOBALGAP certified.

In Muğla, a total of 414 thousand tons of citrus were produced on an area of 105 thousand 225 decares. Additionally, 612 tons of organic citrus were produced on 292 decares, and in 2023, 20,589 tons of good agricultural product citrus were produced on 8,340 decares. In 2024, it is projected that 660 tons of organic citrus will be produced on 271 decares, while 13,368 tons of good agricultural product citrus were produced on 6,660 decares (Anonymous, 2025).

Organic citrus production has gained significant momentum due to increasing consumer demand. Italy and Spain stand out as leading countries in global organic citrus cultivation. The most commonly grown organic citrus fruits include lemon, orange, and grapefruit. In 2022, over 115,000 hectares of citrus fruits were grown organically worldwide, constituting 1.1 percent of the world's total citrus area of 10.6 million hectares. Europe maintained its leading position in organic citrus production with a total of 61,200 hectares, with Italy and Spain emerging as the primary producers. In Latin America, Mexico was the region's largest organic citrus producer, covering 21,492 hectares, followed by Argentina. Despite having favorable climate conditions, Africa lagged behind in 2022 with only 6,534 hectares of

production, with Morocco, Egypt, and South Africa being the most significant producers (Willer et al., 2024).

In the United States, organic citrus sales declined by 5.2% to 98 million pounds in 2022 after strong growth in 2021, but they still held their position as the 7th largest organic produce category, with a 44% price premium over conventional citrus. In Europe, the 2022–2023 season saw stagnation in organic citrus consumption, notably in France and Germany, due to poor weather affecting yields and rising production costs (OPN, 2023).

2. Design

The main material of the research consists of producers who are engaged in organic farming and good agricultural practices in citrus production in Muğla province. The questionnaires of the research were carried out in Bodrum, Fethiye, Köyceğiz, Ortaca and Ula districts of Muğla province between 2017 December and 2018 February with the producers who cultivated citrus fruits according to both organic and good agricultural practices. In the research, 25 producers from 5 districts were determined by purposive sampling method to represent the region. The survey was conducted by face-to-face interviews with the identified producers.

3. Findings

Among the producers participating in the study, 96% are male and 4% is female. The average age of the producers is 61.12 years. In terms of education, 48% of the participating producers have completed primary school, 20% have completed middle school, 16% have graduated from high school, and 16% have a university degree.

Regarding agricultural income, 56% of the producers have agricultural earnings that make up less than 25% of their total income, while 20% have agricultural earnings that constitute more than 75% of their total income.

Additionally, 56% of the farmers are engaged solely in crop production, while 44% are involved in both crop and livestock production. Among the participants, 52% practice organic agriculture in citrus production, while 48% have adopted good agricultural practices.

The study also found that 32% of the producers are engaged in organic lemon production, 25% in organic orange production, and 25% in mandarin production using good agricultural practices. Moreover, 24% have received training in organic farming, 48% in good agricultural practices, and 36% in fertilization.

When it comes to the marketability of products, 60% of the participants believe that organic citrus products are easier to market, while 40% believe that good agricultural products are easier to market. In terms of cost, 52% of the producers think that organic farming is more expensive than good agricultural practices. Furthermore, 80% of the producers express a preference for consuming organic agricultural products as consumers, and 92% believe that organic farming is healthier compared to good agricultural practices.

The area where producers feel they need the most information regarding citrus cultivation is marketing, while the topic they feel they need the least is information about maintaining business records. The primary source of consultation for producers, at a rate of 84%, is the provincial and district agricultural directorates. The topic they consult the most is cultivation, with a rate of 40%.

It has been determined that the majority of the producers learned the criteria for organic farming/good agricultural practices from the Provincial Directorate of Agriculture and the

District Directorate of Agriculture. The factors that influence producers' adoption of organic farming/good agricultural practices primarily include health factors (protecting their own health, the health of their families, workers, and consumers) and environmental protection factors (conservation of soil, animals, plants, and water).

The issues that producers encounter most in organic farming/good agricultural practices primarily involve the use of licensed, certified pesticides and inputs (60%). Another significant issue is related to plant protection and integrated pest management (52%). It has been determined that 96% of the producers conduct soil analysis, leaf analysis, and residue analysis after adopting and implementing organic farming or good agricultural practices.

4. Practical Implications

Farmer training and extension programmes should be organised on the subjects that producers need, primarily on marketing extension.

5. Theoretical Implications

Both organic farming and good agricultural practices contribute to the establishment of a healthy and sustainable agricultural system. These methods help in the conservation of natural resources and support biodiversity. Therefore, agricultural extension efforts should be increased to encourage more farmers to adopt these practices.

6. References

- Anonymous, 2025, Ministry of Agriculture and Forestry. <https://www.tarimorman.gov.tr/Konular/Bitkisel-Uretim>. Accessed 6 May 2025
- Çukur, T., & Saner, G. (2013). Determination of information resources of earthen pond fish farmers in Milas district Muğla province Turkey. *Journal of Food Agriculture & Environment*, 11(1), 754-759.
- Duhan, A., & Singh, S. (2017). Sources of agricultural information accessed by farmers in Haryana, India. *International Journal of Current Microbiology and Applied Sciences*, 6(12): 1559-1565. DOI:10.20546/ijcmas.2017.612.175.
- Opara, U.N. (2008). Agricultural information sources used by farmers in Imo state, Nigeria. *Information Development*, 24(4), 289-295.
- OPN, Organic Produce Network. (2023). Organic citrus sales decline. Citrus Industry Magazine. https://citrusindustry.net/2023/03/16/organic-citrus-sales-decline/?utm_source. Accessed 6 May 2025
- Özçatalbaş, O., & Gürgen, Y. (1998). *Tarımsal Yayım ve Haberleşme*. Adana: Baki Kitabevi.
- Solano, C., Leon, H., Perez, E., & Herrero, M. (2003). The role of personal information sources on the decision-making process of Costa Rican dairy farmers. *Agricultural Systems*, 76, 3-18.
- TUIK (2024) Turkish Statistical Institute. <https://www.tuik.gov.tr/>. Accessed 6 May 2025
- Willer, H., Trávníček, J., & Schlatter, B. (2024). The world of organic agriculture. Statistics and emerging trends 2024.
- Yaseen, M., Xu, S., Yu, W., & Hassan, S. (2016). Farmers' access to agricultural information sources: evidences from rural Pakistan. *Journal of Agricultural Chemistry and Environment*, 5, 12-19. DOI: 10.4236/jacen.2016.51B003.

Empowering Sustainable Winemaking: The Role of Education in Efficient Water and Energy Management

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Short abstract

Apart from its cultural and economic significance, the wine industry is associated with high water and energy consumption, particularly in wineries where electricity accounts for 90% of total energy use. Water is essential for irrigation, cleaning, and sanitation, with up to 6 litres required per litre of wine produced. Despite efforts to promote sustainability, knowledge about consumption patterns across winemaking stages remains limited, hindering integrated resource management. This research developed and analysed a questionnaire to assess energy and water use in wineries and the implementation of efficiency measures. It explored winery characteristics, production scales, and consumption practices. Results revealed a widespread lack of detailed monitoring, even in large wineries producing over one million litres annually, where only centralized systems exist without sector-specific data. Barriers to implementing monitoring technologies were identified as technical and financial, although respondents acknowledged their importance for improving efficiency. The findings highlight the need for better resource management practices and knowledge dissemination. By raising awareness and providing education, winemakers can adopt more effective solutions, enhancing the sector's sustainability, competitiveness, and modernization.

Keywords: Water efficiency; Energy efficiency; Wineries; Sustainability; Education; Monitorisation

1. Purpose

Agriculture is one of the sectors most affected by climate change, leading to substantial losses in agricultural production. At the same time, it is also among the sectors with the highest energy and water consumption. The wine industry, in addition to its cultural and economic importance on a global scale, is one of the most water- and energy-intensive agricultural sectors. According to Trigo et al. (2022) wine is the largest agri-food sector in the European Union in terms of exportations, representing 7.6% of agri-food exportations in 2020.

Considering only winery equipment and infrastructure, energy consumption is mostly electrical and thermal (Gómez-Lorente et al., 2017). In fact, electricity is the main source of energy use, accounting for 90% of the total consumption, and the remaining sources are gas, diesel and fuel oil (de Castro et al., 2024). Baiano (2021) analysed electricity consumption

during the winemaking process, founding that consumption is very high during the harvest season due to the need for refrigeration of grapes and musts.

Water is also a fundamental resource in the wine sector, used for irrigation, cleaning and sanitizing equipment and facilities, controlling fermentation temperatures, and diluting grape juice (Matos et al., 2024). On average, 6 litres of water are required to produce a litre of wine, with variations ranging from 2 to 20 litres, resulting in a water footprint of approximately 800 litres (Cerutti et al., 2021).

Despite the high levels of water and energy consumption in winemaking, there is still a lack of concern regarding winery operations and the implementation of efficient water and energy use strategies to ensure the sector's sustainability. The growing awareness of climate change and the continuous increase in energy and water consumption raised environmental concerns and emphasized the need to develop innovative practices that promote a more sustainable future, ensure the viability of the wine sector, and minimise operating costs.

Education and literacy play a pivotal role in understanding and advancing sustainability, particularly in the areas of energy and water efficiency. Several studies have explored how knowledge, attitudes, and behaviours can be shaped through targeted educational strategies. Aguirre-Bielschowsky et al. (2018) highlighted the importance of structured energy literacy programs in foresting lasting conservation habits, particularly among children. In Pacini et al. (2022) connected environmental education with practical applications to promote climate literacy. Similarly, in Biswas (2020), emphasized how integrating sustainability topics into education can shift public attitudes and support for environmental and healthy living practices. Regarding water conservation, McCarroll & Hamann (2020), developed a holistic educational framework to bridge knowledge gaps related to water systems. Malik et al. (2023) demonstrated how rural literacy enhances adaptative capacity to climate change impacts and improves strategies for sustainability and resilience.

The presented study aims to analyse the results of a questionnaire on water and energy efficiency solutions in the wine sector and to explore how educational and literacy strategies can contribute to enhancing sustainability, reducing water and energy consumption, and maintaining the sector's resilience.

2. Methodology

A questionnaire was developed to identify the energy and water consumption associated with the sector, particularly within winery operations. The questionnaire included a series of questions related to the characteristics of each winery, such as the amount of wine produced annually and the type of wine produced (e.g., red or white).

To characterize water consumption, respondents were asked whether water use is monitored and whether monitoring is sectorized; what the winery's monthly and annual water consumption is; the source of water used (own catchment, public distribution network); the period (harvest or the rest of the year) and the stages of wine production that consume the most water. Similarly, the characterization of energy consumption also considered questions about whether consumption is monitored and sectorized; the winery's annual energy consumption; the energy sources used (e.g., diesel, natural gas, electricity); the periods and stages with the highest energy use; and whether any self-production systems, such as photovoltaic panels, are in place.

Finally, the questionnaire also addressed energy and water efficiency measures. The aim was to determine whether any solutions had already been implemented—such as sensors—and to identify barriers (social, economic, or technological) that hinder their implementation.

Additionally, the questionnaire explored how important these measures are for reducing consumption and costs, preserving resources, and improving the sector's sustainability.

3. Findings

The questionnaire was analysed qualitatively, and the results intended to identify the shortcomings associated with energy and water use in wine production and to propose efficient solutions, guaranteeing the sustainability of energy and water resources and the quality and safety of the final product. The findings also serve as an educational tool to raise awareness among winemakers about the importance of monitoring resource use and adopting efficient practices that promote competitiveness and modernization in the sector. Data from six wineries that responded to the questionnaire are analysed below. In terms of location, respondents indicated that their wineries are situated in the North and Centre of Portugal, specifically in regions such Douro, Dão, Mortágua and Vila Nova de Foz Côa.

The wineries were classified according to their annual wine production (Figure 1(a)), based on the study carried out by (Lisboa et al., 2020). Figure 1(b) illustrates the harvest duration for each winery (Vieira, 2022).

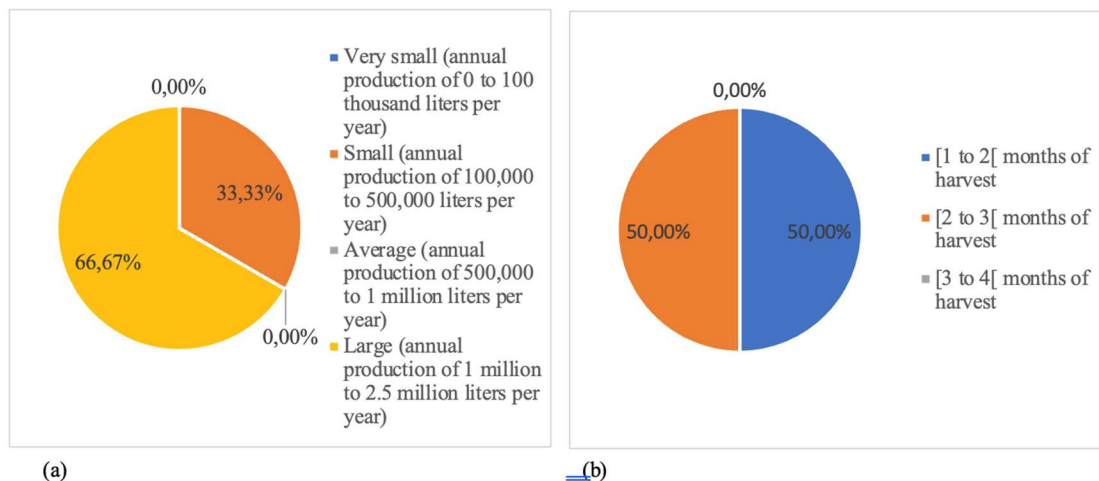


Figure 1. (a) Classification of wineries based on their annual wine production; (b) Harvest period of each winery.

Regarding water consumption in wineries, investigated several aspects of water use, including monitoring systems, specific monthly consumption, water sources and the ratio of water used. Figure 2(a) displays each winery's water monitoring practices, while Figure 2(b) shows the various water sources used.

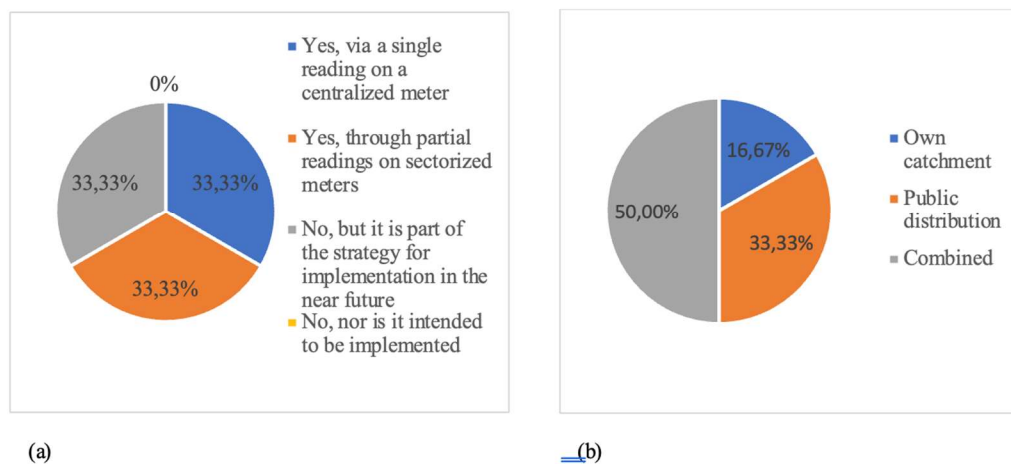


Figure 2. (a) Monitorization strategies implemented; (b) Water sources distribution.

Regarding the stages of wine production with the highest water consumption, the results revealed some variability across wineries (Figure 3). However, 50% of the respondents identified cleaning and sanitation as the tasks with the highest water usage.

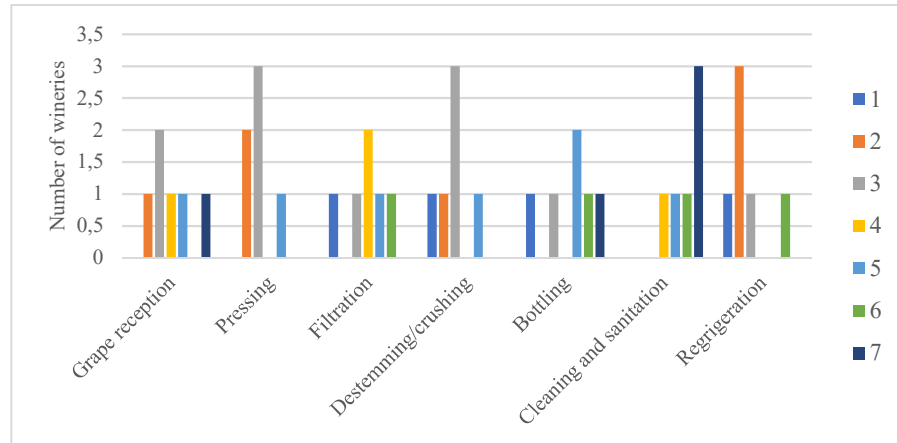


Figure 3: Winemaking tasks water consumption rate (1 is the task with lower consumption, and 7 is the task with higher consumption)

The ratio of water used to produce a litre of wine varied from winery to winery with values between 2.5 to 580 litres. This wide variation indicates the absence of a standardized production process to minimize water usage and suggests that not all wineries have efficient and sustainable practices.

For the energy consumption field, the questionnaire also explored energy monitoring practices and the sources of energy used in wine production. Figure 4(a) shows the monitorization strategies implemented for energy consumption, and Figure 4(b) outlines the various energy sources used. It is evident that electricity is the primary energy source in wine production.

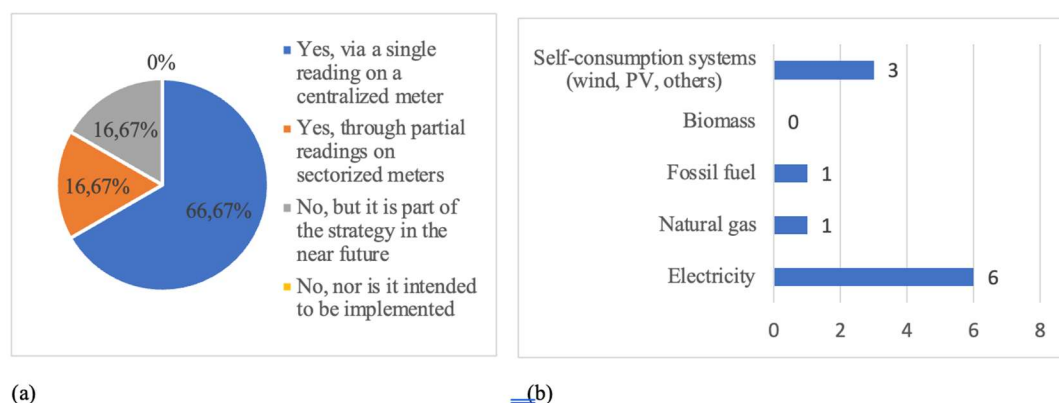


Figure 4. (a) Monitorization strategies implemented; (b) Energy sources used in the wineries.

Similarly, to water consumption, the questionnaire allows to understand what stages of the winemaking process have higher energy consumption (Figure 5).

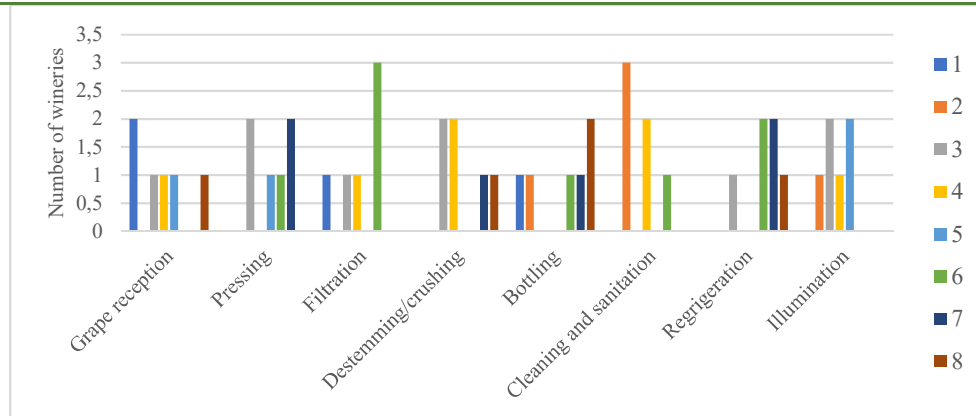


Figure 5: Winemaking process energy consumption of each winery

4. Practical and theoretical implications

Although not all wineries have implemented efficiency solutions, all participants recognized the importance of adopting energy and water-saving techniques in wine production. Regarding water efficiency, 50% of respondents reported having implemented measures such as reusing sanitizing water, promoting employee awareness, using hose guns checking for leaks, upgrading to more efficient equipment, and installing partial meters. However, only 16.7% of the participants reported using rainwater harvesting systems, and none of the participants have water leak detection systems.

In contrast, 83.3% of the participants had implemented energy-efficient solutions in wineries, such as replacement of lighting with LED lights, installation of photovoltaic panels, and upgrade of equipment. All the wineries reported regular equipment maintenance and inspection. However, 83.3% still use original equipment, which can negatively impact efficiency and winemaking quality.

The results also showed that all wineries consider the implementation of energy and water efficiency solutions as essential for the development of the wine sector. Nonetheless, 83.3% of the participants cited a lack of knowledge about these solutions as significant barrier to the sustainable development of the sector. Figure 6 summarizes participants' views on the importance of specific goals in the context of energy and water efficiency. All participants consider that is very important to reduce water and energy consumption.

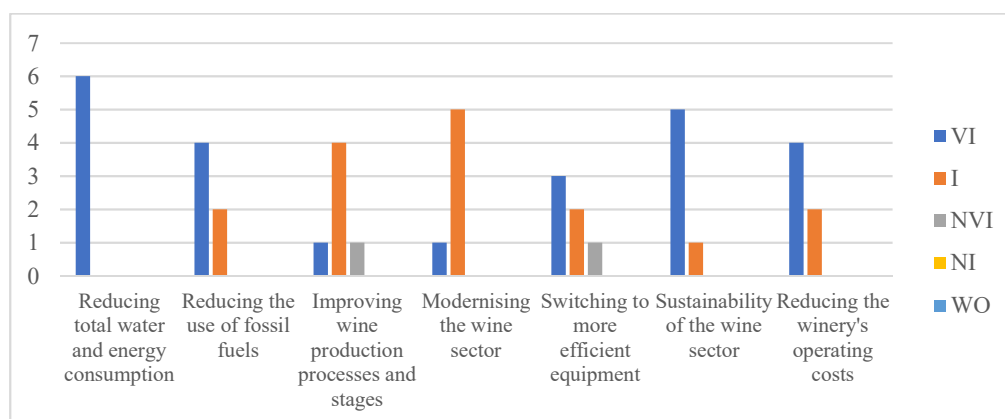


Figure 6: Major goals to improve the efficiency of winemaking (VI – very important; I – important; NVI – not very important; NI – not important; and WO – without opinion)

Finally, the barriers to implementing water and energy efficiency solutions in the viticulture sector were also analysed (Figure 7), revealing that the related costs can be a limitation, followed by the technical barriers.

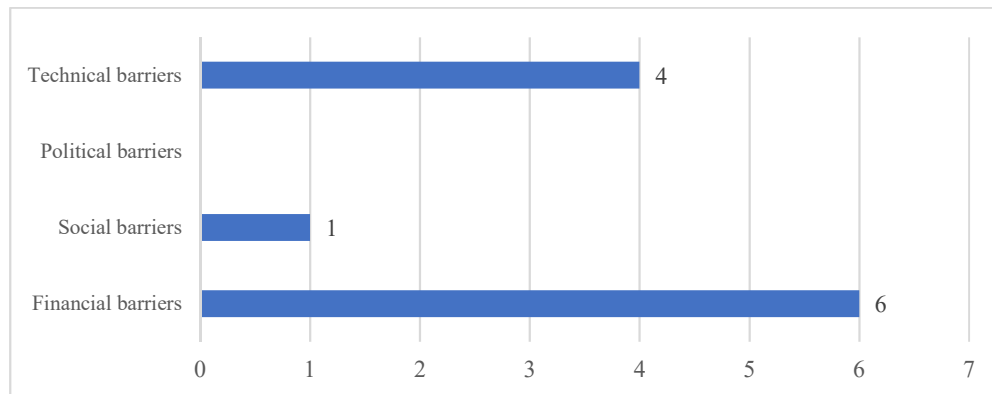


Figure 7. Barriers that influence the implementation of efficiency improvement solutions.

The findings lead to the conclusion that education and literacy are crucial for promoting energy and water efficiency in the wine sector. By increasing awareness and technical understanding, education empowers professionals to adopt sustainable practices, implement efficient technologies, and make informed decisions. Furthermore, it would also help to overcome knowledge gaps and resistance to change, while fostering a culture of innovation and environmental responsibility, which are key elements for enhancing sustainability and competitiveness of the winemaking industry.

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5. References

- Aguirre-Bielschowsky, I., Lawson, R., Stephenson, J., & Todd, S. (2018). Kids and Kilowatts: Socialisation, energy efficiency, and electricity consumption in New Zealand. *Energy Research & Social Science*, 44, 178–186. <https://doi.org/10.1016/j.erss.2018.04.020>
- Baiano, A. (2021). An Overview on Sustainability in the Wine Production Chain. *Beverages*, 7(1), Article 1. <https://doi.org/10.3390/beverages7010015>
- Biswas, A. (2020). A nexus between environmental literacy, environmental attitude and healthy living. *Environmental Science and Pollution Research*, 27(6), 5922–5931. <https://doi.org/10.1007/s11356-019-07290-5>
- Cerutti, A., Campo, G., Zanetti, M., & Ruffino, B. (2021). Optimization of the water treatment process in an Italian winery: A case study. *Journal of Water Process Engineering*, 41, 102013. <https://doi.org/10.1016/j.jwpe.2021.102013>
- de Castro, M., Baptista, J., Matos, C., Valente, A., & Briga-Sá, A. (2024). Energy efficiency in winemaking industry: Challenges and opportunities. *Science of The Total Environment*, 930, 172383. <https://doi.org/10.1016/j.scitotenv.2024.172383>
- Gómez-Lorente, D., Rabaza, O., Aznar-Dols, F., & Mercado-Vargas, M. J. (2017). Economic and Environmental Study of Wineries Powered by Grid-Connected Photovoltaic Systems in Spain. *Energies*, 10(2), Article 2. <https://doi.org/10.3390/en10020222>
- Lisboa, S., Saraiva, A., Dias, I., Saraiva, R. S., Mamede, H., & Oliveira, M. O. O. (2020). GESTÃO SUSTENTÁVEL DA ÁGUA EM ADEGAS NACIONAIS – DESAFIOS ATUAIS E FUTUROS. *Revista da UI_IPSantarém*, 8(3), Article 3. <https://doi.org/10.25746/ruiips.v8.i3.21340>

- Malik, I., Ahmed, M., Gulzar, Y., Baba, S. H., Mir, M. S., Soomro, A. B., Sultan, A., & Elwasila, O. (2023). Estimation of the Extent of the Vulnerability of Agriculture to Climate Change Using Analytical and Deep-Learning Methods: A Case Study in Jammu, Kashmir, and Ladakh. *Sustainability*, 15(14), Article 14. <https://doi.org/10.3390/su151411465>
- Matos, C., Castro, M., Baptista, J., Valente, A., & Briga-Sá, A. (2024). The use of water in wineries: A review. *Science of The Total Environment*, 951, 175198. <https://doi.org/10.1016/j.scitotenv.2024.175198>
- McCarroll, M., & Hamann, H. (2020). What We Know about Water: A Water Literacy Review. *Water*, 12(10), Article 10. <https://doi.org/10.3390/w12102803>
- Pacini, A., Edelmann, H. G., Großschedl, J., & Schlüter, K. (2022). A Literature Review on Facade Greening: How Research Findings May Be Used to Promote Sustainability and Climate Literacy in School. *Sustainability*, 14(8), Article 8. <https://doi.org/10.3390/su14084596>
- Trigo, A., Fragoso, R., & Marta-Costa, A. (2022). Sustainability awareness in the Portuguese wine industry: A grounded theory approach. *International Journal of Agricultural Sustainability*, 20(7), 1437–1453. <https://doi.org/10.1080/14735903.2022.2150377>
- Vieira, F. R. (2022). *Contributo para a sustentabilidade ambiental na adegas: Uso eficiente da água* [masterThesis, s.n.]. <https://repositorio.ulisboa.pt/handle/10400.5/25468>

Bridging Knowledge and Agriculture: A Socioeconomic Framework for Assessing Agroecological Transitions in Agri-Food Systems

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Short abstract

This study proposes a socioeconomic framework to assess the economic, social, and environmental impacts of agroecological transitions in agri-food systems. Agroecological transitions present both opportunities and trade-offs across multiple dimensions, necessitating a comprehensive understanding of internal and external influencing factors. The study adopts an integrative theoretical approach, including a critical review of existing frameworks, identification of conceptual gaps, and development of an integrated assessment model. Preliminary findings reveal significant variability in the socioeconomic performance of agroecological practices, largely due to inconsistent methodologies and metrics, which complicate comparative analysis. The proposed framework employs a participatory, trade-off analysis (TOA) approach, combining qualitative and quantitative data with modelling tools to evaluate innovations in technology and institutions. Practical implications include improved stakeholder decision-making and resource allocation, while theoretical contributions involve a shift from simple cost-benefit analysis to a nuanced understanding of trade-offs and synergies. The framework promotes interdisciplinary collaboration and adaptive management in agri-food systems.

1. Purpose

Agroecology has emerged as a transformative approach to agriculture that integrates ecological principles with social and economic considerations to promote sustainable and equitable food systems. Originally conceptualized in the early 20th century, agroecology today is widely recognized as a transdisciplinary science. As a transdisciplinary science,

agroecology comprises a set of agricultural practices, and a social movement aimed at addressing the complex challenges facing global food systems, including environmental degradation, social injustice, and food insecurity (Fiore et al., 2024). Compared to other approaches, the agroecological literature has still several gaps preventing a full understanding of its potential ((Reza et al., 2025)). Several authors emphasize the need to understand the internal and external factors influencing the transition process and propose methodologies to assess human capital, management capacity, agroecosystem quality and transformability ((Darmaun, Hossard, et al., 2023). Understanding the socioeconomic performance of agroecological transitions allows stakeholders to appreciate the interplay between ecological benefits and economic returns, leading to a more complete picture of agroecology's impact (Jacobi & Itty, 2024; Prost et al., 2023)

Agroecological transitions in agri-food systems offer potential benefits but also involve trade-offs between social, political, economic, and environmental dimensions. Scaling up successful small-scale agroecological practices to larger agricultural systems also poses challenges. Research needs to explore strategies for doing so while maintaining the socio-economic benefits of these practices. ((Mottet et al., 2020)). (Fiore et al., 2024) explore how socio-economic aspects shape and challenge agroecology as a path to sustainable food systems. The authors emphasized the need for bottom-up, participatory research methods and collaboration with stakeholders. Collaborative efforts are key in promoting context-specific, sustainable, and effective agroecological transitions. (Miller et al., 2022)) identify the key needs for realizing transitions to agroecology in Europe, particularly the study evaluates the effectiveness of existing EU and national level policies in supporting agroecological practices. The results demonstrate that for agroecology to become the mainstream model for transforming agriculture into more sustainable and resilient agri-food systems, it requires a fully integrated multiscale systems approach that considers various processes, relationships, actors, and sustainability indicators across all scales, from local farms to global contexts. Additionally, the study emphasizes the importance of economic viability for farmers and food system actors, highlighting the need for new and emerging technologies, particularly in digitalization and breeding, to be integrated into the agroecological transformation, along with a robust analytical framework and multiscale policy design to support large-scale adoption. Recently, (Assogba et al., 2022) seeks to understand the barriers to the broader diffusion of agroecology, identifying challenges related to policy, governance, and market dynamics that hinder the agroecological transition in local food systems. For example, the findings show that the lack of adapted machinery, shortage of skilled advisors for knowledge transfer and poor community awareness are critical factors preventing the broader diffusion of agroecology. On the other hand, (Darmaun, et al., 2023) highlight the importance of collective organization among farmers in developing territorialized supply chains, which facilitates access to various strategic resources such as commercial, cognitive, social, and material resources. This access enables farmers to implement agroecological practices more effectively and enhances their economic viability by coupling changes in agricultural practices with their economic valorization. Thus, perspectives from socio-economic sciences are essential to illuminate the drivers, barriers, and outcomes of agroecological transitions in diverse contexts. Understanding the socioeconomic performance of agroecological transitions allows stakeholders to appreciate the interplay between ecological benefits and economic returns, leading to a more complete picture of agroecology's impact (Mouratiadou et al., 2024). Based on these arguments, this study intends to propose a socioeconomics framework to assess economic, environmental and social impacts of agroecological transitions in agri-food systems. Such comprehensive frameworks not only promote the adoption of sustainable

practices but also ensure that the benefits of agroecological transitions are equitably distributed across communities, thereby reinforcing the foundational goals of sustainable.

2. Approach

This study employs an integrative theoretical approach to develop a socioeconomic framework for assessing the multidimensional impacts of agroecological transitions in agri-food systems. The methodology follows a three-stage approach:

1. **Critical Review of Existing Frameworks:** The first stage involves a thorough examination of current frameworks related to agroecological transitions. This review aims to identify conceptual gaps, particularly in how these frameworks address trade-offs and co-benefits associated with transitioning to agroecological practices.
2. **Identifying Conceptual Gaps:** In the second stage, the study focuses to assess how well they capture the complexities of economic, social, and environmental interactions within agri-food systems, as well as the implications of these interactions for stakeholder engagement and governance.
3. **Developing an Integrated Assessment Framework:** The final stage involves synthesizing insights gained from the previous stages to create a comprehensive assessment framework. This integrated framework will incorporate economic, social, and environmental dimensions, allowing for a holistic evaluation of agroecological transitions. It aims to facilitate better understanding and management of trade-offs and co-benefits, ultimately supporting more effective governance and stakeholder collaboration in agri-food systems.

3. Findings

The preliminary results of the analysis of studies on agroecological transitions in agri-food systems emphasizes the need for a more integrated approach to address the complexities of agroecological transitions. Assessing these transitions requires a comprehensive set of indicators that can capture the complexity and multidimensionality of agroecology. The Tool for Agroecological Performance Evaluation (TAPE) is a comprehensive framework that combines social, political, economic, and environmental indicators to evaluate the performance of agroecological systems (Costa-Pereira et al., 2024; Mottet et al., 2020). Similarly, the Agroecology Criteria Tool (ACT) provides a set of criteria and indicators for assessing agroecological transitions at the farm level (Costa-Pereira et al., 2024). To effectively assess agroecological transitions, it is crucial to employ a diverse set of indicators that capture the multifaceted nature of these changes. By integrating these indicators into the assessment framework, stakeholders can gain a comprehensive understanding of the dynamics at play, ultimately fostering more resilient and inclusive agri-food systems capable of addressing contemporary challenges such as food insecurity and climate change. Table 1 summarises some indicators recently used to assess agroecological transitions in agri-food systems.

Table 1: Key indicators recently used to assess agroecological transitions in agri-food systems

Dimension	Key Indicators	References
Social	Community participation, empowerment, social justice, cultural practices	(Aye et al., 2024; Darmaun, Chevallier, et al., 2023; Raigón Jiménez et al., 2023)
Political	Policy coherence, governance structures, regulatory frameworks, participatory design	(Fonseca et al., 2024; Miller et al., 2022)
Economic	Farm viability, market access, investment, economic resilience	((Prost et al., 2023; Wang et al., 2024)
Environmental	Biodiversity, resource efficiency, greenhouse gas emissions, land use, soil health	(Jacobi & Itty, 2024; Wang et al., 2024)

Social Dimension

The preliminary findings show that the social dimension of agroecological transitions focuses on the interactions and dynamics among stakeholders, including farmers, communities, and institutions. The level of participation in decision-making processes and the strength of social networks within communities are critical. Tools like focus group discussions and participatory approaches have been used to assess these aspects. Education and knowledge-sharing are essential for fostering agroecological practices. Indicators such as the availability of training programs and the adoption of agroecological principles by farmers are important. Assessing the distribution of benefits and challenges among different groups, including access to resources, is vital. The integration of local knowledge and traditional practices into agroecological systems is a key indicator. This includes the preservation of indigenous farming techniques and cultural values.

Economic Dimension

In the economic dimension, the preliminary analysis reveals that the economic performance of agroecological farms, including profit margins and cost efficiency, is a key indicator. Recent studies have shown that agroecological practices can lead to long-term improvements in profitability (Landert et al., 2020; Wang et al., 2024). Regarding market access and value chain, the presence of fair trade practices and the integration of small-scale farmers into markets are the critical indicators. On the other hand, the availability of funding for agroecological practices, including grants and subsidies, is also an important indicator. The ability of farming systems to withstand economic shocks, such as price fluctuations and market changes, is a key indicator. Diversification of income sources is often used as a measure of resilience.

Political Dimension

The political dimension involves the role of policies, governance, and institutional support in facilitating agroecological transitions. In this context, the alignment of agricultural policies with agroecological principles and the provision of incentives for sustainable practices are critical. The involvement of stakeholders in policy design and implementation ensures that policies are context-specific and effective. The effectiveness of governance structures, including the involvement of local governments and NGOs, is a key indicator.

Environmental Dimension

This dimension focused on the ecological sustainability of agroecological practices. The preliminary results demonstrate that the impact of these practices on biodiversity, soil health and ecosystem services is a critical indicator when evaluating these services. Meanwhile, resource efficiency is evaluated based on the effective use of water, energy, and other resources. Reducing greenhouse gas emissions through practices such as agroforestry and organic farming is also a key indicator.

4. Practical Implications

The integrated assessment framework offers pathways for more sustainable, equitable, and resilient agri-food systems. By employing a comprehensive framework that integrates economic, social, and environmental dimensions, policymakers and stakeholders can make informed decisions that balance trade-offs and co-benefits. This leads to more effective strategies that promote sustainability and resilience in agri-food systems. Effective governance can facilitate collaboration among farmers, policymakers, and researchers, ensuring that knowledge exchange is not only encouraged but also operationalised through

participatory approaches. For instance, the establishment of regional coordination centers for Agricultural Knowledge and Innovation Systems (AKIS) can enhance local adaptability by tailoring strategies to specific biophysical and socio-economic contexts, ultimately driving more inclusive transitions

5. Theoretical Implications

Theoretical implications of agroecological transitions highlight the necessity for interdisciplinary approaches that integrate ecological, social, and economic perspectives, ultimately fostering a more holistic understanding of sustainable food systems.

6. References

- Assogba, C.-G., Vodouhê, G. T., Adjé, B., Dassou, A., Tovignan, S. D., Kindomihou, V., & Vodouhê, S. D. (2022). Agroecological transition in Southern Benin: What challenges for more efficient vegetable farming systems? *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 123(2), 205–214. <https://doi.org/10.17170/kobra-202210116965>
- Aye, Z. C., Castella, J.-C., Xiong, M., Phimmasone, S., & Ehrensperger, A. (2024). How to measure agroecology? A rapid appraisal approach based on focus group discussions. *Agroecology and Sustainable Food Systems*, 48(10), 1428–1461. <https://doi.org/10.1080/21683565.2024.2386477>
- Costa-Pereira, I., Aguiar, A. A. R. M., Delgado, F., & Costa, C. A. (2024). A Methodological Framework for Assessing the Agroecological Performance of Farms in Portugal: Integrating TAPE and ACT Approaches. *Sustainability*, 16(10), 3955. <https://doi.org/10.3390/su16103955>
- Darmaun, M., Chevallier, T., Hossard, L., Lairez, J., Scopel, E., Chotte, J.-L., Lambert-Derkimba, A., & de Tourdonnet, S. (2023). Multidimensional and multiscale assessment of agroecological transitions. A review. *International Journal of Agricultural Sustainability*, 21(1). <https://doi.org/10.1080/14735903.2023.2193028>
- Darmaun, M., Hossard, L., de Tourdonnet, S., Chotte, J.-L., Lairez, J., Scopel, E., Faye, N. F., Chapuis-Lardy, L., Ndienor, M., Cissé, M. F. N., & Chevallier, T. (2023). Co-designing a method to assess agroecosystems undergoing an agroecological transition: results of a case study in Senegal. *Italian Journal of Agronomy*, 18(4), 2195. <https://doi.org/10.4081/ija.2023.2195>
- Fiore, V., Borrello, M., Carlucci, D., Giannoccaro, G., Russo, S., Stempfle, S., & Roselli, L. (2024). The socio-economic issues of agroecology: a scoping review. *Agricultural and Food Economics*, 12(1), 16. <https://doi.org/10.1186/s40100-024-00311-z>
- Fonseca, A. F., Polita, F., & Madureira, L. (2024). How Agroecological Transition Frameworks Are Reshaping Agroecology: A Review. *Land*, 13(11), 1930. <https://doi.org/10.3390/land13111930>
- Jacobi, J., & Itty, N. M. (2024). Agroecological transitions. In *Elgar Encyclopedia of Interdisciplinarity and Transdisciplinarity* (pp. 18–23). Edward Elgar Publishing. <https://doi.org/10.4337/9781035317967.ch05>
- Miller, D., Legras, S., Barnes, A., Cazacu, M., Gava, O., Helin, J., Irvine, K., Kantelhardt, J., Landert, J., Latruffe, L., Mayer, A., Niedermayr, A., Povellato, A., Schaller, L., Schwarz, G., Smith, P., Vanni, F., Védrine, L., Viaggi, D., ... Vlahos, G. (2022). Creating Conditions for Harnessing the Potential of Transitions to Agroecology in Europe and Requirements for Policy. *EuroChoices*, 21(3), 72–79. <https://doi.org/10.1111/1746-692X.12374>
- Mottet, A., Bicksler, A., Lucantoni, D., De Rosa, F., Scherf, B., Scopel, E., López-Ridaura, S., Gemmil-Herren, B., Bezner Kerr, R., Sourisseau, J.-M., Petersen, P., Chotte, J.-L., Loconto, A., & Tiftonell, P. (2020). Assessing Transitions to Sustainable Agricultural and Food

- Systems: A Tool for Agroecology Performance Evaluation (TAPE). *Frontiers in Sustainable Food Systems*, 4. <https://doi.org/10.3389/fsufs.2020.579154>
- Prost, L., Martin, G., Ballot, R., Benoit, M., Bergez, J.-E., Bockstaller, C., Cerf, M., Deytieux, V., Hossard, L., Jeuffroy, M.-H., Leclère, M., Le Bail, M., Le Gal, P.-Y., Loyce, C., Merot, A., Meynard, J.-M., Mignolet, C., Munier-Jolain, N., Novak, S., ... van der Werf, H. (2023). Key research challenges to supporting farm transitions to agroecology in advanced economies. A review. *Agronomy for Sustainable Development*, 43(1), 11. <https://doi.org/10.1007/s13593-022-00855-8>
- Raigón Jiménez, M. D., Vélez Zabala, F. J., & Leandro Baladrón, P. (2023). Indicators for agroecological transition: Food security, nutrition, well-being, promotion of a sustainable food model. *Magna Scientia UCEVA*, 3(1), 100–115. <https://doi.org/10.54502/msuceva.v3n1a10>
- Reza, M. S., Sultana, N., Vega, S. M., & Sabau, G. (2025). Agroecology: the science and art of building sustainable agri-food systems. A case study from Costa Rica. *Agroecology and Sustainable Food Systems*. <https://doi.org/10.1080/21683565.2025.2476176>
- Wang, W., AL-Huqail, A., Ali, E., Abbas, M., & Assilzadeh, H. (2024). Analysis of the sustainability index for ecologically low-input integrated farming: A comprehensive assessment of environmental, economic, and social impact. *Ecological Modelling*, 493, 110701. <https://doi.org/10.1016/j.ecolmodel.2024.110701>

Adoption of Pheromone Trap for Eco-friendly Vegetables Cultivation

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Short Abstract

The main aim of the study was to assess the adoption of pheromone traps by farmers in northern Bangladesh. Data were collected using a structured interview schedule with the sampled farmers. The data were analysed using Stata software to apply and interpret a logit model. The results indicated that 66.6% of farmers were aware of and informed about pheromone traps, but only 35.9% had adopted their use in vegetable cultivation. The logit analysis revealed that several explanatory variables significantly influenced adoption, including age, gender, dependency ratio, access to information, distance to information centres, participation in group activities, and access to training. The findings suggest that government and non-government organizations should implement targeted programs to facilitate information dissemination and consider these significant factors. Such efforts could enhance the adoption of pheromone traps, promoting eco-friendly vegetable cultivation practices in the northern region of Bangladesh.

Key words: Adoption, Pheromone Trap, Vegetables Cultivation and Bangladesh

1. Purpose

The conventional agriculture favours the use of improved crop varieties, synthetic fertilizers, and pesticides (Roy et al., 2013). Consequently, this causes the environmental pollution, primarily due to the excessive use of chemical fertilizers and pesticides. The eco-friendly good practices encompass the implementation of a wide range of climate smart technologies (Taneja et al., 2019). Despite ongoing support for ecofriendly technologies in various countries, the level of adoption remains unsatisfactory due to the influence of different factors (Abegunde et al., 2020). The pheromone trap is a biological insect control method aimed at reducing the overuse of chemical insecticides (Kabir et al., 2023). In Bangladesh, the government extension organization such as Department of Agricultural Extension (DAE) has been providing advisory services and implementing the National Agricultural Technological Programme (NATP) on different types of the climate smart practices namely pheromone trap since 2016. Therefore, the purposes of the study are to determine farmers' adoption status pheromone trap and to explore the determinant factors that can influence the adoption of pheromone trap as an ecofriendly good practice.

2. Methodology

The study was conducted in *Biral* sub-district at Dinajpur district in northern Bangladesh. Then, sample size was determined by a mathematical formula given by Yamane (1967) as:

$$n = N / \{1 + N (e^2)\} \dots\dots\dots (1)$$

Where, N is the sample frame or population, n is the required sample size and e is the margin of error (fixed at 0.05). Structured interview schedule was used for data collection. Adoption decision of pheromone trap i.e., the dependent variable was measured by dummy response using logit model (Aryal et al., 2018). The data were analysed using Stata 15.0 software.

3. Findings

The results indicated in the Figure 1 that 66.6 % of farmers were informed on pheromone trap, but only 35.9% adopted. It could be said that there is huge gap between information received and adoption status of pheromone trap as eco-friendly practice.

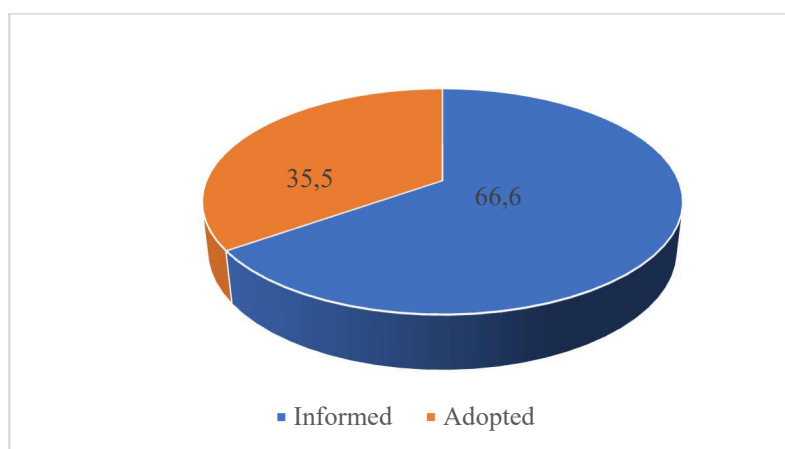


Figure 1: Information received and Adoption Status of Pheromone Trap

The logit analysis revealed in Table 1 that among the different socioeconomic and institutional factor such as age, gender, dependency ratio, information access, distance of information centre, participation in group activities, and training access significantly affect the adoption of pheromone trap in ecofriendly vegetables cultivation. The factors related to agricultural extension and advisory services such as farmers' information access, distance of

information centre, participation in group actions, and training access are the significant influential factors that can affect the adoption of good practices globally. On the other hand, education, farm size, input access and access to Information, Communication and Technology (ICT as mobile) as well as credit access did not affect the adoption of Pheromone trap significantly. From the experiential view, participation in farmers cooperative/federation and sharing knowledge can affect the adoption level of good practices in a more likely way in the European context.

Table 1: Logit estimation for the déterminants factor of Pheromone Trap (PT) adoption

Determinant factors	Adoption Pheromone Trap (PT)
Age	-0.015* (0.008)
Gender	0.434* (0.226)
Education	-0.019 (0.024)
Dependency ratio	0.287** (0.105)
Fram size	0.075 (0.177)
Input Access	0.001 (0.229)
Information Access	0.401* (0.198)
Distance of info center (FIAC)	-0.440*** (0.080)
Participation in group activités	0.752*** (0.178)
Access to ICT/mobile	0.311 (0.193)
Training accès	1.504*** (0.226)
Crédit Access	0.266 (0.186)

[Note: ***, ** & * refers to significant at 99%, 95% and 90% confidence level respectively, Standard errors are presented in parentheses]

4. Practical & Theoretical Implications

This study makes an empirical contribution to the literature by using an econometric logit model to investigate the factors that influence farmers' adoption of pheromone trap. It also identifies the obstacles for non-adoption of pheromone trap in vegetables cultivation. The study suggests that different types of extension programs are necessary to overcome the barriers and minimize the factors for promoting the adoption of pheromone trap. In this perspective, extension advisors can play important role as the information providers to the farmers. The educators and extension advisors can also serve collaboratively to promote the pheromone trap as good agricultural practices. By doing so, it could accelerate the production of ecofriendly vegetables cultivation.

5. References

- Abegunde, V. O., Sibanda, M., & Obi, A. (2020). Determinants of the adoption of climate-smart agricultural practices by small-scale farming households in King Cetshwayo District Municipality, South Africa. *Sustainability*, 12(1), 195. DOI: <https://doi.org/10.3390/su12010195>
- Aryal, J. P., Rahat, D. B., Maharjan, S., & Erenstein, O. (2018). Factors affecting the adoption of multiple climate-smart agricultural practices in the Indo-Gangetic Plains of India. *Natural Resources Forum*, 42, 141–158. DOI: <https://doi.org/10.1111/1477-8947.12152>
- Kabir, M. H., Nur-e-Alam, S. M., Datta, A., Tan, M. L., & Rahman, M. S. (2023). Understanding vegetable farmers' adoption, dis-adoption, and non-adoption decisions of pest

-
- management by pheromone trapping. Plos One, 18(9), e0292254. DOI: <https://doi.org/10.1371/journal.pone.0292254>
- Roy, R., Chan, N. W., Uemura, T., & Imura, H. (2013). The vision of agri-environmental sustainability in Bangladesh: How the policies, strategies and institutions delivered? Journal of Environmental Protection, 4, 40-51. DOI: 10.4236/jep.2013.48A2006
- Taneja, G., Pal, B. D., Joshi, P. K., Aggarwal, P. K., & Tyagi, N. K. (2019). Farmers' preferences for climate-smart agriculture-an assessment in the Indo-Gangetic Plain (pp. 91-111). Springer Singapore.
- Yamane, T. (1967). Statistics, An Introductory Analysis, 2nd ed. Harper and Row, New York.

Special Session 3E

Special session: Advisory skills at the frontier – insight from short food supply chain advising from Horizon Europe Advisory Networks COREnet and EU4Advice

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1. Purpose

COREnet and EU4Advice are among the first Advisory Networks funded by the EC Horizon Europe's programme. Advisory Networks are multi-actor projects that connect advisors across all EU Member States in a European network, aiming to:

- help advisors stay up to date with cutting-edge knowledge and innovation; and
- facilitate opportunities for them to exchange and share experiences on how to best tackle challenges or seize opportunities on farms, in forests and rural villages (EU CAP Network, 2025)

In this session, we will present transferable insights from both projects that are relevant across all types of advisory work. We also invite participants to engage in a dialogue about knowledge and skills that can be shared across advisory practices in different areas of specialism, from conventional advisory topics to more niche areas.

Short Food Supply Chains (SFSCs) are gaining popularity worldwide—particularly in the EU—where governments and civil society promote them as a way to build more inclusive, resilient, and sustainable food systems. Despite this, SFSCs remain marginal in the overall food system. A key barrier to up- and, vitally, out-scaling SFSCs lies in identifying and addressing knowledge/skills gaps, and empowering independent action among farmers, small-scale food entrepreneurs and actors throughout the entire value chain—from farm to fork.

The COREnet and EU4Advice projects are exploring the relationship between SFSC advising and enabling enhanced performance and impact of SFSCs, particularly from an up-and out-scaling perspective in order to develop an EU-wide SFSC Advisory Network.

As reference points, this session will present two key pieces of work from these projects on which to frame a participatory discussion and exchange of relevant good practices:

- the creation of an SFSC advisory guide, reflecting a typology of SFSCs operating in diverse contexts, to provide basic/core knowledge, skills and competencies together with professional standards for SFSC advising (COREnet).

- the use of Living Labs to identify SFSC advisors' training needs, pilot training content and tools, and design certified training based on micro-credentials (EU4Advice).

2. Approach

Using these cases as a canvas, the session aims to structure a collaborative discussion around the broader development of advisory knowledge and skills, in frontier or 'leading & bleeding edge' contexts (Quinn-Patton, 2018; Macken-Walsh et al., 2021). This session, arranged as a participatory panel discussion with plenty of room for input from all participants, will explore the following four key questions:

1. **How to Develop a SFSC Advisory Guide and Typology, and Micro-credential System for Advisor Training**
What are your tips, tricks, and best practices for creating effective advisor training tools, such as an SFSC typology, advisory guide, and a system of certified micro-credentials? What are the pearls, puzzles and proposals you can share? (Wielinga and Parea, 2016; SKIN, 2017; EU CAP Network, 2025)
2. **Advising for Learning, Collaboration, and Co-creation**
Working with SFSC business advice involves engaging with multiple actors. Thus, advisors must be skilled in fostering learning environments and facilitating co-creation. How can advisory methods for learning, collaboration, and co-creation be 'distilled', codified, shared and encouraged?
3. **Who Is the Advisor?**
In collaborative settings, advisors may take many forms—including consumers, urban and peri-urban residents, public procurement actors, and others. What are the implications of the fact that many SFSC advisors do not even identify as advisors?
4. **Integrating SFSC Advisors into the AKIS**
The integration of SFSC advisors into the Agricultural Knowledge and Innovation System (AKIS) differ across the EU. How can AKISs better reach and connect SFSC advisors and support their training and knowledge development?

This session offers a valuable opportunity to:

- Learn from and contribute to two pioneering Horizon Europe projects dealing with Advisory Networks,
- Explore challenges and solutions in developing 'frontier' advisory skills and systems,
- Engage with others on how to share and transfer knowledge and practices across diverse advisory roles.

Welcome! 😊

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3. References

- EU CAP Network (2025). *Research Needs for Practice*. Available at https://eu-cap-network.ec.europa.eu/publications/research-needs-practice_en
- Macken-Walsh, A., Javornicky, M., Forde, A., Naughton, A., Quiédeville, S., Home, R., Bettoni, M., Díaz Puente, J. M., Augustyn, A. M. (2021). *Impact Assessment Handbook*. D5.2,

-
- LIAISON H2020 project. <https://liaison2020.eu/wp-content/uploads/2021/09/LIAISON-Assessment-Tools.pdf>
- Quinn-Patton, M. (2018). The fifth operating principle. In *Invigorate with Leading-Edge Inputs* (pp. 233-262). SAGE Publications, Inc, <https://doi.org/10.4135/9781506347592.n8>
- SKIN (2017) *SKIN 'Good Practices' Handbook for the Identification and Collection of 'Good Practices' in Short Food Supply Chains*. SKIN project (Horizon 2020). DOI:10.13140/RG.2.2.18873.67682. Available at: https://www.researchgate.net/publication/318212410_SKIN_'Good_Practices'_Handbook_for_the_Identification_and_Collection_of_'Good_Practices'_is_Short_Food_Supply_Chains_SKIN_project_Horizon_2020
- Wielinga, E., Paree, P. (2016) *Report on the development and final methodology for the AgriSpin Cross Visits: An Improved Methodological Approach*. AgriSpin project Deliverable 2.4

Session 4E

SUPPORTING AGROECOLOGICAL TRANSITION: NEW METHODS AND APPROACHES

Agroecological transitions in the Douro wine region: Trade-off Analysis (TOA) methodology

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Short abstract

The agroecological transition in wine-producing regions involves navigating complex *trade-offs* between environmental sustainability, economic viability, and social resilience. This study aims to develop and apply a transdisciplinary framework to support decision-making in agroecological transitions by evaluating socio-ecological *trade-offs* in viticulture. Focusing on the Douro Valley (Portugal), the research integrates participatory methodologies, modeling tools, and scenario analysis to co-produce knowledge with local stakeholders. The methodological approach includes a systematic literature review, a multi-criteria assessment of decision-support tools, and empirical fieldwork using participatory interviews, scenario construction, and *trade-off* analysis. The findings are expected to identify innovative practices and context-specific pathways to sustainable viticulture, while addressing conflicts between productivity, biodiversity, climate adaptation, and socio-economic dimensions. This framework contributes to operationalizing agroecology in territorial development, aligning scientific evaluation with the realities and needs of winegrowers. The outcomes will also provide inputs for policy instruments, such as the Common Agricultural Policy, to better support agroecological transitions.

1. Purpose

In the context of Mediterranean viticulture, the impacts of climate change, soil degradation, water scarcity, and pressure from global markets have driven the search for more sustainable alternatives. These solutions include, for example, the adoption of cover crops, the reduction of pesticide use, the integration of digital technologies, and the diversification of value chains (Altieri et al., 2015; Fonseca et al., 2024). However, these transformations entail the management of socio-ecological *trade-offs*—namely, compromises between potentially conflicting objectives such as productivity, biodiversity conservation, social equity, and economic viability (Antle & Valdivia, 2021; Breure et al., 2024).

Despite the growing body of literature on agroecology, methodological gaps persist in the integrated assessment of such *trade-offs*, particularly in mountainous winegrowing regions. Many approaches remain fragmented, focusing on technical or ecological indicators while neglecting institutional, participatory, and territorial dimensions that are crucial to agroecological transition (Guzmán et al., 2018; Rocher et al., 2024). This limitation undermines the ability of winegrowers and farm managers to make informed decisions that are adapted to the complexity of their systems.

The research aims to respond to a critical gap in agroecological transition studies: the lack of integrated frameworks that support decision-making based on the analysis of *trade-offs* among ecological, economic, and social dimensions. The purpose of this study is twofold. First, it seeks to conceptualize and implement a participatory framework to assess *trade-offs* in viticulture systems undergoing agroecological transformation. Second, it intends to apply this framework in the Douro Valley to identify context-specific strategies that foster sustainable practices while acknowledging territorial particularities such as steep slopes, biodiversity, cultural heritage, and aging rural populations. This work contributes to broader sustainability goals by facilitating locally adapted solutions and supporting transitions aligned with EU policy priorities such as the Green Deal and Farm to Fork Strategy.

2. Methodology

This scientific research project adopts a mixed-methods and transdisciplinary approach, combining qualitative and quantitative methods to develop and test a decision-support framework in the context of socio-ecological *trade-offs* associated with agroecological transitions in wine-producing regions. The methodology is structured into five sequential and interdependent stages, integrating literature review, theoretical-conceptual development, and empirical field application.

Stage 1: Systematic literature review - Using the PRISMA protocol, a systematic review of academic literature on agroecological transitions in Mediterranean viticulture is conducted. The review includes bibliometric analysis (e.g., keyword co-occurrence, thematic mapping) and qualitative content analysis to assess methodological trends, participation levels, and *trade-off* themes. This stage identifies research gaps and theoretical frameworks relevant to *trade-off* analysis in viticulture.

Stage 2: Integrative review of decision-support tools - This phase analyzes existing multi-criteria and *trade-off* methodologies, evaluating their capacity to integrate ecological, economic, and social indicators. A matrix of tools is developed, classifying methods based on participatory potential, indicator relevance, data requirements, and scalability. This review supports the conceptual design of the *trade-off* framework.

Stage 3: Development of the framework - A participatory *trade-off* analysis framework is designed by integrating findings from Stages 1 and 2. The framework includes (i) co-constructed sustainability indicators, (ii) actor typologies, (iii) participatory scenario-building, and (iv) *trade-off* visualization tools (e.g., spider graphs, decision trees). The framework emphasizes transdisciplinarity, integrating local and scientific knowledge.

Stage 4: Empirical application in the Douro Valley - Semi-structured interviews, stakeholder mapping, and participatory workshops are conducted with winegrowers, cooperatives, technicians, and policy actors. Scenarios reflecting plausible futures (e.g., climate adaptation strategies, market changes) are developed and evaluated by stakeholders using multi-criteria ranking and *trade-off* dialogues.

Stage 5: Validation and synthesis – The final stage includes validating the framework with stakeholders and synthesizing findings in a format accessible to researchers and policymakers. Emphasis is placed on deriving policy-relevant recommendations and operational guidelines for local institutions.

3. Findings (expected)

Preliminary findings from the literature review and early field interviews suggest:

- A predominance of ecological approaches in agroecological research, with underrepresentation of social and institutional dynamics.
- Limited integration of participatory methods and scenario-building tools.

- Frequent but implicit reference to *trade-offs*, especially between productivity and biodiversity, or between innovation and farmer capacity.
- Recognition among Douro stakeholders of environmental pressures (e.g., erosion, climate risk) and growing interest in sustainable practices, though often constrained by market structures and institutional barriers.

The application of the framework is expected to surface latent tensions, such as:

- Productivity vs. soil conservation in steep-slope viticulture.
- Short-term profitability vs. long-term climate resilience.
- Technological innovation vs. generational renewal and local capacity.

By formalizing these *trade-offs* through actor engagement and visual tools, the research will offer nuanced pathways for action that are context-sensitive and participatory.

4. Practical Implications

This scientific research aims to advance the theoretical and methodological understanding of agroecological transitions in the wine sector by designing and validating a decision-support framework co-created with winegrowers. This framework will enable them to assess and manage the socio-ecological *trade-offs* inherent in transformations of their production systems. The expected outcomes are structured along three dimensions: systematized scientific knowledge, methodological innovation, and territorial application.

First, the study aims to produce an in-depth mapping of the scientific literature on agroecological transitions in viticultural contexts globally, with particular attention to the practices, trajectories, and decision-making models adopted. This analysis will identify the types of transitions underway—such as the adoption of regenerative practices, conversion to organic production, productive diversification, or agroforestry integration—as well as the contextual factors influencing their implementation (González de Molina et al., 2019; Tiftonell, 2020). The characterization of decision-making processes associated with these transitions will also shed light on the role of different forms of knowledge—scientific, technical, and local—in shaping sustainable strategies, contributing to a more robust understanding of agri-food system transformation conditions (Duru et al., 2015; Mier y Terán Giménez Cacho et al., 2018).

Second, the integrative review of decision-support methodologies in *trade-off* contexts will systematize the most relevant analytical and participatory approaches for the field of agroecology. The objective is to identify models and tools capable of addressing multiple criteria and values, acknowledging that farmers' decisions are not solely technical or economic but also social, ethical, and territorial (Loos et al., 2014; Lamine et al., 2021). The comparative analysis of instruments such as multi-criteria analysis, biophysical-economic models, and participatory co-assessment processes will highlight their potential, limitations, and suitability for Mediterranean viticultural systems.

Third, the study aims to develop a transdisciplinary *trade-off* analysis framework that not only integrates economic, environmental, and social dimensions but is also tested and adapted to the empirical context of the Douro region. This framework is intended to enable winegrowers to visualize the potential implications of diverse technical and strategic choices—such as replacing herbicides with cover crops, introducing digital sensors for environmental monitoring, or reducing fossil fuel use—thus fostering a deliberative and reflective approach to the future of their production systems (Magne et al., 2022; Paracchini et al., 2019). Additionally, the framework is expected to serve as an educational tool, encouraging dialogue between wine producers, technicians, and researchers, and facilitating the negotiation of multiple objectives in a context of complexity and uncertainty.

The empirical application of the framework in the Douro region will help identify concrete patterns of *trade-offs* faced by local winegrowers, reveal tensions between productivity and sustainability, and illustrate possible pathways for more integrated and resilient agroecological transitions. The results may inform public policy and technical support instruments, while also strengthening local capacities for autonomous and informed decision-making (HLPE, 2019; Madureira et al., 2021).

Finally, this research aspires to make an innovative contribution to advancing methodologies for agroecological sustainability assessment by moving beyond unidimensional approaches and proposing an operational framework that links analytical knowledge with the experiential knowledge of local actors. By placing winegrowers at the center of the decision-making process and incorporating the plurality of values and objectives at stake, this framework can be adapted to other agricultural and geographical contexts, contributing to the dissemination of transformative and contextually relevant practices across agri-food systems. In this sense, the expected outcomes aim both at scientific knowledge production and the delivery of practical, field-oriented solutions.

5. Theoretical Implications

This research aims to make a significant contribution to the advancement of theoretical, methodological, and practical knowledge regarding agroecological transitions in viticultural contexts, at a time when the urgency of transforming agri-food systems is widely recognized in the face of multiple environmental, social, and economic challenges. The proposal is grounded in a transdisciplinary approach that integrates agroecological science with local knowledge and the decision-making processes of territorial actors, following a logic of co-production of contextualized and actionable solutions.

From a scientific standpoint, the study contributes to a deeper understanding of the dynamics and constraints that shape agroecological transitions, addressing not only the technical aspects of sustainable practices but also the social and political processes that enable or hinder their implementation (González de Molina et al., 2019; Lamine et al., 2021). The integrated analysis of transition pathways in wine regions will highlight the diversity of possible trajectories, challenging normative and linear models of change and valuing the plurality of adaptive strategies developed by farmers in specific contexts (Duru et al., 2015; Tittone, 2020).

Methodologically, the research advances the construction and validation of a socio-ecological *trade-off* analysis framework designed to support winegrowers' decision-making processes during transitions. By combining analytical tools (e.g., multi-criteria analysis and biophysical-economic modeling) with participatory methodologies (e.g., deliberative workshops and scenario building), this approach enables the integration of multiple evaluation criteria, reflecting the values and preferences of the actors involved (Loos et al., 2014; Magne et al., 2022). This contribution is particularly relevant in a field still largely dominated by technocratic approaches, which tend to marginalize local knowledge and the complexity of agricultural decisions (Mier y Terán Giménez Cacho et al., 2018).

At the applied level, the research seeks to generate tangible impacts in the Douro Valley territory by strengthening the agency of winegrowers in response to pressures associated with intensification, climate change, and market demands. By providing a decision-support tool that is sensitive to local contexts and oriented toward sustainability, the project is expected to foster social and technical innovation processes that enhance the resilience of viticultural systems while valuing endogenous resources, ecosystem services, and territorial cohesion (Madureira et al., 2021; HLPE, 2019).

Additionally, the proposed framework can be replicated or adapted to other Mediterranean farming contexts, contributing to the development of public policies that are more

responsive to territorial diversity and the challenges of small- and medium-scale agriculture. Its articulation with existing planning and evaluation instruments (such as agroecological sustainability indicators or participatory technical advisory systems) may further enhance its relevance and utility for policymakers and rural development institutions (Paracchini et al., 2019).

Finally, this research is of broader relevance within the context of the transition toward sustainable food systems, recognizing the centrality of agroecology as a science, a practice, and a transformative movement. By contributing to the operationalization of agroecological principles in sectors of high economic and symbolic value—such as viticulture—this work actively supports the development of solutions anchored in social equity, ecological circularity, and long-term economic viability (Altieri & Nicholls, 2020; Wezel et al., 2020).

6. References

- Altieri, M. A., & Nicholls, C. I. (2020). Agroecology: Emerging trends and future directions. *Agronomy*, 10(3), 483. <https://doi.org/10.3390/agronomy10030483>
- Altieri, M. A., Nicholls, C. I., Henao, A., & Lana, M. A. (2015). Agroecology and the design of climate change-resilient farming systems. *Agronomy for Sustainable Development*, 35(3), 869–890. <https://doi.org/10.1007/s13593-015-0285-2>
- Antle, J. M., & Valdivia, R. O. (2021). Trade-off analysis for sustainable agriculture and climate change adaptation. *Agricultural Systems*, 190, 103096. <https://doi.org/10.1016/j.agsy.2021.103096>
- Breure, T. S., Estrada-Carmona, N., Petsakos, A., & Antle, J. M. (2024). A systematic review of the methodology of trade-off analysis in agriculture. *Nature Food*, 5, 211–220. <https://doi.org/10.1038/s43016-024-00926-x>
- Duru, M., Therond, O., & Fares, M. (2015). Designing agroecological transitions; A review. *Agronomy for Sustainable Development*, 35(4), 1237–1257. <https://doi.org/10.1007/s13593-015-0318-x>
- Fonseca, A., Polita, F., & Madureira, L. (2024). How agroecological transition frameworks are reshaping agroecology: A review. *Land*, 13(11), 1930. <https://doi.org/10.3390/land13111930>
- González de Molina, M., López-García, D., & Sevilla Guzmán, E. (2019). Agroecology and politics: How to get sustainability? About the necessity for a political agroecology. *Agroecology and Sustainable Food Systems*, 43(10), 1181–1205. <https://doi.org/10.1080/21683565.2019.1629482>
- Guzmán, G. I., López, D., Román, L., & Alonso, A. M. (2018). Participatory action research in agroecology: Building local organic food networks in Spain. *Agroecology and Sustainable Food Systems*, 42(3), 243–262. <https://doi.org/10.1080/21683565.2017.1394418>
- HLPE – High Level Panel of Experts on Food Security and Nutrition. (2019). Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. *Committee on World Food Security*. <http://www.fao.org/3/ca5602en/ca5602en.pdf>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>
- Paracchini, M. L., Bulgheroni, C., Borreani, G., Tabacco, E., Banterle, A., Bertoni, D., ... & Macaluso, D. (2019). A diagnostic system to assess sustainability at a farm level: The SOSTARE model. *Agricultural Systems*, 173, 184–195. <https://doi.org/10.1016/j.agsy.2019.03.007>
- Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., ... & Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural

-
- resource management. *Journal of Environmental Management*, 90(5), 1933–1949. <https://doi.org/10.1016/j.jenvman.2009.01.001>
- Rocher, L., Melloul, E., Blight, O., & Bischoff, A. (2024). Effect of spontaneous vegetation on beneficial arthropods in Mediterranean vineyards. *Agriculture, Ecosystems & Environment*, 359, 108740. <https://doi.org/10.1016/j.agee.2023.108740>
- Tittonell, P. (2020). Assessing resilience and adaptability in agroecological transitions. *Agricultural Systems*, 184, 102862. <https://doi.org/10.1016/j.agsy.2020.102862>
- Wezel, A., Herren, B. G., Kerr, R. B., Barrios, E., Gonçalves, A. L. R., & Sinclair, F. (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. *Ecological Indicators*, 108, 105107. <https://doi.org/10.1016/j.ecolind.2019.105107>
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Impact of Agricultural Extension on Agroecological Transitions of peri-urban Market Gardening in Ouagadougou (Burkina Faso): A Kirkpatrick Model Evaluation

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Short abstract

Purpose | This study investigates the impact of agricultural extension and advisory services (EAS) on enhancing the implementation and outcomes of agroecological transitions processes in market gardening, and thus to the emergence of urban sustainable agrifood systems.

Design/Methodology/Approach | The study was conducted in the peri-urban area of Ouagadougou in Burkina Faso. A mixed methods was used. 416 market gardeners were interviewed on their adoption of agroecological practices, their access to EAS, and their perception of the effect EAS on the implementation and outcomes of the agroecological transitions of their farms. The effectiveness of EAS was evaluated at four of the adoption sequences: Reaction, Learning, Implementation and Results. The random mixed effect ANOVA model was applied. The Sankey diagram was used to visualise the progression of the modalities of the different adoption sequences: Interviews and a participatory analysis were conducted to identify and explore factors influencing the effects of EAS, and draw solutions.

Findings | The interest of market gardeners in agroecology is growing. The adoption rate of agroecological practices is still low. EAS are provided by a variety of operators and are accessible to only 46 % of producers. Access to EAS has an overall positive effect on all adoption sequences of agroecological practices. It helps to raise awareness, meeting the challenges of co-creating new knowledge, developing new capacities of producers to

address challenges and seize the opportunities related to the adoption of agroecology. The magnitude of effects of EAS decreases along the adoption sequence, from access to services to the acquisition of knowledge, its implementation and its impact on the application of agroecology. That decrease is related to the quality of the services provided, the socio-economic profile of producers, intrinsic features of agroecology but also and above all to access to other innovation support services essential for the implementation of agroecology.

Practical and theoretical implications | The results showed that the successful promotion of agroecology requires adequate investment in EAS and other innovation support services. An evaluation based on the Kirkpatrick model is an effective approach to highlight the conditions for successful adoption sequences. The evaluation of the effects of EAS should be done within the overall framework of the innovation ecosystem. Beyond evaluating the effects of access to services, the Kirkpatrick model can reveal the state of the innovation ecosystem and enable the development of a sound theory of change for EAS interventions for agroecological transitions.

Keywords | pluralistic extension and advisory services, sustainable agriculture, adoption, innovation support services, West Africa

Co-design of SMART indexes to assess agrobiodiversity in NUC farming: the experience of 9 Living Labs in Europe

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Short abstract

This paper presents a participatory approach to co-designing SMART indicators for assessing ecosystem services (ES) in agrobiodiverse farming systems, with a focus on neglected and underutilised crops (NUCs). Developed within the Horizon 2020 DIVINFOOD project, the indicators were co-created by stakeholders—farmers, researchers, technicians, and retailers—across nine European Living Labs. The methodological framework was based on the Common International Classification of Ecosystem Services (CICES v5.1) and structured around interactive workshops using card games, ranking exercises, and World Café discussions. Eight key ecosystem services were prioritized, and 21 SMART indicators were finalized, including field-validated metrics for food provision, genetic diversity, soil regulation, pest control, and more. The indicators were selected based on ease of use, cost-efficiency, and relevance to NUC farming systems. Initial empirical data were collected from 27 on-farm trials, validating key indicators such as yield, species diversity, and weed suppression. These indicators offer practical tools for farmers to monitor sustainability, provide empirical backing for policy advocacy, and enhance the visibility of NUCs in agri-food systems. The results contribute to a growing body of research on participatory ecosystem assessment and support transitions toward more resilient and diversified agricultural landscapes.

Keywords: agrobiodiversity, Living Lab, ecosystem services, neglected and underutilized crop (NUC), co-design.

1. Purpose

Measuring ecosystem services (ES) is widely recognised as essential for understanding ecosystem dynamics, evaluating human impacts, and guiding sustainability strategies in agriculture. The ability of ecosystems to provide multiple services—ranging from food provision to climate regulation—depends on their health, resilience, and biodiversity (Layke, 2009; Maes et al., 2016). Particularly, healthier ecosystems tend to deliver a wider array of benefits over longer time periods (Millennium Ecosystem Assessment [MEA], 2005). However, while ecosystem services frameworks have matured significantly, translating their complexity into actionable tools remains a challenge, especially in agricultural systems dominated by data variability, methodological inconsistencies, and undervalued stakeholder knowledge (Locatelli et al., 2017).

This extended abstract presents a novel set of co-designed SMART indicators—Specific, Measurable, Achievable, Relevant, and Time-bound—for assessing ecosystem services in agrobiodiverse farming systems. These indicators were developed through participatory processes across nine Living Labs in Europe as part of the H2020 **DIVINFOOD** project, which promotes the cultivation and valorisation of **Neglected and Underutilised Crops (NUCs)**. NUCs include crop species largely overlooked by mainstream agriculture, policy, and research, yet they are often well adapted to local conditions and culturally significant (Padulosi et al., 2002). By co-designing monitoring tools with actors across the food value chain—farmers, technicians, processors, retailers, researchers, and NGOs—DIVINFOOD aims to both assess and enhance the ecological and socio-economic benefits of NUCs in diverse European contexts.

The rationale behind the SMART indicators is twofold: first, to operationalize the assessment of ecosystem services using methods that are both scientifically rigorous and farmer-friendly; second, to raise awareness of the multifunctionality of NUC-based systems, thereby enhancing their perceived value in the market and among policymakers. The approach embraces the complexity of agrobiodiversity by expanding traditional genotype-environment models ($G \times E = \text{yield and quality}$) to include a broader array of ecological, social, and economic benefits ($G \times E = \text{ES} + \text{other benefits} + \text{costs}$). This paper highlights how stakeholder engagement in knowledge co-production fosters more locally relevant, inclusive, and sustainable agricultural innovations.

2. Methodology

The co-design of the SMART indicators unfolded through a robust participatory methodology embedded in the DIVINFOOD project's Living Labs. These Living Labs served as regional hubs for experimentation, dialogue, and iterative learning involving multi-actor groups along the food value chain. The methodological approach drew heavily from sustainability science, food democracy principles (Lang, 1998), and frameworks promoting inter- and transdisciplinarity (Bettencourt & Kaur, 2011).

2.1. Ecosystem Services Framework

The methodology was anchored in the **Common International Classification of Ecosystem Services (CICES v5.1)**, a comprehensive and hierarchical classification system widely adopted in both research and policy domains (Czúcz et al., 2018). CICES was selected over alternatives like TEEB or TAPE due to its capacity to avoid misclassifications and better capture linkages between ecosystems and human well-being. Eight ecosystem services were shortlisted from the original 86 listed in CICES, based on relevance to NUCs, feasibility of measurement, and

stakeholder input. These included: food provision, regulation of soil quality, genetic resources, regulation of baseline flows and extreme events, pollination, pest/disease/weed control, habitat provision, and cultural services.

2.2. Participatory Workshop Design

A tailored half-day workshop was developed to support the co-selection of ecosystem services and indicators. This workshop employed a **“card game”** format to facilitate understanding and engagement. Each ES was represented on a card with simplified descriptions, and participants used a voting system to prioritize services for monitoring. Three ecosystem services were mandatory across all Living Labs—food, genetic resources, and pest/disease/weed control—to ensure cross-site comparability.

Workshops were structured in four phases:

1. **Prioritization** of ecosystem services through individual and group reflection.
2. **Plenary voting** to finalize ES selection.
3. **World Café sessions** to identify or refine indicators for selected ES.
4. **Final plenary discussion** to assign monitoring responsibilities and reflect on the process.

In addition to the workshop, some sites implemented a **“Treasure Hunt”** pre-activity to ground abstract ES concepts in local landscapes, encouraging participants to identify tangible examples of services in the field.

2.3. Expert Panel and Indicator Pre-selection

An expert panel composed of agronomists, ecologists, and social scientists collaborated to develop a preliminary matrix of 44 indicators. These were reviewed and enriched by workshop participants. Ultimately, 21 indicators were validated through empirical on-farm data collection and stakeholder deliberation.

3. Findings

The co-design process resulted in a final set of **21 SMART indicators** covering the eight selected ecosystem services. These indicators are specific enough to guide action at farm and landscape levels, yet simple enough to be integrated into routine practice with minimal technical or financial burden.

3.1. Ecosystem Services Relevance

Workshop participants—particularly farmers—ranked food provision as the most relevant ecosystem service, emphasizing both subsistence and market potential of NUCs. This was followed by regulation of soil quality and conservation of genetic resources. Least prioritized was cultural value, despite some recognition of its tourism and local identity roles. Figure 1 visualises these preferences using a weighted average system based on votes across the nine workshops.

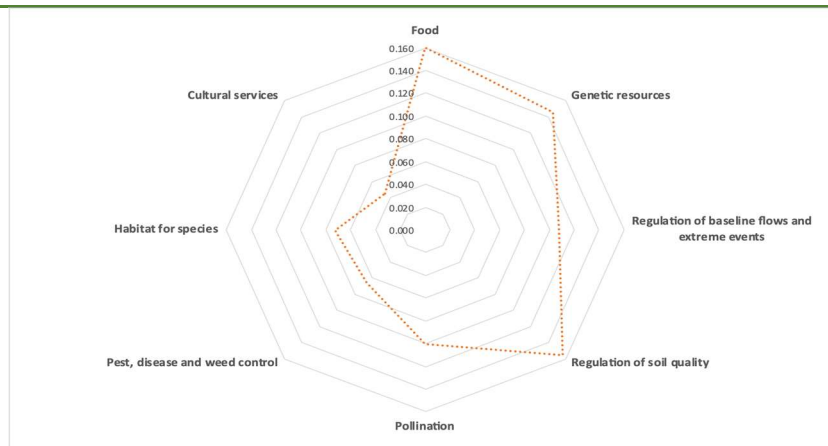


Figure 1: Relevance of the Ecosystem Services, as perceived by group ‘producers’

3.2. Indicator Selection

From the initial pool, participants suggested 23 new indicators and 16 alternative measurement techniques. For example, in relation to soil quality, participants proposed monitoring topsoil pH using simple paper strips, and nitrogen fixation through crop residue analysis. Under genetic resources, indicators included the number of NUC species grown and their plot proportions.

A few key indicators from the final SMART table include:

- **Food:** NUC yield (kg/m^2), stability of yield and demand, and protein content.
- **Soil quality:** nitrogen content, pH, fertilizer use, and plant residues.
- **Pest control:** weed coverage (%), rotation practices, early plant vigour.
- **Genetic resources:** number of cultivated NUC species, diversity of cultivars, rotation components.

The indicator set thus enables a multidimensional assessment of ecosystem services from NUC systems, while offering a flexible monitoring protocol aligned with local capacity.

3.3. Empirical Validation

During the second farming season, data were collected across 27 on-farm trials in seven Living Labs, validating eight mandatory indicators. This included yield, number of NUC species, and weed coverage. Standardization of data (e.g., converting yield to kg/m^2) facilitated comparative analysis, despite diversity in farming contexts and crop types.

4. Practical Implications

The co-designed SMART indicators represent a substantial advance in translating ecosystem services theory into **farm-level practice**. They offer several practical contributions:

- **Policy Advocacy:** The indicators provide robust, field-validated metrics to advocate for NUC inclusion in agri-food policy, biodiversity conservation, and climate strategies. Their simplicity enhances communication with non-expert audiences, including policymakers and consumers, bridging the science-policy gap.
- **Farmer Empowerment:** Because the indicators were co-developed with and for farmers, they reflect local realities and promote autonomy in agroecological monitoring. Farmers can track ecological outcomes, improve agronomic practices, and substantiate claims of environmental stewardship in value chain negotiations.

- **Sustainability Transitions:** The monitoring framework supports regional food system transitions by making visible the multi-functionality of underutilised crops. This visibility is essential to building legitimacy around non-mainstream practices and creating new markets for alternative crops.
- **Replicability and Scalability:** The methodology is adaptable to other regions, crops, or farming systems. Its alignment with the CICES framework also ensures interoperability with global biodiversity monitoring efforts, such as IPBES and the EU Biodiversity Strategy for 2030.
- **Transdisciplinary Knowledge Co-production:** Finally, the project demonstrates how knowledge co-production can enrich sustainability science. It validates a research approach that transcends disciplinary silos, integrates farmer knowledge, and enhances the societal relevance of ecosystem services assessments (Waltner-Toews et al., 2003).

5. References

- Czúcz, B., Arany, I., Potschin-Young, M., Bereczki, K., Kertész, M., Kiss, M., ... & Haines-Young, R. (2018). Where concepts meet the real world: A systematic review of ecosystem service indicators and their classification using CICES. *Ecosystem Services*, 29, 145-157.
- Layke, C. (2009). *Measuring Nature's Benefits: A Preliminary Roadmap for Improving Ecosystem Service Indicators*. WRI Working Paper. World Resources Institute, Washington DC. <http://www.wri.org/project/ecosystem-service-indicators>.
- Locatelli, B., Vallet, A., Fedele, G., & Rapidel, B. (2017). Analyzing ecosystem services to manage territories. In *Living territories to transform*, 106.
- Maes, J. et al. (2016). An indicator framework for assessing ecosystem services in support of the EU Biodiversity Strategy to 2020. *Ecosystem Services* 17, 14–23. <http://dx.doi.org/10.1016/j.ecoser.2015.10.023>
- Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC. ISBN 1-59726-040-1
- Padulosi, S., Hodgkin, T., Williams, J.T., Haq, N. (2002). Underutilized crops: trends, challenges and opportunities in the 21st Century. In: J.M.M. Engels, V.R. Rao, A.H.D. Brown, M.T. Jackson eds. *Managing plant genetic diversity*. Wallingford, UK: CABI Publishing; Rome: International Plant Genetic Resources Institute (IPGRI).
- Szira F. et al. (2024). *Deliverable 3.2 - Report on NUCs agronomic performances in specific environments of the first selected varieties (season 1&2)*. DIVINFOOD project.

Land use characterization in the Itamarati settlement through aerial survey: contributions to research, rural and university extension, and agrifood system transformation

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Short abstract

This study analyzes land use in the Itamarati settlement, the largest agrarian reform area in Latin America, to understand its implications for family farming, public policy, and agri-food

system transformation. Drone imagery from 2023 covered 17 farms (totaling 200.08 ha) and identified key land use categories: agricultural production (PA), low-growing vegetation (VR), and exposed soil (SE). Land use efficiency ($PA/TT \times 100$) varied across farms, averaging 60%; those with lower soil exposure tended to be more efficient. Strong positive correlations between PA and total area (TT), and between VR and TT, suggest larger properties have more productive land and vegetative cover. Cluster analysis revealed distinct farm profiles, and factor analysis showed land use is shaped by multiple interacting variables. The results underscore the role of education and technical assistance in promoting sustainable land use practices. The study reinforces the theoretical relevance of landscape configuration and localized knowledge in agri-food systems and supports practical applications through targeted rural extension and data-informed planning to improve productivity and resilience among family farmers.

1. Purpose

This study characterizes land use across rural properties within the Itamarati settlement—Latin America's largest agrarian reform area—to offer insights to support family farming, inform public policy, and contribute to the transformation of agrifood systems in rural reform contexts. Using drone-based imagery and statistical analyses, the research aimed to assess variability in land use, intensity of agricultural exploitation, and relationships among land use categories.

2. Design

Drone-based aerial imagery collected in 2023 by the Rural Development Center Project (Federal University of Grande Dourados) was used to map land use across 17 rural properties in Ponta Porã, Mato Grosso do Sul, Brazil. Land use was classified into nine categories (anthropized area (AA); vegetated area (AV); water body (MDA); agricultural production (PA); unspecified production areas (APNE); exposed soil (SE); arboreal vegetation (VA); low-growing vegetation (VR); native vegetation (VN) and analysed individually and collectively using descriptive statistics (mean, standard deviation, minimum, maximum, and area percentages).

One-way ANOVA (5% significance level), followed by Tukey's test, was used to compare means among land use categories (LUCs) and total area (TT), identifying intensively used categories. Spearman correlation (5%) was applied to assess associations among LUCs, including an efficiency index ($PA/TT \times 100$) to evaluate land use for agriculture. Multivariate analysis, including cluster analysis and factor analysis, was performed in Minitab to identify patterns of similarity between land use categories and rural properties.

3. Findings

The total area of the 17 rural properties was 200.08 hectares (100%), divided among the LUC categories in descending order: PA (36.81%), VR (24.42%), SE (20.05%), AV (7.33%), VN (4.19%), APNE (3.51%), VA (2.25%), MDA (0.82%), and AA (0.30%).

The variable means (in descending order), along with standard deviations and ranges, were as follows: TT: 11.77 ± 12.32 (2.20–50.51); PA: 6.14 ± 5.21 (0.49–15.62); VR: 2.87 ± 3.98 (0.16–16.25); SE: 2.36 ± 6.66 (0.00–26.19); VN: 1.19 ± 2.08 (0.06–5.66); AV: 0.86 ± 1.32 (0.01–4.99); APNE: 0.58 ± 1.21 (0.01–4.30); VA: 0.26 ± 0.23 (0.002–0.78); MDA: 0.18 ± 0.30 (0.01–0.99); and AA: 0.035 ± 0.019 (0.01–0.07).

Comparison tests showed that TT had significantly higher means than all LUC categories ($P < 0.05$), except for PA, where no significant difference was found ($P > 0.05$). The means among the nine LUC categories were not significantly different from one another ($P > 0.05$).

Correlation analysis revealed strong positive relationships between PA and TT, and between VR and TT ($P \leq 0.001$). Moderate positive correlations were also found between SE and AV, VR and AV, and VR and PA ($P < 0.05$). No significant correlations were observed among the remaining variables ($P > 0.05$). These findings suggest that greater total area (TT) tends to be associated with larger areas of PA and VR. Additionally, an increase in VR was related to increases in both AV and PA, possibly indicating spatial proximity or transitional use, such as agricultural areas adjacent to or alternating with pastureland. The correlation between SE and AV may reflect agricultural cycles that temporarily expose soil between planting periods.

Factor analysis indicated that the largest variations in land use were explained by PA, SE, and VR, while the smallest were associated with MDA and VA. The first rotated factor accounted for approximately 70% of the variance, with high positive loadings on PA, SE, TT, VR, VN, and AV. The second rotated factor showed high positive loadings on APNE and AA and high negative loadings on VA and MDA. Dendrograms identified clusters of farms with similar characteristics, suggesting opportunities for collaborative efforts and knowledge sharing among farmers. Variable clustering also revealed three major groups: (1) AA and APNE, (2) MDA and VA, and (3) the remaining LUC variables.

Land use intensity, calculated as $PA/TT \times 100$, varied considerably across farms, with an average efficiency of 60% (range: 18.96%–89.54%). Farms with lower soil exposure (SE) tended to show higher efficiency (t-test = -1.87; $P = 0.09$).

In summary, rural properties were predominantly characterized by a strong agricultural orientation or potential among land reform settlers in Itamarati.

4. Practical Implications

The study is relevant for rural development programs and agricultural extension services (Souza-Esquerdo, Sieber, & Bergamasco, 2022). Using the systematized data can be strategic to update, advise, and collaboratively develop knowledge at multiple levels (Álvarez de Fernández, Rivera, & Rojas, 2006). High variability in exposed soil (2.36 ± 6.65) suggests the adoption of divergent soil management practices (Ali & Salam, 2021). The variation in land use strategies among clusters of farms may lead to differentiated technical advisory approaches (Conti, Villalba, & Landini, 2024). This means that field extension agents may develop capacity building tailoring support based on specific land use profiles (Moita & Andrade, 2009).

In practice, VR areas may have greater potential for agricultural use, particularly as pasture or in mixed-use vegetation systems (Opedes, Nedala, Múcher, Baartman, & Mugagga, 2023). Such integration could support local biodiversity (especially pollinators and other ecosystem services), which, in turn, may enhance agricultural productivity, income generation, and food security (Dewa, Makoka, & Ayo-Yusuf, 2022). Farms with higher efficiency and lower soil exposure can serve as references or starting points

for knowledge sharing and mutual learning (Kitchen, Clay, Shannon, & Clay, 2018).

Although based on a single-year dataset, the observed land use variability and production–soil correlations add to the advisory landscape and provide actionable insights into local management patterns (Ackerman & Stein, 2008). While revitalising rural areas and securing food security, further efforts should tackle aspects such as traceability of food production,

community identity, and social organisation (Pavlov & Kudryavtsev, 2020). Educational programs that facilitate peer exchanges could accelerate sustainable practices in food production and livelihood (Fernández, Rojas, Llauro, Hermidas, & Pérez, 2017).

The findings can support land use planning so that stakeholders (including policymakers) could apply similar methods to identify trends, prioritize areas for intervention, or monitor policy impacts over time (Bojer & Assen, 2022). The use of efficiency indicators could be adopted as a practical metric for evaluating land use intensity across different contexts, helping people and institutions to monitor progress and outcomes (Mantey, 2019).

Agrifood system transformation in rural settlements depends on embedding education and training into land reform programs (Vargas, Thies, & Camargo, 2022). Thus, education programs in rural areas should be a core pillar (not just as a support activity) of rural development policy to assist transition pathways towards sustainable agriculture and agrifood economies (Haynes-Maslow, Osborne, & Pitts, 2018).

5. Theoretical Implications

This study contributes to the theoretical understanding of how land use dynamics reflect broader socio-technical systems in agrarian reform areas (Naufal, Asriadi, & Absar, 2022). By identifying patterns of correlation, land use efficiency, and clustering of property profiles, land management can be further linked to barriers and opportunities perceived by farmers (resource availability, land use intentions, among others) (Bojer & Assen, 2022). This supports the broader theoretical claim that agrifood system transformation is not only technical or economic, but also deeply connected to spatial patterns, local strategies, and knowledge flows (Mantey, 2019). It also reinforces frameworks that view agroecological transitions and territorial development as driven by learning, adaptation, and context-specific choices (Naufal et al., 2022).

Furthermore, the finding that efficiency varied significantly with lower soil exposure suggests that biophysical indicators can serve as proxies for management quality, offering a bridge between land use science, rural advisory systems, and farmer behavior (Haynes-Maslow et al., 2018).

6. References

- Ackerman, D., & Stein, E. D. (2008). Estimating the variability and confidence of land use and imperviousness relationships at a regional scale. *JAWRA Journal of the American Water Resources Association*, 44(4), 996–1008. <https://doi.org/10.1111/j.1752-1688.2008.00215.x>
- Ali, M., & Salam, M. (2021). Assessment of land use and land cover changes in Savar Upazila under Dhaka district in Bangladesh: A remote sensing (RS) – geographic information system (GIS) approach. *International Journal of Research and Studies Publishing*, 11(12), 399–406. <https://doi.org/10.29322/ijrsp.11.12.2021.p12057>
- Álvarez de Fernández, T., Rivera, A. B., & Rojas, L. R. (2006). Algunas recomendaciones para la integración de los actores del proceso investigativo y la extensión en la educación superior. *Revista de Ciencias Sociales*, 12(1), 84–92.
- Bojer, A., & Assen, M. (2022). GIS and remote sensing-based land degradation assessment and mapping: Case study Adea Woreda. *Research Square*. <https://doi.org/10.21203/rs.3.rs-1876897/v1> (Preprint).
- Conti, S., Villalba, A. E., & Landini, F. P. (2024). Vínculos entre investigación agropecuaria y extensión rural: Factores clave y propuestas de abordaje desde una revisión sistemática de literatura. *Revista de Economía e Sociología Rural*, 62(1), e265087. <https://doi.org/10.1590/1806-9479.2022.265087>

-
- Dewa, O., Makoka, D., & Ayo-Yusuf, O. (2022). A deliberative rural community consultation to assess support for flood risk management policies to strengthen resilience in Malawi. *Water*, 14(6), 874. <https://doi.org/10.3390/w14060874>
- Fernández, L. A. E., Rojas, G. B. P., Llauro, M. L. A. T., Hermidas, N. V. C., & Pérez, L. O. C. (2017). Cómo integrar las actividades extensionistas desde las dimensiones: Académica, laboral e investigativa. *Correo Científico Médico*, 21(4).
- Haynes-Maslow, L., Osborne, I., & Pitts, S. (2018). Best practices and innovative solutions to overcome barriers to delivering policy, systems and environmental changes in rural communities. *Nutrients*, 10(8), 1012. <https://doi.org/10.3390/nu10081012>
- Kitchen, N. R., Clay, S. A., Shannon, D. K., & Clay, D. E. (2018). Understanding and identifying variability. In *Precision agriculture basics*. <https://doi.org/10.2134/precisionagbasics.2016.0033>
- Moita, F. M. G. S. C., & Andrade, F. C. B. (2009). Ensino-pesquisa-extensão: Um exercício de indissociabilidade na pós-graduação. *Revista Brasileira de Educação*, 14(41), 269–280. <https://doi.org/10.1590/S1413-24782009000200006>
- Mantey, S. (2019). Suitability of unmanned aerial vehicles for cadastral surveys. *Ghana Mining Journal*, 19(1), 1–8. <https://doi.org/10.4314/gm.v19i1.1>
- Naufal, N., Asriadi, A., & Absar, S. (2022). Avoiding mistakes in drone usage in participatory mapping: Methodological considerations during the pandemic. *Forest and Society*, 6(1), 226–242. <https://doi.org/10.24259/fs.v6i1.14117>
- Opedes, H., Nedala, S., Múcher, C., Baartman, J., & Mugagga, F. (2023). How can drones uncover land degradation hotspots and restoration hopespots? An integrated approach in the Mount Elgon region with community perceptions. *Land*, 13(1), 1. <https://doi.org/10.3390/land13010001>
- Pavlov, A., & Kudryavtsev, A. (2020). Factors and directions of public policy for rural development. <https://doi.org/10.2991/assehr.k.200113.082>
- Souza-Esquerdo, V. F., Sieber, S. S., & Bergamasco, S. M. P. P. (2022). Desafios do ensino da extensão rural: Práticas e metodologias na produção do conhecimento com agricultores e agricultoras familiares. *Revista Brasileira de Educação do Campo*, 7, e14751. <https://doi.org/10.20873/uft.rbec.e14751>
- Vargas, D. L., Thies, V. F., & Camargo, R. A. L. (2022). Reconfigurações e alternativas para as políticas e os processos de assistência técnica e extensão rural. *Emancipação*, 22, 1–3.

Session 5E

Online

The Role Of Education And Advising In The Implementation Of Agritourism On Farms: Modern Approaches And Prospects

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Short abstract

Agrotourism, a globally expanding sector at the intersection of agriculture and tourism, presents significant opportunities for rural economic diversification, enhanced farm income, and preserving agricultural heritage across diverse international landscapes. The increasing appetite of urban populations for authentic rural experiences, locally sourced food, and connections with nature fuels the growth of agrotourism as a vital strategy for bolstering rural economies and fostering resilience against agricultural market fluctuations. However, the successful integration of tourism activities within working farms worldwide is not without its challenges. Farmers often face a knowledge gap in tourism management, marketing, hospitality, and regulatory compliance, necessitating targeted support for a smooth transition and sustainable operation. Therefore, the roles of training and consulting become crucial in equipping farmers with the necessary skills and knowledge to enhance their competitiveness and ensure the long-term viability of their agrotourism ventures. Across the globe, various innovative approaches to training and consulting are being developed and implemented, tailored to the specific socio-economic contexts, cultural nuances, and levels of tourism infrastructure development in different regions. The role of education and consulting in organizing training and cross-visits in implementing agritourism in farms is considered.

Keyword: agritourism.

1. Purpose

Agritourism is becoming an increasingly popular trend in the global tourism industry. The global agritourism market is expanding rapidly, driven by growing consumer interest in authentic natural experiences. A report by Grand View Research (2025) estimates that the global agritourism market will grow at a compound annual growth rate (CAGR) of 10.9% from 2025 to 2033. However, successful integration of tourism activities into working farms often faces knowledge gaps in tourism management, marketing, hospitality, and compliance, requiring targeted support for a smooth transition and sustainable operation. Training and consultancy, therefore, become crucial in equipping farmers with the necessary skills and knowledge. Various innovative approaches to training and consultancy are being developed and implemented worldwide, tailored to the specific socio-economic contexts, cultural nuances, and levels of tourism infrastructure development in different regions. The

role of education and consultancy in organizing training and cross-visits in implementing agritourism on farms is discussed.

2. Approach

The foundation for the successful implementation of agritourism is education. Farmers must understand the basics of the tourism business, including marketing, service quality management, environmental responsibility, and customer communication. These programs include seminars, webinars, workshops, and training materials. Modern educational programs focus on integrating agritourism into the curricula of agricultural universities and colleges. Advisory services play an important role in bringing innovations to farmers planning to develop agritourism. The primary tool in this is training with the organization of cross-visits. They allow participants to see successful examples of running agritourism businesses, get acquainted with innovative approaches, and receive practical recommendations from colleagues.

3. Finding

Modern approaches to agritourism training and consultancy are characterized by adaptability, accessibility, and the integration of modern technologies. Key methodologies include:

- **Specialized educational programs:** They cover important areas such as tourism principles, marketing and branding for agritourism, hospitality management, sustainable agricultural practices relevant to tourism, rural development strategies, and the legal framework governing tourism activities.
- **Practical workshops and master classes:** These workshops often focus on developing tangible skills such as creating engaging farm tours, organizing on-farm events (e.g., cooking courses, harvest festivals), implementing effective online booking systems, and providing high-quality customer service.
- **Use of digital platforms and e-learning:** Online courses, webinars, interactive learning modules and digital toolkits provide flexible and cost-effective training opportunities for farmers in remote areas. These platforms can cover topics from digital marketing and social media promotion to online booking system management and virtual farm tours.
- **Collaborative networks and industry associations:** These networks often organize seminars, conferences, and study tours, facilitating mutual learning and the dissemination of best practices (e.g., GAN - Global Agritourism Network).
- **On-farm and hands-on training:** Study tours, internships, and exchange programs allow farmers to see first-hand effective operating models, customer engagement strategies, and the integration of agricultural production with tourism.

We propose including training in the basics of agritourism in university curricula for interested students of all disciplines. To this end, we are preparing a new “Agritourism Management” course with an interactive learning system. Training in agritourism will help students navigate their future career choices. Children of farmers and others will have a unique opportunity to learn how to organize and manage agritourism on farms, increasing their competitiveness. This course will also be of interest to extension workers. Organizing agritourism training and cross-visits for farmers allows them to see successful examples of agritourism businesses, learn about innovative approaches, and receive practical recommendations from colleagues. Farmers participating in such programs increase their income by 20–30% (Che et al., 2022) by improving the quality of service and attracting new customers.

4. Practical implications

The organization of advisory services with training is effective when they include training with cross-visits.

Cross-visits involve the exchange of knowledge and experience between farmers (Kastenholz et al., 2021). Such visits allow participants to learn about successful practices, implement local farming methods and improve the quality of services for tourists. It also contributes to the creation of cooperation networks that attract additional resources and investments.

The following stages must be completed to successfully organize cross-visits:

Planning: Defining the objectives of the visit, selecting participants, and developing the program.

Implementation: Conducting visits, including excursions, seminars, and practical classes.

Evaluation: Analyzing the results of the visits and identifying areas for further cooperation.

There are many successful examples of organizing cross-visits in Europe and America. For example, in Germany, this led to an increase in the number of tourists by 15% (Schmidt et al., 2021). In the USA, the Farm-to-Farm Visits program aims to increase farmers' income by 25% (Johnson et al., 2020). Ukrainian farmers, for example, in the Carpathian region, allowed farmers to get acquainted with innovative approaches, such as creating ecological trails, conducting master classes in traditional crafts, and organizing village festivals. Therefore, the development of agritourism on farms requires a comprehensive approach that combines education, advisory support, and innovation with the active participation of local communities, which are the main elements of success in this area. Therefore, agritourism development on farms requires the widespread introduction of an integrated approach combining educational programs and advisory support with cross-visits to prepare a competitive agritourism owner.

5. Theoretical implications

The future of training and consulting in global agrotourism is poised for further innovation and expansion, driven by several key trends:

- **Emphasis on Sustainability and Responsible Tourism:** Training programs are increasingly incorporating principles of sustainable agriculture, environmental stewardship, and responsible tourism practices to ensure the long-term viability and positive impact of agrotourism ventures

- **Building Digital Literacy and E-commerce Capabilities:** As online presence becomes crucial for attracting tourists, training will focus on equipping farmers with the digital skills necessary for effective online marketing, e-commerce transactions, and customer relationship management.

- **Tailored and Demand-Driven Training:** Future training initiatives will likely adopt more personalized approaches, catering to individual farmers' specific needs and skill levels and adapting to the evolving demands of the tourism market.

- **Integration of Technology for Enhanced Learning:** Augmented reality (AR), virtual reality (VR), and artificial intelligence (AI) are emerging as potential tools to create more engaging and interactive learning experiences in agrotourism training.

- **Strengthening Public-Private Partnerships:** Collaborative efforts between government agencies, agricultural organizations, tourism boards, educational institutions, and private sector consultants will be crucial for developing comprehensive and practical training and consulting frameworks for the agrotourism sector worldwide.

In conclusion, it should be noted that education and advisory services with training and cross-visits are integral to the successful implementation of agritourism in farms. Thanks to high-quality training and timely expert support, farmers can not only acquire the necessary

knowledge and skills but also minimize risks, increase the competitiveness of their agritourism products, and contribute to the sustainable development of rural areas. Further development of the training and consulting system in agritourism requires the consolidation of efforts by the state, business, research institutions, and public organizations to create a favorable environment for the growth of this promising industry.

6. References

- Che, D., Veeck, A., & Veeck, G. (2022). Economic impacts of agritourism on farm households. *Journal of Agricultural Economics*, 73(2), 345-360.
- Grand View Research. (2025). Agritourism Market Size 2025-2033. <https://www.imarcgroup.com/agritourism-market>
- Johnson, R., Smith, T., & Brown, L. (2020). Farm to Farm Visits: Enhancing agritourism through knowledge exchange. *Journal of Extension*, 58(3), 1-12.
- Kastenholz, e., Carneiro, M.J., Eusebio, C. (2021). Agritourism experiences: Drivers and outcomes. *Tourism Management Perspectives*, 38, 100-112.
- Smith, J., Brown, A., & Green, T. (2021). Agritourism as a tool for rural development: Evidence from Eastern Europe. *Journal of Rural Studies*, 45(3), 123-135.

Communication Methods for Aflatoxin Management to Facilitate Household Food Security in Southwest Nigeria

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Short abstract

Food security is a global concern, particularly due to chronic hunger conditions, especially in Africa. Grain legumes are crucial for nutritious food but face challenges, including aflatoxin contamination. This research explores the influence of communication methods on grain legume farmers' knowledge, attitudes, and practices (KAP) in aflatoxin management in Southwest Nigeria. Methods used are the Modified Delphi Method, Focus Group Discussions, Photovoice, and In-depth Interview. Results indicate that farmers' knowledge of aflatoxin management varies based on their exposure to training. They have a positive attitude towards managing aflatoxin and are willing to adopt management practices such as the use of the antitoxin product known as Aflasafe. The high cost of Aflasafe is a barrier to adoption. Effective communication methods that enhance grain farmers' knowledge, attitudes, and practices include demonstrations, training of trainers (ToT), and farmer-to-farmer communication. The study concludes that communication methods significantly improve grain legume farmers' knowledge, attitudes, and practices on aflatoxin management.

1. Purpose

Food insecurity remains a pressing issue in Africa, with millions affected by chronic hunger and malnutrition (FAO, 2009; FAO et al., 2021; Leisner, 2020). In 2021 alone, 278 million Africans experienced hunger, and projections show 670 million people may remain undernourished by 2030 due to the COVID-19 pandemic's impact on agri-food systems (FAO et al., 2021).

Grain legumes (e.g., soybean, chickpeas, cowpeas, lentils) play a key role in food security due to their nutritional value, soil fertility benefits, and economic potential (Jha et al., 2022; Neda, 2020; Vanlauwe et al., 2019). When intercropped with cereals or tubers, they improve productivity (De Ron, 2015; Pypers et al., 2011). However, production faces constraints, especially aflatoxin contamination, which undermines food safety and incomes (Achaglinkame et al., 2017; PACA, 2015).

Aflatoxin thrives in Africa due to climatic conditions and subsistence farming systems with poor storage (Ortega-Beltran & Bandyopadhyay, 2021). Its invisible nature and low awareness among farmers and consumers increase the risk (Chilaka et al., 2022; Udomkun et al., 2017). Adoption of good agricultural practices and improved storage, alongside awareness creation, are vital mitigation measures (Achaglinkame et al., 2017; Falade, 2019; Leslie et al., 2023).

Despite efforts to raise awareness, including Nigeria's communication campaigns and Aflasafe promotion (Johnson et al., 2018; Ortega-Beltran & Bandyopadhyay, 2021), aflatoxin knowledge remains limited among farmers. Communication plays a central role in agricultural development, and the effectiveness of such campaigns depends on the communication approach used (Age et al., 2012; Egwu, 2016).

Given that awareness campaigns have been conducted in Nigeria to enhance knowledge about aflatoxins among various stakeholders, including farmers, researchers, and extension agents, it is of utmost importance to examine the impact of communication methods on the knowledge, attitudes, and practices of grain legume farmers in aflatoxin management. Given this context, the specific research objectives include the following:

- to identify grain legume farmers' knowledge of aflatoxin management in Southwest Nigeria.
- to determine grain legume farmers' attitudes towards aflatoxin management in Southwest Nigeria.
- to describe grain legume farmers' practices towards aflatoxin management in Southwest Nigeria.
- to explore communication methods that contribute to farmers' knowledge, attitudes, and practices on aflatoxin management in Southwest Nigeria.

2. Methodology

The study was conducted in Southwest Nigeria, chosen as an alternative to the Northeast—a major grain legume-producing region—due to ongoing security challenges that have disrupted production (Aluko et al., 2016). Enhancing legume cultivation in the Southwest is therefore critical.

Participants included aflatoxin experts from research institutes and grain legume farmers, selected purposively for their relevance to the research. The study focused on two Agricultural Development Program (ADP) zones in Oyo State—Saki and Oyo—known for their comparative advantage in grain legume production.

This study used different methods to collect sequentially empirical evidence, including the Modified Delphi Method, Focus Group Discussion (FGD), Photovoice, and In-depth Interview.

2.1 Modified Delphi method

Eight aflatoxin experts participated in two rounds of online interviews via Microsoft Teams. In the first round, they rated draft focus group discussion (FGD) questions on a 1–5 scale and provided suggestions for refinement. In the second round, they evaluated the revised questions using a 1–10 scale to gain greater discrimination between questions. The responses were analyzed, and mean scores were used to develop the final set of FGD questions.

2.2 Focus group discussion

Three focus groups, each with 10–13 participants, were conducted (Groups F1, F2, and F3). Most participants, averaging 45 years of age were members of a cooperative society. Many also engaged in petty trading or artisan work alongside farming.

A researcher moderated each session using guided questions to prompt open and reflective discussion. Conversations were audio-recorded to ensure accurate data capture and support thematic analysis.

2.3 Photovoice

To gain a deeper understanding of the prevailing practices employed by the participants to manage aflatoxin contamination, Photovoice was employed. The researcher supervised the process by ensuring farmers photographed their aflatoxin management practices. After taking 13 photos, the farmers were asked to choose the five most significant images and discuss them. These discussions were audio-recorded to accurately capture each participant's feedback. This method enabled detailed data analysis, allowing the researcher to identify key themes and patterns in the conversations. This participatory approach allowed participants to capture and share their experiences and perspectives through visual narratives. Using smartphones, participants took photographs of their prevailing practices, which served as a catalyst for critical discussions about the images and their meanings.

2.4 In-depth interview

An in-depth interview method was used to collect detailed information from one retailer of Aflasafe, a substance used for aflatoxin management. The goal was to gain insights from the retailers' perspectives. The interview was conducted online using Microsoft Teams and was audio recorded, with the participants' consent. This interview aimed to understand the retailer's experiences and opinions regarding the sale and effectiveness of Aflasafe. The collected data provided valuable insights into the practical aspects of aflatoxin management from those directly involved in its distribution.

3. Findings

3.1 Farmers' knowledge of aflatoxin

Knowledge of aflatoxin varied across zones, largely depending on exposure to training. Farmers in the Saki zone (Groups F1 and F2), who had received training, demonstrated high awareness. They recognized aflatoxin as a harmful, invisible mycotoxin that reduces crop quality and yield, affects health, and lowers market value. They could also identify signs of contamination in crops like cowpea and understood factors that contribute to aflatoxin, such as delayed harvesting, rainfall, and overcrowded planting. They were aware of management options like Aflasafe, though only a few had access to it.

In contrast, farmers in the Oyo zone (Group F3) lacked awareness. They had never heard of aflatoxin, its risks, or management practices and admitted having no local or chemical method to manage it.

3.2 Attitudes toward aflatoxin management

Across all zones, farmers showed a positive attitude toward managing aflatoxin, despite different levels of knowledge. Farmers in the Saki zone acknowledged the challenges, citing the time, cost, and difficulty of accessing inputs. They expressed frustration over limited support from the government and researchers but remained open to adopting solutions. They emphasized the need for accessible inputs and information, and called on researchers to provide support.

Group F3, though uninformed, showed readiness to adopt management practices if provided with resources. They indicated willingness to use chemicals or other solutions if made available.

3.3 Aflatoxin management practices

Practices varied across zones, and this is shown in table 1 below.

Table 1: Prevailing Practices on Aflatoxin Management

Agricultural Zones	Groups	Preharvest Management Practices	Postharvest Management Practices	Traditional Method
Saki	F1	Uproot contaminated crops, thinning, chemical use, Aflasafe use	Sun drying, sorting, storing in bags and putting on wooden pallets, spraying with chemical	Ash use, sun drying, neem leaf use
	F2	Uproot contaminated crops, Aflasafe use	Grading, sorting, sun drying, putting on wooden pallets	None
Oyo	F3	None	Spraying with chemicals, sorting, storing in sealed container	None

Cost was a common concern, especially for Aflasafe. Farmers noted that while the International Institute of Tropical Agriculture (IITA) initially supplied it for free, costs were later introduced, limiting adoption.

3.4 Communication methods and KAP (Knowledge, Attitude, Practices) of grain legume farmers

Participants were asked about the factors influencing their knowledge, attitudes, and practices (KAP) regarding aflatoxin management. They identified their information sources, communication methods, and frequency of communication. Before receiving aflatoxin training, farmers had no prior knowledge of it. After training with visual demonstrations and flyers, farmers in the Saki zone (F1 and F2) gained awareness of aflatoxin, developed a positive attitude, and were eager to adopt management practices. Even those who missed the training learned from interactions with trained farmers, which increased their knowledge and willingness to adopt the practices.

Group F1 identified IITA, extension agents, and their farmer group as key information sources, stating, "We have the All Farmers' Association of Nigeria (AFAN), where we share information monthly." Group F2 similarly cited IITA and their farmer group, mentioning, "In the past, IITA introduced us to aflatoxin through training, and we meet regularly through AFAN." Group F3, however, reported lacking any training on aflatoxin management and

noted that extension agents had not visited their area, though they maintain a good information-sharing network.

The communication methods used in training—demonstrations and flyers—greatly increased knowledge, both explicit and tacit, about aflatoxin. Group F2 farmers noted radio broadcasts through Broadcasting Corporation of Oyo State (BCOS), Oluyole FM, and Gambari, but mentioned poor reception in their area. They suggested using stations like Alaga or Asabari for better coverage of aflatoxin management information.

Communication frequency varied: Group F1 mentioned training occurred four years ago (2020), with monthly farmer group meetings at different times, while Group F2 recalled training two years ago (2022).

4. Practical Implications

This study offers valuable insights for improving aflatoxin management among grain legume farmers:

- **Expand Access to Training:** The significant variation in farmers' knowledge across different zones highlights the need to broaden the reach of training programs. Approaches such as Training of Trainers (ToT) workshop, on-farm demonstrations, and community-based workshops can help close the knowledge gap and ensure that farmers in all areas are equally informed.
- **Build on Farmers' Positive Attitudes:** Even farmers who lacked prior awareness of aflatoxins showed a willingness to adopt management practices after engaging in discussions during the study. This suggests that when farmers are given the right information, they are open to change. Extension efforts should focus not only on transferring knowledge but also on fostering positive attitudes through direct, personal engagement.
- **Address Cost Barriers:** While farmers are adopting various aflatoxin mitigation practices, the high cost of products like Aflasafe limits broader uptake. To promote widespread use, there is a need for policy support in the form of subsidies, cost-sharing schemes, or the development of affordable alternatives that smallholder farmers can easily access.
- **Prioritize Effective Communication Methods:** The study found that peer learning, demonstrations, and printed materials were more impactful than radio broadcasts, which had limited reach. Future communication strategies should emphasize channels that are locally accessible and culturally relevant. Enhancing radio coverage and tailoring content to local contexts is most effective when it combines mass media with farmer-to-farmer learning interactions, following up with farmers over time on their behaviour change.

5. Theoretical Implications

This study advances understanding of how communication methods influence grain legume farmers' knowledge, attitudes, and practices (KAP) in aflatoxin management. It supports the KAP model, showing that interactive methods—like farmer-to-farmer communication, ToT, demonstrations, and flyers—boost knowledge and behavior change. The findings align with revised KAP frameworks emphasizing participatory communication and social learning (Liao et al., 2022). The study also show that attitude shifts can occur before full knowledge acquisition, challenging the model's linear assumptions. By identifying cost as a major barrier to adopting tools like Aflasafe, the study suggests that economic factors must be integrated into behavioral models. Even with high knowledge and positive attitudes, practice may lag without affordability (Awuor et al., 2023).

6. References

- Achaglinkame, M. A., Opoku, N., & Amagloh, F. K. (2017). Aflatoxin contamination in cereals and legumes to reconsider usage as complementary food ingredients for Ghanaian infants: A review. *Journal of Nutrition & Intermediary Metabolism*, 10, 1–7. <https://doi.org/10.1016/j.jnim.2017.09.001>
- Age, A. I., Obinne, C. P. O., & Demenongu, T. S. (2012). Communication for sustainable rural and agricultural development in Benue State, Nigeria. *Sustainable Agriculture Research*, 1(1). <https://doi.org/10.5539/sar.v1n1p118>
- Aluko, O. J., Osikabor, B., Adejumo, A. A., & Sumade, S. (2016). Perceived effect of Boko-Haram insurgency on means of accessing cowpea from North-East Nigeria to Bodija Market, Ibadan, Oyo State, Nigeria. *OALib*, 03(06), 1–6. <https://doi.org/10.4236/oalib.1102723>
- Awuor, A. O., Wambura, G., Ngere, I., et al. (2023). A mixed methods assessment of knowledge, attitudes and practices related to aflatoxin contamination and exposure among caregivers of children under 5 years in western Kenya. *Public Health Nutrition*, 26(12), 3013–3022. <https://doi.org/10.1017/S1368980023000150>
- Chilaka, C. A., Obidiegwu, J. E., Chilaka, A. C., Atanda, O. O., & Mally, A. (2022). Mycotoxin regulatory status in Africa: A decade of weak institutional efforts. *Toxins*, 14(7), 442. <https://doi.org/10.3390/toxins14070442>
- De Ron, A. (2015). *Grain legumes* (A. M. De Ron, Ed.; Vol. 10). Springer New York. <https://doi.org/10.1007/978-1-4939-2797-5>
- Egwu, E. W. (2016). Communication and adoption behaviour of information technology by rural farmers in Ebonyi State. *Asian Journal of Agriculture and Rural Development*, 6(1), 14–20. <https://doi.org/10.18488/journal.1005/2016.6.1/1005.1.14.20>
- Falade, T. (2019). Aflatoxin management strategies in Sub-Saharan Africa. In *Mycotoxins - Impact and Management Strategies*. IntechOpen. <https://doi.org/10.5772/intechopen.78784>
- FAO. (2009). *Food insecurity in the world economic crises-impacts and lessons learned*.
- FAO, IFAD, UNICEF, WFP & WHO. (2021). *Food security and nutrition in the world the state of transforming food systems for food security, improved nutrition and affordable healthy diets for all*. <https://doi.org/10.4060/cb4474en>
- Jha, U. C., Nayyar, H., Parida, S. K., Deshmukh, R., von Wettberg, E. J. B., & Siddique, K. H. M. (2022). Ensuring global food security by improving protein content in major grain legumes using breeding and ‘omics’ tools. *International Journal of Molecular Sciences*, 23(14), 7710. <https://doi.org/10.3390/ijms23147710>
- Johnson, A. M., Fulton, J. R., Abdoulaye, T., Ayedun, B., Widmar, N. J. O., Akande, A., Bandyopadhyay, R., & Manyong, V. (2018). Aflatoxin awareness and aflasafe adoption potential of Nigerian smallholder maize farmers. *World Mycotoxin Journal*, 11(3), 437–446. <https://doi.org/10.3920/WMJ2018.2345>
- Leisner, C. P. (2020). Review: Climate change impacts on food security- focus on perennial cropping systems and nutritional value. *Plant Science*, 293, 110412. <https://doi.org/10.1016/j.plantsci.2020.110412>
- Leslie, J. F., Morris, J. B., Gurung, J. K., Harvey, J. J. W., Ayalew, A., Baker, R., & Zhang, G. (2023). Mycotoxin communications: Managing messages for different audiences. *Frontiers in Sustainable Food Systems*, 6. <https://doi.org/10.3389/fsufs.2022.1095256>
- Liao, X., Nguyen, T. P. L., & Sasaki, N. (2022). Use of the knowledge, attitude, and practice (KAP) model to examine sustainable agriculture in Thailand. *Regional Sustainability*, 3(1), 41–52. <https://doi.org/10.1016/j.regsus.2022.03.005>

- Neda, E. K. (2020). Grain legumes production in Ethiopia: A review of adoption, opportunities, constraints and emphases for future interventions. *Turkish Journal of Agriculture - Food Science and Technology*, 8(4), 977–989. <https://doi.org/10.24925/turjaf.v8i4.977-989.3254>
- Ortega-Beltran, A., & Bandyopadhyay, R. (2021). Contributions of integrated aflatoxin management strategies to achieve the sustainable development goals in various African countries. *Global Food Security*, 30, 100559. <https://doi.org/10.1016/j.gfs.2021.100559>
- Partnership for Aflatoxin Control in Africa [PACA] (2015). Aflatoxin impacts and potential solutions in agriculture, trade, and health: An introduction to aflatoxin impacts in Africa. *United Nations*. https://www.un.org/esa/ffd/wp-content/uploads/sites/2/2015/10/PACA_aflatoxin-impacts-paper1.pdf
- Pypers, P., Sanginga, J.-M., Kasereka, B., Walangululu, M., & Vanlauwe, B. (2011). Increased productivity through integrated soil fertility management in cassava–legume intercropping systems in the highlands of Sud-Kivu, DR Congo. *Field Crops Research*, 120(1), 76–85. <https://doi.org/10.1016/j.fcr.2010.09.004>
- Udomkun, P., Wiredu, A. N., Nagle, M., Bandyopadhyay, R., Müller, J., & Vanlauwe, B. (2017). Mycotoxins in Sub-Saharan Africa: Present situation, socio-economic impact, awareness, and outlook. *Food Control*, 72, 110–122. <https://doi.org/10.1016/j.foodcont.2016.07.039>
- Vanlauwe, B., Hungria, M., Kanampiu, F., & Giller, K. E. (2019). The role of legumes in the sustainable intensification of African smallholder agriculture: Lessons learnt and challenges for the future. *Agriculture, Ecosystems & Environment*, 284, 106583. <https://doi.org/10.1016/j.agee.2019.106583>

Green Entrepreneurial Intentions in Higher Education Institutions

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Short Abstract

The concept of ‘going green’ has been emphasised recently, particularly in contemporary societies. Various researchers consider the business community primarily responsible for activities that negatively affect the environment and explain the growing importance of environmental sustainability and the role of green entrepreneurship (GE) in response to social problems, climate change and ecological sustainability. It is therefore necessary to emphasise ‘going green’ both in the business and entrepreneurial field and in higher education institutions (HEIs). HEIs need to be involved in this process, involving teachers and students. Although interest in the present research topic of green entrepreneurial intentions (GEI) is growing, it is essential to understand the factors that influence these intentions, thus evolving research in this area. The study therefore investigates GEI and behaviours among university students. Using the Theory of Planned Behaviour (TPB) as a framework, the influences of contextual factors such as entrepreneurial education, university environmental support and entrepreneurial motivation are examined. Data will be collected from a sample of students from a school at the University of Trás-os-Montes and Alto Douro (UTAD) that includes scientific areas such as Agronomy, Forest Sciences and Landscape Architecture,

Veterinary Sciences and Zootechnics. Students' responses at the Agrarian Veterinary Sciences School (AVSS) will be analysed using a quantitative methodology. The study will provide insights for thought for different stakeholders, namely teachers, students, university decision-makers, and entrepreneurs who want to bring entrepreneurship initiatives in higher education into line with the Sustainable Development Goals (SDGs).

Keywords | university entrepreneurial support, entrepreneurial education, green entrepreneurial intention, sustainable entrepreneurship.

1. Purpose

The concept of 'going green' has been emphasised in recent years, particularly in contemporary societies. Various researchers consider the business community primarily responsible for activities that negatively affect the environment and explain the growing importance of environmental sustainability and the role of green entrepreneurship (GE) in response to social problems, climate change and ecological sustainability. It is therefore necessary to emphasise 'going green' both in the business and entrepreneurial fields and in higher education institutions. Although interest in the topic of this research is growing, there is still a lack of literature supporting green entrepreneurial intentions (GEI). According to Zhang et al. (2024), young people today (known as generation Z or millennials), especially recent graduates, have strong entrepreneurial intentions and a social conscience, and they prioritise preserving a sustainable future over corporate profits. Thus, the essential question of understanding the factors that influence these intentions is crucial to advancing research. The intention to carry out a behaviour is the first step towards the behaviour itself. According to CabanaVillca et al. (2024), green entrepreneurship involves implementing sustainable innovations to promote the green economy among customers and entrepreneurs are faced with the dilemma of whether their project is really 'green'. For Cabana-Villca et al. (2024), green entrepreneurship means making a positive impact through ecological activities such as reuse, recycling, clean processes and waste management. Green entrepreneurship contributes to developing green firms that engage entrepreneurs and businesses committed to promoting social change (Rauch & Hulsink, 2015). These businesses are more likely to last longer and have more sales than those adhering to non-green entrepreneurship concepts (Rauch & Hulsink, 2015). In order to achieve the crucial SDGs of good health and wellbeing, sustainable cities and communities, industry, innovation, and infrastructure, adaptation to climate change and responsible production and consumption, universities have to be involved in this process, involving teachers and students (Zhang et al., 2024) The study, therefore, investigates GEI and the resulting social change in behaviour among university students. As a basic framework, the influences of contextual factors such as entrepreneurial education, university support and incentives for change are examined, resulting in the conceptual model proposed in Figure 1.

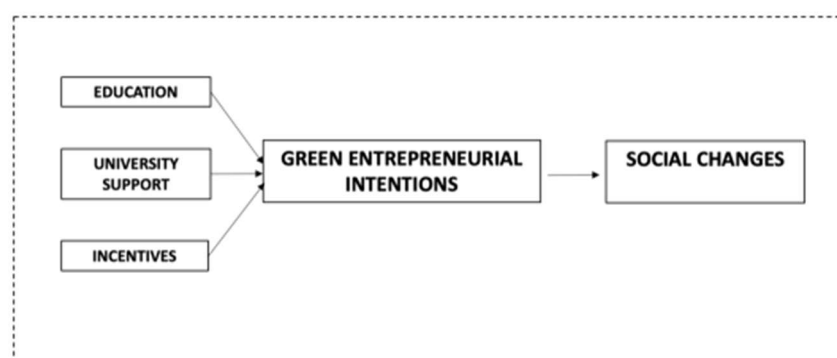


Figure 1. Conceptual Model

2. Methodology

The data was selected and collected from a sample of students belonging to the Agrarian Veterinary Sciences School (AVSS) from the University of Trás-os-Montes e Alto Douro, which includes scientific areas such as Agronomy, Forest Sciences and Landscape Architecture, Veterinary Sciences and Zootechnics.

A quantitative approach was adopted with a questionnaire application. The questionnaire was structured into two sections, with the first section focusing on the respondents' characterisation. The second section comprises measures from variables – Green Entrepreneurial Education, Green Entrepreneurial Support, Green Entrepreneurial Intentions, Promoting Social Changes, Incentives, Green Entrepreneurial Skills and Attractiveness of the Career. The different constructs were elaborated according to the theoretical models, with the variables selected based on the university context and literature review (Table 1).

Table 1. Summary of variables used in the questionnaire

Variables		Source of scale validation
Green entrepreneurial education	5 itens	Mia el al., 2022
University Support	6 itens	Saeed et al., 2015
	1 item	Cabana-Villca et al., 2024
Incentives	4 itens	Mia el al., 2022
Green entrepreneurial intention	5 itens	Liñan & Chen (2009)
		Amankwah & Sesen (2021)
Social Changes	5 itens	Mia el al., 2022

3. Findings

Figure 1 presents the conceptual model resulting from this study, and in addition, details on variables and sources employed are available in Table 2. A total sample of 124 valid questionnaires was collected, and the data were analysed using IBM SPSS version 29 for descriptive statistics. The sample consists of 124 fully completed surveys from students at the AVSS School. In terms of gender composition, there is a predominance of females (78,2%) over males (21,8%), with an average age of 23, with a minimum age of 18 and a maximum of 49. Most of the students surveyed do not have professional experience (53,2%), and when asked if they (or their family members) own businesses, 87,1% answered negatively. Regarding their nationality, 91.9 per cent of the students are Portuguese and 8.1 per cent are foreigners. Of the 10 students of other nationalities, 95% come from Portuguese-speaking countries (Angola, Guiné and São Tomé). Most respondents are in their 2nd and 3rd year (25.8% and 49.2% respectively). Concerning entrepreneurship training, most students (68,5%) have never attended an entrepreneurship course, and 4% have attended at least one mandatory course. The relevant fact is that 32 students (25,8%) decided to study at UTAD because of its strong reputation in entrepreneurship. Further information is available in Table 2.

Table 2. Characterisation of the participating students

<i>n</i> = 124		
	Frequência	%
Higher Education Institution (HEI)		
University of Trás-os-Montes and Alto Douro - Agrarian Veterinary Sciences School	124	
Sex		
Male	27	21,8%
Female	97	78,2%
Other	0	-
Idade		
Average ages: 23 (minimum 18; maximum 49)		
(18-21)	92	74,2%
(22-25)	12	9,7%
(26-29)	7	5,6%
>29	13	10,5%
Nationality		
Portuguese	114	91,9%
Other	10	8,1%
Cycle of Studies		
CTEsP	0	-
Licenciatura	74	59,7%
Mestrado	6	4,8%
Mestrado Integrado	44	35,5%
Doutoramento	0	0%
Degree		
Agricultural Engineering	21	16,9%
Forestry Engineering	1	0,8%
Zootechnical Engineering	12	9,7%
Winemaking	24	19,4%
Winemaking and Viticulture	218	4%
Veterinary Medicine	19	49,2%
year attended		
1º	20	16,1%
2º	32	25,8%
3º	61	49,2%
4º	0	-
5º	11	8,9%
Student Profile		
Regular	100	80,6%
Student-worker	24	19,4%
Other	0	-
Work Experience		
Yes	58	46,8%
No	66	53,2%
Family entrepreneurship - own/family business		
Yes	16	12,9%
No	108	87,1%
Entrepreneurship training		
Yes	39	31,5%
No	85	68,5%

4. Theoretical Implications

This study sought to address the relationship between the variables of education, university support and incentives regarding GEI and the increase in social change. The education construct for GE can influence students' pro-environmental behaviour (Zhang et al., 2024) through knowledge and ethical responsibility (Mia et al., 2022). Recognising harmful behaviours, replacing them with beneficial ones, and improving individual and social problem-solving skills will help students achieve their full potential through a more active contribution to society (Mia et al, 2022; Thirupathy et al., 2020). In this construct, the item with the highest average (4.38) response was 'EDU 5- My university education makes me interested in becoming an entrepreneur'. University support is related to the relationship between student entrepreneurs and universities. It seeks to understand whether the university environment is favourable for developing entrepreneurship, whether through financial support (scholarships or loans for entrepreneurs (Maritz et al., 2022), the creation of project work with mentors (Liu et al., 2022) or practical training activities (Zhang et al., 2024). University support relates to actions that help students have the necessary tools for the future and the successful development of the GE. In this context, the answers were

different. All seven items had lower averages, and three had averages below 3 points. The response with the lowest value was 'My university has specialised offices that provide advice on developing entrepreneurship' (2.28), followed by 'My university offers courses on green entrepreneurship' (2.86), and 'My university provides project work centred on green entrepreneurship'. The incentives construct refers to the motivation of entrepreneurs to bring society closer to environmental goals, ensuring the sustainability of the process (Makki et al., 2020). These incentives refer to creating strong links with the GE and other stakeholders, academia, citizens, companies and the government (Del Vecchio et al., 2021). The answer with the highest average (4.17) refers to the importance of monetary incentives: 'Monetary incentives would motivate young green entrepreneurs'. The concept of GE is important for increasing students' intentions after graduation or during their apprenticeship phase. It is vital that university students become interested in entrepreneurship as a possible occupation, adopt entrepreneurship and that GE is attracted by the belief of promoting social change (Bilan et al., 2017). The relationship between the two constructs, GEI and Social Changes, seeks to understand whether university students' GEI promotes (or not) social change.

5. Pratical Implications

This study provides information on how students perceive GE. If the results indicate a high green entrepreneurship intention, this could suggest a growing interest in creating businesses that address environmental issues, thus contributing to SDG 12 (Responsible Production and Consumption). According to Cabana-Villca et al. (2024), this information would be valuable in designing educational and support policies that encourage the formation of green entrepreneurship among the students in UTAD, thus contributing to SDG 4 (Quality education) and SDG 8 (Decent work and economic growth) (Cabana-Villca et al., 2024). The authors point out that GE is a growing initiative, so knowledge of students' backgrounds and preferences for this type of activity is essential. The conceptual model of this study could show the factors that need to be maximised to increase GEI and social changes. Furthermore, deepening this study through structural equations could reveal these factors, such as green education, university support, and incentives, namely, access to financial resources. Its strength will be the establishment of multivariate analyses that will facilitate the identification of correlations between the variables described and presented in the literature review. The collection instrument could also be used effectively in future research to refine and improve the survey items for future studies.

6. References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Al Mamun, A., Kumar, N., Ibrahim, M. D., & Bin Yusoff, M. N. H. (2017). Validating the Measurement of Entrepreneurial Orientation. *Economics and Sociology*, 10(4), 51-66. doi:10.14254/2071-789X.2017/10-4/5
- Alvarez-Risco A., Mlodzianowska, S., Zamora-Ramos, U., & Del-Aguila-Arcentales, S. (2021). Green entrepreneurship intention in university students: The case of Peru. *Entrepreneurial Business and Economic Review*, 9(4), 85-100. <https://doi.org/10.15678/EBER.2021.090406>
- Bilan, Y., Zos-Kior, M., Nitsenko, V., Sinelnikau, U., & Ilin, V. (2017). Social component in sustainable management of land resources. *Journal of Security and Sustainability Issues*, 7, 107-120

- Cabana-Villca, R., Alvarez-Risco, A., Andrés-Moncada, R., Marin-Aracena, C., Del-Aguila-Arcntales, Davies, N. M., Yáñez, J. A. (2024). Green entrepreneurial intentions among university students in Chile: use of PLS-SEM. *Development Studies Research*, 11:1, 2336909. <https://doi.org/10.1080/21665095.2024.2336909>
- Del Vecchio, P.; Secundo, G.; Mele, G.; Passiante, G. (2021). Sustainable entrepreneurship education for circular economy: Emerging perspectives in Europe. *International Journal of Entrepreneurial Behaviour & Research*, 27, 2096–2124.
- Genoveva, G., & Tanardi, J. (2022). Green entrepreneurship: a new paradigm for millennials in Indonesia. *International Journal of Sustainable Development and Planning*, 17(4), 1133–1140. <https://doi.org/10.18280/ijstdp.170410>
- GLiu, M., Gorgievski, M. J. , Qi, J., & Paas, F. (2022). Increasing Teaching Effectiveness in Entrepreneurship Education: Course Characteristics and Student Needs Differences. *Learning and Individual Differences*, 96: 102147. <https://doi.org/10.1016/j.lindif.2022.102147>
- Mabkhot, H., Semlali, Y., Gelaidan, H., Abdelwahed, N., & Shaari, H. (2023). Green entrepreneurial intentions in Saudi youth: cultural insights and implications. *Discover Sustainability*, 480(5), 1-19. <https://doi.org/10.1007/s43621-024-00750-0>
- Makki, A.A.; Alidrisi, H.; Iqbal, A., & Al-Sasi, B.O. (2020). Barriers to Green Entrepreneurship: An ISM-Based Investigation. *Journal of Risk and Financial Management*, 13, 249.
- Maritz, A., Nguyen, Q., & Ivanov, S. (2022). Student Entrepreneurship Ecosystems at Australian Higher Education Institutions. *Journal of Small Business and Enterprise Development*, 29 (6), 940–100957. <https://doi.org/10.1108/JSBED-11-2021-0466>
- Perez-Luyo, R. (2023). Green entrepreneurship intention among high school students: a teachers' view. *Frontiers in Education*, 8. <https://doi.org/10.3389/feduc.2023.1225819>
- Ramayah, T., Rahman, S. A., & Taghizadeh, S. K. (2019). Modelling green entrepreneurial intention among university students using the entrepreneurial event and cultural values theory. *International Journal of Entrepreneurial Venturing*, 11(4), 394–412. <https://doi.org/10.1504/IJEV.2019.101629>
- Rauch, A., & Hulsink, W. (2015). Putting entrepreneurship Education where the intention to Act lies: An investigation into the impact of entrepreneurship education on entrepreneurial behavior. *Academy of Management Learning & Education*, 14, 187–204.
- Shehzad, M. U., Zhang, J., Latif, K. F., Jamil, K., & Waseel, A. H. (2023). Do green entrepreneurial orientation and green knowledge management matter in the pursuit of ambidextrous green innovation: A moderated mediation model. *Journal of Cleaner Production*, 388. <https://doi.org/10.1016/j.jclepro.2023.135971>
- Yi, G. (2021). From green entrepreneurial intentions to green entrepreneurial behaviors: The role of university entrepreneurial support and external institutional support. *Entrepreneurship and Management Journal*, 17, 963-979. <https://doi.org/10.1007/s11365-020-00649-y>
- Zevender, P. S., Ahman, E., Mulyadi, H., Kurjono, & Kusnendi (2025). A Bibliometric Analysis of Global Research for Mapping the Green Entrepreneurial Intentions. *Jurnal Pendidikan Progresif*, 15(1), 239-263. DOI: 10.23960/jpp.v15.i1.202517
- Zwan, P., Verheul I., & Thurik A. R. (2012). The entrepreneurial ladder, gender, and regional development. *Small Business Economics*, 39(3), 627-43. <https://doi.org/10.1007/s11187-011-93347>

Appendices

Table 3. Education Statistics

		EDU1	EDU2	EDU3	EDU4	EDU5
N	Valid	124	124	124	124	124
	Average	4.24	4.21	3.65	3.77	4.38

Table 4. Incentives Statistics

		INC1	INC2	INC3	INC4
N	Valid	124	124	124	124
	Average	4.17	3.56	4.08	3.78

Table 5. University Support Statistics

		SUP1	SUP2	SUP3	SUP4	SUP5	SUP6	SUP7
N	Valid	124	124	124	124	124	124	124
	Average	3.10	2.86	2.99	3.42	3.00	3.09	2.28

Table 6. Green Entrepreneurial Intentions Statistics

		G.EI1	G.EI2	G.EI3	G.EI4	G.EI5
N	Valid	124	124	124	124	124
	Average	4.02	4.46	4.32	4.22	4.23

Table 7. Social Changes Statistics

		PSC1	PSC2	PSC3	PSC4	PSC5
N	Valid	124	124	124	124	124
	Average	3.73	3.80	3.56	3.94	4.15

Exploring sustainability awareness and practices related to food among hospitality and tourism students

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Short abstract

This study explores how sustainability education within Hospitality and Tourism Schools (HTS) can shape students' food-related knowledge, attitudes, and practices, using a longitudinal Knowledge, Attitude, and Practice (KAP) survey conducted across 12 schools in the Turismo de Portugal network. The research was carried out at two key moments - the beginning and end of the academic year - allowing the assessment of students' evolving understanding of food sustainability concepts, attributes, and behaviours. The survey covered multiple dimensions, including cooking habits, food sourcing, and awareness of environmental impacts. By applying the KAP framework in this context, the study provides a structured foundation for integrating sustainability more effectively into hospitality and

tourism education. Importantly, it enables alignment of educational content with the principles of Agricultural Knowledge and Innovation Systems (AKIS). This approach opens new pathways for equipping students to act as change agents, promoting local sourcing, reducing waste, and supporting sustainability in agrifood systems throughout their careers.

Keywords | food sustainability, sustainability education, hospitality and tourism students, agrifood systems

1. Purpose

The present study aims to contribute to answering the research question: “What impact does the approach to sustainability have on the Hospitality and Tourism Schools (HTS) students' practices related to food?” The survey intends to establish a baseline assessment of students' knowledge, attitudes and practices (KAP) regarding various sustainability issues, thereby contributing to guiding the curriculum revision for the Hospitality and Tourism programs, ensuring that sustainability education is effectively integrated and that students are equipped to make informed decisions that promote sustainable food practices.

2. Design

A Knowledge, Attitude, and Practice (KAP) survey was conducted in the 12 Hospitality and Tourism Schools (HTS) of the network of Turismo de Portugal. From 2017, the programmes in the HTS have two independent subjects on Sustainable Tourism and Accessible Tourism. Besides, several activities related to Sustainability/Sustainable Development are conducted in every school, and some activities are common to the schools' network

This survey was designed to establish a baseline assessment of incoming students' knowledge, attitudes, and practices related to various sustainability issues, with the ultimate goal of informing curriculum revision for the Hospitality and Tourism programs. Data collection was carried out in two phases: Round 1, administered at the beginning of the academic year, and Round 2, conducted at the end of the year, coinciding with the completion of the one-year program.

KAP surveys and their variations have a long-standing history of characterising key attributes within populations of interest (García-González et al., 2020). This survey covered areas, including participants' knowledge and perceptions of food sustainability, alongside practices on food organisation, cooking habits, shopping practices, and food safety. In particular, the section on sustainable eating explored respondents' understanding of sustainability-related terminology and their awareness of the environmental impacts associated with various food groups. Attitudes toward purchasing more sustainable products and the values that influence sustainable food shopping behaviours were assessed, as well. Additionally, behaviour took our attention, as only changes in behaviour can lead hospitality and tourism students to make sustainable decisions when planning and implementing menus and gastronomy experiences.

The study incorporates a comprehensive survey addressing multiple dimensions related to food sustainability, adapted from a study of the Spanish adult population's attitudes and knowledge on food sustainability at a national level reported by García-González et al. (2020). The reason for the selection of this questionnaire was the coverage of the themes and the cultural context proximity of the population. The last section of the questionnaire was adapted from a quantitative approach form to investigate Chinese students' Sustainable Development knowings from a study carried out by Chen et al. (2022) based on the Sustainable Development Goals (SDG) and the learning objectives of Education for Sustainable Development. Chen et al. ((2022) study combines three subconstructs—Sustainable Development (SD) knowledge, SD attitudes, and SD behaviours, although only

the behaviour part was adapted to be included in the HTS survey. Nevertheless, it is important to recognise that sustainable behaviour is too multifaceted to be adequately captured by a brief self-report scale (Chen et al., 2022). The selection of instruments widely tested guarantees the optimum design and applicability of the questionnaire.

The questions from the original surveys were in English, nevertheless, they were professionally reviewed and translated into Portuguese by a certified professional. The questionnaire was carried out in both languages, Portuguese and English, as HTS have programmes in both languages, following approval from the school department's management. The survey was conducted in two phases, at the beginning and the end of the programme (that is now a school year long). The round 1 conducted between November 30th and December 31st, 2023, 102 students participated. In the second phase conducted between June 21st and August 21st, 2024, 39 students agreed to participate and answered the survey. By that time, they were finishing their path at school, and they were organising or starting the curricular internship. Some demographic data, such as age and gender, were collected. It was also considered important to ask in what country students finished their school path before enrolling on the EHT to analyse if there are any statistical differences between the responses from the students who studied in Portugal and European countries, and non-European countries and statistics of the sample are presented in the Appendix (Table 1). In the present exercise, we analyse the results of round 1 and round 2 of the survey.

3. Findings

It is important to present the definition of a food system to set the scene. A Food system encompasses the entire range of actors and their interlinked value-adding activities. The food system comprises sub-systems (e.g. farming system, waste management system, input supply system, etc.) and interacts with other key systems (e.g. energy system, trade system, health system, etc.). (Food and Agriculture Organization of the United Nations, n.d.)

In the first part of the KAP survey, the comprehension of various food sustainability terms was assessed, and the most recognised were "environmental impact" and "food waste", identified by 97% of students. "Greenhouse gas emissions" was recognised by 100% of the students surveyed in round 2. "Food waste" and "Environmental impact" followed. Based on these indicators, the additive synthetic index was compiled with the 'Yes' answers, which refer to the recognition of the terms. The distribution is shown in Table 1.

Table 1: Students who acknowledged the meaning of different terms related to food sustainability, at the beginning (round 1) and at the end (round 2) of the programme (%)

		Round 1	Round 2	Total
Recognised terms	Carbon footprint	61.8	79.5	66.7
	Sustainable food	90.2	92.3	90.8
	Environmental impact	98.0	94.9	97.2
	Biodiversity	90.2	92.3	90.8
	Short food supply chains	28.4	41.0	31.9
	Greenhouse gas emissions	86.3	100.0	90.1
	Green water-blue water	32.4	28.2	31.2
	Invisible water	28.4	23.1	27.0
	Social responsibility	83.3	94.9	86.5
	Circular economy	46.1	89.7	58.2
	Food waste	97.1	97.4	97.2
	By-product valorisation	50.0	59.0	52.5

Students were also asked to rate the importance of a list of attributes which can be used to classify a sustainable diet, on a scale of 1 to 5, 1 being “not important at all” and 5 being “very important”. In the first round they perceived a sustainable diet should incorporate “few ingredients”, followed by “meat consumption” and the in round 2 the attributes “Low processing”, “Plenty of fresh products” and “Legume consumption” had the higher score, because they have the highest mean rank, in Mann-Whitney test. “Meat consumption” was the least graded attribute in round 2, even if it is a common understanding that meat consumption has a big impact on the environment and the EAT-Lancet Commission Report points out that animal-sourced foods, particularly red meat, are associated with significantly higher environmental impacts per serving relative to other food categories (Willett et al., 2019).

Table 2: Perceived attributes that define a sustainable diet, on a scale of 1–5 (1=not important at all to 5=very important) in the Hospitality and Tourism Students, at the beginning (round 1) and at the end (round 2) of the programme.

	Round	N	Mean Rank	Sum of Ranks
Low environmental impact	Round 1	102	68.53	6990.00
	Round 2	39	77.46	3021.00
Respectful of biodiversity	Round 1	102	68.95	7033.00
	Round 2	39	76.36	2978.00
No additives	Round 1	102	65.73	6704.00
	Round 2	39	84.79	3307.00
Low processing	Round 1	102	66.23	6755.00
	Round 2	39	83.49	3256.00
Few ingredients	Round 1	102	70.22	7162.50
	Round 2	39	73.04	2848.50
Plenty of fresh products	Round 1	102	66.53	6786.00
	Round 2	39	82.69	3225.00
Organic growth	Round 1	102	67.63	6898.00
	Round 2	39	79.82	3113.00
Typical from own culture	Round 1	102	67.35	6870.00
	Round 2	39	80.54	3141.00
Affordable	Round 1	102	68.82	7020.00
	Round 2	39	76.69	2991.00
Easy to cook	Round 1	102	69.41	7079.50
	Round 2	39	75.17	2931.50
Legume consumption	Round 1	102	66.65	6798.00
	Round 2	39	82.38	3213.00
Meat consumption	Round 1	102	73.60	7507.00
	Round 2	39	64.21	2504.00
Transparency of the food chain	Round 1	102	70.10	7150.00
	Round 2	39	73.36	2861.00
Fair trading practices	Round 1	102	67.16	6850.50
	Round 2	39	81.04	3160.50

Based on the average of the 14 indicators, we create the synthetic index of - Attributes of sustainable diet (Cronbach's Alpha 0.853), which shows the following distribution among the respondents.

Table 3. Test Index Attributes of sustainable diet, per round.

		Mean	Standard Deviation
Round	Round 1	4.6	.47
	Round 2	4.8	.49
	Total	4.6	.48

Minimum=1, maximum=5

The average index values are very similar in the two rounds, although there is a slight difference (higher) in round 2.

Relating sustainability with health, 67,6% of the students in round 1 and 64,1% in round 2 stated that they believed that sustainable diet and healthy diet terms were related, and 23,5% in round 1 and 30,8% in round 2 specified that they believed the indices were dependent.

Students were asked to evaluate how important it is to acquire sustainable food on a scale from 1 to 5, 1 being “not important at all” and 5 being “very important”. The total sample’s mean score was higher at the end of the programme (round 2), students considered it more important and were willing to pay more for food and drinks produced sustainably.

Table 4. Importance and willingness to pay more money for food and drink products that are produced in a sustainable way, in Hospitality and Tourism Students, at the beginning (round 1) and at the end (round 2) of the programme.

	Round	N	Sum of	
			Mean	RanRanks
How important is it for you that the products you consume are produced in a sustainable way?	Round 1	102	69.11	7049.00
	Round 2	39	75.95	2962.00
To what extent are you willing to pay more money for food and drink products that are produced in a sustainable way?	Round 1	102	67.68	6903.00
	Round 2	39	79.69	3108.00

About the questions on sustainability practices, the students were asked to choose accordingly to the frequency of the practice on a scale of 1 to 5, 1 being “never” and 5 being “daily or almost daily”. The students surveyed at the beginning of the programme graded lower the statements “I eat seasonal fruits, vegetables, berries, mushrooms and legumes” and “I avoid food waste” and the higher noted was “I avoid products that have been transported from far away” and “I would buy sustainable food products more often if they were more available”, with the highest Mean Rank. The students surveyed at the end of the programme gave a higher rank to “I would buy sustainable food products more often if they were more available” and “I avoid food waste”, and a lower rank to “I avoid products that have been transported from far away”.

Table 4: Practices on sustainability related to food, in Hospitality and Tourism Students, at the beginning (round 1) and at the end (round 2) of the programme.

	Round	N	Mean Rank	Sum of Ranks
I pay attention to the consumption of meat and dairy products	Round 1	102	68.58	6995.50
	Round 2	39	77.32	3015.50
I pay attention to the consumption of products transported by plane	Round 1	102	69.60	7099.50
	Round 2	39	74.65	2911.50
I pay attention to the consumption of greenhouse-grown vegetables	Round 1	102	70.93	7234.50
	Round 2	39	71.19	2776.50
I eat seasonal fruits, vegetables, berries, mushrooms and legumes.	Round 1	102	65.93	6725.00
	Round 2	39	84.26	3286.00
I avoid food waste	Round 1	102	66.00	6732.00
	Round 2	39	84.08	3279.00
I avoid products that have been transported from far away	Round 1	102	71.76	7320.00
	Round 2	39	69.00	2691.00
I use energy-efficient cooking methods.	Round 1	102	68.10	6946.00
	Round 2	39	78.59	3065.00
I can easily access fresh food if I want to	Round 1	102	70.73	7214.50
	Round 2	39	71.71	2796.50
I would buy sustainable food products more often if they were more available.	Round 1	102	65.57	6688.00
	Round 2	39	85.21	3323.00

A Mann-Whitney U test was used due to the ordinal nature of Likert-scale data. The practices that presented statistically significant differences between rounds: "I eat seasonal fruits, vegetables, berries, mushrooms and legumes" ($U=1472,000$; $p=0.012$), "I avoid food waste" ($U=1479,000$; $p=0.011$), "I would buy sustainable food products more often if they were more available" ($U=1435,000$; $p=0.007$).

4. Practical implications

The study offers valuable insights into how hospitality and tourism students perceive and engage with agrifood systems' sustainability, highlighting both their awareness and gaps in knowledge and practice. From a practical perspective, these results can inform curriculum development in hospitality and tourism education by exposing students to decisions within the Agricultural Knowledge and Innovation Systems' context. Food can promote the effect of transformative learning saying that the process of teaching students how to think critically about social issues related to food can improve their awareness of these issues and contribute to possible solutions for changing habits, reinforcing their sense of social responsibility, and promoting social change (Mair & Sumner, 2017). Even though students do not participate in every part of the system, they will make decisions that may contribute

to the flourishing of short food chains, promoting local produce and sustainability. On a larger scale, once working in restaurants possessing the ability to support local agricultural practices and economies, positioning restaurants as pivotal agents in influencing consumption behaviours.

5. Theoretical implications

From a theoretical standpoint, this study contributes to the growing body of research on sustainability education by applying the Knowledge, Attitude, and Practice (KAP) framework in a tourism and hospitality context. The results reinforce the need for longitudinal studies to assess the long-term impact of sustainability education on behavioural change. Moreover, the findings suggest that awareness alone does not necessarily translate into sustainable practices, pointing to the importance of exploring motivational and structural barriers that may hinder behavioural change. Future research could benefit from mixed-method approaches, including qualitative insights, to deepen the understanding of how students' values, habits, and external influences shape their agrifood systems' sustainability-related decisions.

6. References

- Chen, C., An, Q., Zheng, L., & Guan, C. (2022). Sustainability literacy: Assessment of knowingness, attitude and behavior regarding sustainable development among students in China. *Sustainability (Switzerland)*, 14(9). <https://doi.org/10.3390/su14094886>
- Food and Agriculture Organization of the United Nations. (n.d.). *Food systems and safety*. <https://www.fao.org/food-systems/en/>.
- García-González, Á., Achón, M., Krug, A. C., Varela-Moreiras, G., & Alonso-Aperte, E. (2020). Food sustainability knowledge and attitudes in the Spanish adult population: A cross-sectional study. *Nutrients*, 12(10), 1–21. <https://doi.org/10.3390/nu12103154>
- Mair, H., & Sumner, J. (2017). Critical tourism pedagogies: Exploring the potential through food. *Journal of Hospitality, Leisure, Sport and Tourism Education*, 21, 195–203. <https://doi.org/10.1016/j.jhlste.2017.06.001>
- Vandamme, E. (2009). Concepts and challenges in the use of Knowledge-Attitude Practice surveys: A Literature review. [Details missing—please provide publisher or source if available]
- Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., ... Murray, C. J. L. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, 393(10170), 447–492. [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4)

Appendix

General characteristics of respondents

Table 1 presents the students answering the first and second round of the survey. The respondents' characteristics are organised by Programme, School, Qualifications before enrolling HTS, age range, Gender and Country of residence before enrolling HTS.

The majority of participants resided in Portugal before studying at EHT, 87,2% in round 1 and 71,1% in round 2, with smaller percentages from countries non-members of the European Union, such as Brazil, Angola, and a smaller number of students from other nations. For simplification, the countries where students completed their scholarship before enrolling at HTS were grouped into Portugal and EU countries and non-European countries.

Table 1: General characteristics of students respondents at the beginning (round 1) and at the end (round 2) of the programme, school year 2023-2024

		Round 1	Round 2
Programme	F&BM	2.9	2.6
	GHA	5.9	25.6
	GPC	30.4	23.1
	GPP	14.7	10.3
	GRB	31.4	23.1
	GT	14.7	7.7
	HOM		7.7
School	EHT Algarve	6.9	25.6
	EHT Coimbra		30.8
	EHT Douro-Lamego	21.6	10.3
	EHT Estoril		12.8
	EHT Lisboa		12.8
	EHT Oeste		
	EHT Portalegre	14.7	
	EHT Portimão	2.0	2.6
	EHT Porto	38.2	
	EHT Setúbal	2.0	
	EHT Viana do Castelo	8.8	
	EHT Vila Real de Santo António	5.9	5.1
Qualifications before HTS	12º regular education	37.3	30.8
	12º professional education	55.9	46.2
	University degree	6.9	23.1
Age Range	18-20 years old	58.8	38.5
	21-24 years old	20.6	23.1
	over 24 years old	20.6	38.5
Gender	Female	52.0	48.7
	Male	48.0	51.3
Country of residence before enrolling HTS	NonEU	12.7	28.9
	PortugalAndEU	87.3	71.1

Table 2: Pearson Chi-Square Tests characterisation of the samples at the beginning (round 1) and at the end (round 2) of the programme, school year 2023-2024

		Round
ProgrammeN	Chi-square	20.268
	df	6
	Sig.	.002*.b.c
SchoolN	Chi-square	92.677
	df	10
	Sig.	<.001*.b.c
Qualifications before HTS	Chi-square	7.373
	df	2
	Sig.	.025*
Age Range 3	Chi-square	5.811
	df	2
	Sig.	.055
Gender	Chi-square	.119
	df	1
	Sig.	.730
Country of residence before enrolling HTS	Chi-square	5.117
	df	1
	Sig.	.024*

Results are based on nonempty rows and columns in each innermost subtable.

*. The Chi-square statistic is significant at the 0,05 level.

Table 3: Test Index Attributes of sustainable diet, per round

	Round	N	Mean	Std. Deviation	Std. Error Mean
Attributes of sustainable diet	Round 1	24	4.583	.4718	.0963
	Round 2	12	4.756	.4934	.1424

Minimum=1, maximum=5

Table 4: Test Statistics. Grouping Variable: Round

	I pay attention to the consumption of meat and dairy products	I pay attention to the consumption of products transported by plane	I pay attention to the consumption of greenhouses grown vegetables	I eat seasonal fruits, vegetables, berries, mushrooms and legumes.	I avoid products that have been transported far away	I avoid products that have been transported far away	I use energy efficient cooking methods.	I can easily access fresh food if I want to	I would buy sustainable food products more often if they were more available.
Mann-Whitney U	1742.500	1846.500	1981.500	1472.000	1479.000	1911.000	1693.000	1961.500	1435.000
Wilcoxon W	6995.500	7099.500	7234.500	6725.000	6732.000	2691.000	6946.000	7214.500	6688.000
Z	-1.182	-.678	-.036	-2.507	-2.553	-.378	-1.429	-.133	-2.707
Asymp. Sig. (2-tailed)	.237	.498	.972	.012	.011	.706	.153	.894	.007

Special Session 6E

How can Living Labs become effective tools for farmer advisory? The case of LivingSoiLL (Mission Soil EU project)

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1. Purpose

The aim of this special session is to foster a transdisciplinary reflection on how to engage busy advisors and farmers in the Living Lab approach by understanding their constraints, addressing misperceptions, and developing strategies to overcome them. Accordingly, the session targets both researchers and advisors attending the conference.

2. Approach

The project LivingSoiLL — Healthy Soil to Permanent Crops Living Labs is part of the EU Mission A Soil Deal for Europe (Mission Soil) funded under the EU Research and Innovation Programme Horizon Europe. Its main objective is to promote sustainable land and soil management in both urban and rural areas. LivingSoiLL (<https://livingsoill.eu>), which has been ongoing for over a year, is establishing five Living Labs across Europe focused on improving soil health in permanent crops such as vineyards, olive groves, chestnut groves, hazelnut orchards, and apple orchards. These Living Labs are built on experimentation and the co-creation of solutions to enhance soil health across more than 50 experimental sites.

3. Findings and implications

The expected outcomes of this session are to gather diverse perspectives and practical strategies on how to make Living Labs an inclusive and effective approach for promoting co-learning and co-innovation, with the active engagement of advisors and farmers.

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