

Increasing crop diversification requires diversity in teaching, training and learning

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- Crop diversification is a dynamic process that should be tailor-made to local contexts to help achieve sustainable agrifood systems.
- The complex and uncertain context of crop diversification requires actors to search and contextualize knowledge for action with adapted tools, resources and dedicated networks.
- Instead of ready-to-use and prescriptive solutions, tools and resources to design, assess and drive crop diversification strategies are needed.
- AKIS actors need to be outfitted with new skills and attitudes to act within and have impact on the sociotechnical context.
- Specific knowledge, know-how and soft skills are needed to accompany farmers, advisors and all actors in agricultural knowledge systems
- Current training and education programmes still need to take up concepts, approaches and tools related to crop diversification
- DiverIMPACTS provides tools and resources that can be directly mobilized by actors

Introduction

Crop diversification can help achieve the EU Green Deal and the Farm to Fork sustainability goals by making food systems more resilient, fair and environmentally friendly^[1]. It has been proven to enhance crop yields, biodiversity, and the provision of several ecosystem services including water quality, pest and disease control and soil quality^[2]. However, crop diversification is hindered by several barriers all along the value chain as well as within the sociotechnical systems^[3]. Results from DiverIMPACTS^[4,5] confirm that a lack of knowledge and skills are among the barriers that prevent farmers as well as advisors from fostering crop diversification. To address this, a paradigm shift is required, with strategic adaptations and changes in the Agricultural Knowledge and Innovation System (AKIS).

Indeed, crop diversification is not just about adding new crops in the field. It is a dynamic process that should be tailor-made according to local contexts (pedoclimatic and socio-economic), local market characteristics, as well as the objectives and preferences of farmers. Diversification strategies also depend on the management of the farms, the relations between the AKIS actors (e.g., farmers, farm workers, agricultural educators, researchers, non-academic experts, public and independent private advisors, and supply chain representatives) and the environment. The dynamic and context-dependent nature of crop diversification management requires the use of updated and contextualised knowledge, which calls for specific skills and attitudes.

What is crop diversification?

Crop diversification means increasing the diversity of crops in space and time using diversification practices such as rotation extension, multiple cropping, intercropping, and/or a combination of these practices.

Farmers need to mobilize a wide range of theoretical and technical knowledge adapted to their specific regional or national contexts. Yet, currently, agricultural teaching and advisory services in Europe mostly focus on individual crops within simple rotations that depend on high use of external inputs, and which produce a low variety of products for streamlined value-chains. Consequently, the knowledge required for crop diversification processes is either not available or poorly disseminated among relevant AKIS actors. Researchers, teachers and advisory actors need to adapt their activities to fit the crop diversification rationale. This requires a new set of skills, knowledge and attitudes that higher education and professional training can enable.

Approach and results

Inventory of needs: advisors, training and education

In order to identify the current gaps in skills and knowledge for crop diversification as well as the needed infrastructure for teaching and advisory services, a set of workshops were carried out in seven European countries with relevant AKIS actors (farmers, advisors, agricultural educators, researchers). In parallel, scientific literature, including outputs from the PRO AKIS project¹ and results from DiverIMPACTS was also analysed.

Interviews with key actors from education, advisory and training² were carried out, and practical needs and experiences from the 25 DiverIMPACTS case studies working on crop diversification were reviewed.

Innovative ways of teaching the identified skills were subsequently tested in a series of training sessions. Based on these experiences, potential changes in current teaching and advisory approaches as well as in their practical contents were identified.

Key challenges facing AKIS actors (mainly farmers and advisors)

What does a farmer need in order to implement a diversified cropping system successfully?

To diversify the cropping systems, farmers need to:

- Master theoretical and technical agronomic knowledge about new crops and crop combinations as well as diversification strategies.
- Adapt their crop rotation, both crops and practices, to their local situations and changing contexts (e.g., climate, markets, etc.) in order to get the most out of diversification;
- Adapt or purchase new machinery and learn to use it properly;
- Adapt facilities on the farm and access market outlets for new crops (storage, market, labour, etc.);
- Have time, desire and financial means to achieve all previous points.

How can a farmer progress given the uncertainty and complexity around crop diversification?

In addition to climate change and market dynamics that bring a lot of uncertainty, information on crop diversification and its effects - at the cropping system, farm and value-chain level - is complex and not always available or incomplete.

To cope with this uncertainty and complexity, farmers bring together knowledge from multiple sources, as well as various actors from the so-

1 PRO AKIS is a EU-funded project that compiled an inventory of the AKIS organisations, institutions and their linkages in the 27 EU countries. More information available at proakisinventory.eu.

2 TEAGASC (www.teagasc.ie), EUFRAS (www.eufiras.eu), APCA-Resolia (resolia.chambres-agriculture.fr), Inagro (www.inagro.be)

cio-economic environment and different types of tests at the farm level, thus leading to a diversity of trajectories. They have to set up a continuous and adaptive learning process to redesign cropping systems, mobilise new knowledge, reorganise the work, and interact with new stakeholders.

To achieve this continuous transition process, farmers and advisors need to develop skills that enable them to adapt to a complex and evolving context and ask the right questions to the right disciplines. They have to be inventive and outgoing in order to find information in different channels and combine it themselves.

How can a farmer make use of relationships with advisors, teachers, people in the value chain and in society?

It all starts with the idea to increase crop diversification. This may come from a farmer or farmer group, and they may get support and/or criticism from consumers, suppliers, buyers, advisors, etc. Farmers need to be able to manoeuvre between and with these stakeholders and create multi-actor dialogues. For that, they need to be able to ana-

lyse their plan, the situation and the stakeholders, to communicate with them, and to reflect on their own goals and adapt them. Consequently, there is a need for more space for exchange in order to foster co-construction and innovation. In addition to a transformation of the farmer's work activities, we need a transformation of the role and attitude of all the value-chain stakeholders. In particular, advisors and teachers active in this field have to be reflexive and facilitating rather than solely being knowledge providers.

Skills and knowledge needed

Even though straightforward knowledge is available about how to grow a variety of different crops, it appears that current and accessible knowledge and skills don't address the key challenges that farmers and advisors are facing. While considering these gaps and outputs from the literature and from DiverIMPACTS, a set of needs was sorted and is presented in table 1 (page 5).

Recommendations for the education and advisory system

To promote crop diversification, several short-term and long-term actions can be undertaken to improve teaching and training for all AKIS actors. While short-term actions utilise existing resources and are faster to implement, long-term actions aim to change paradigms and general skills, which are necessary to sustain and make collaborative work and co-innovation successful.

1

Create and share knowledge and skills needed to understand the functioning of the agri-food system beyond the field level.

Short term: Promote peer-to-peer teaching and knowledge sharing between farmers

Mixed groups of farmers with shared interests are able to efficiently share and articulate a diverse set of knowledge and skills. We recommend structuring, expanding and funding such groups at regional and national levels.

Long term: Spread diverse knowledge on crop diversification (concepts, strategies, features, benefits, value chain dynamics, etc.)

- Use virtual tools to set up large-scale (national and/or European) information sharing infrastructure on crop diversification: platforms, networks of actors (i.e. EIP-Agri network), etc.
- Reinforce current training and education agricultural programs by (i) sharing biological and technical knowledge on crop diversification (ii) introducing more multi-disciplinarity and (iii) developing the systems approach (i.e., conceptual framework and associated means and tools) suitable for crop diversification.

2

Support diversified systems design under complex and uncertain contexts

Short term: To better understand complex diversification processes in the agri-food system, build and use hybrid knowledge in training and education by:

- creating living labs favourable for innovation and contextualized knowledge design, and
- connecting training and teaching programs to these living labs to train and familiarise future actors to this approach.

Long term: Sustain training programmes over time to update AKIS actors' knowledge on diversification (ongoing knowledge).

Life-long training already proposed in the PRO AKIS project^[7] should include the concept of diversification as a fundamental principle and address both advisors and farmers, based on recommendation #1.

3

Outfit AKIS actors with new skills and attitudes to act within and have impact on the sociotechnical context

Short term: Implement regional knowledge broker positions to allow and improve coordination and learning between actors

Build an open-access European platform that gathers resources on crop diversification (e.g., methods on co-innovation workshops, methodological guide for stakeholder analysis, toolbox for diversification, etc.); that can easily be picked up by different AKIS actors (advisors, teachers, groups of farmers, etc.).

Long term: Change the paradigm in accompaniment and learning approaches to move from a knowledge-giver/taker relationship toward a coach/decision-maker relationship

- Develop an innovation broker function among advisors by providing training programs at the national level on (i) facilitation skills and participatory approaches, (ii) analysis and diagnosis skills (iii) value-chain and multi-stakeholder environment.
- Use the second pillar CAP budget foreseen for training to finance these training programs at the national and regional scale.

4

Support and enable continuous training

To support EU rural development and implement the Green Deal, it is essential to allow AKIS actors to continuously train and learn. This will allow them to develop and master the knowledge, skills and attitudes mentioned above in order to successfully implement crop diversification at the agri-food level. To go further, and along with the ambition of DiverIMPACTS, it is paramount that as many AKIS actors as possible attain a minimum level of knowledge on crop diversification. This could be guaranteed by the set-up and delivery of a certificate or a national diploma on crop diversification for sustainable agri-food systems

Table 1: Synthesis of needs to foster and implement crop diversification and associated knowledge, skills and attitudes for all AKIS actors. Knowledge refers to theoretical, technical and empirical knowledge; skills refers to “know-how” and ways of doing things; and attitudes broadly includes attitudes and soft-skills. Associated resources from DiverIMPACTS are also listed. For more information see^[6].

Needs to foster and implement crop diversification	How to address the need? knowledge, skills and attitudes to develop	What resources and results can be used to fill the need? Examples from DiverIMPACTS (see page 6 for references)
Understand diversification strategies and systems and the resulting dynamics of change in farming practices	Learn about	<ul style="list-style-type: none"> • Practice Abstracts to learn more about crop sequences, practices and technical results^[A] • Success stories can be a source of inspiration or an example to follow^[B] • Agronomic knowledge on ecosystem services, trade-offs and economic performances^[C] • Global indicator to assess the potential of ecosystem service provision of the crop rotation^[D] • Catalogue of solutions to remove barriers at the farm level^[E]
	Be able to	<ul style="list-style-type: none"> • Tools to assess sustainability of crop diversification strategies at different levels of agri-food systems (MASC, DEXIPM, at the cropping system scale, SMART^[F] at the farm scale, MAELIA^[G] at the territory scale, LCA protocols at the value chain scale)^[H] • List of criteria and indicators to evaluate crop diversification sustainability and performance^[I,J] • Indicators to evaluate crop diversification benefits^[K] • Tool for the selection of indicators for agriculture sustainability assessment^[L]
Design diversified systems under complex and uncertain contexts	Learn about	<ul style="list-style-type: none"> • Identification and analysis of barriers to crop diversification^[M] • Catalogue of solutions to create and develop new value chains to help actors^[E] • Toolbox of ingredients to drive crop diversification^[N] • Webinar on on-farm and on-station experimental results with reference to the experimental stations or farms to visit/contact^[O]
	Be able to	<ul style="list-style-type: none"> • Series of webinars to share and promote relevant information within the project^[P] • Toolbox to help select adapted resources to answer actor needs in a complex system^[Q] • Policy Brief on actionable knowledge and co-innovation^[R]
Acquire the attitude to act within and have an impact on the sociotechnical context	Learn about	<ul style="list-style-type: none"> • Value chain organisation (actors, interactions, contracts, price) • On-farm experimentation (methods of experimentation and interpretation, dissemination)
	Be able to	<p>Search and contextualise knowledge for action by:</p> <ul style="list-style-type: none"> • Choosing and manipulating tools to search for and disseminate relevant information • Networking and exchanging using social/professional networks and platforms
Acquire the attitude to act within and have an impact on the sociotechnical context	Learn about	<ul style="list-style-type: none"> • Adapt his/her own attitude to address problems from different angles • Interact and communicate in a multi-actor context • work as an innovation broker • take up a participative approach
	Be able to	<ul style="list-style-type: none"> • Resources for developing skills to improve inter-sector communication and exchange^[S]

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Imprint

Publisher: École Supérieure d'Agriculture (ESA), France

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Reviewers: Laura Kemper (FiBL)

Permalink: <https://zenodo.org/record/6801262>

This policy brief was elaborated in the DiverIMPACTS project. The project runs from June 2017 to May 2022.

The goal of DiverIMPACTS – Diversification through Rotation, Intercropping, Multiple Cropping, Promoted with Actors and value-Chains towards Sustainability – is to achieve the full potential of diversification of cropping systems for improved productivity, delivery of ecosystem services and resource-efficient and sustainable value chains.

Project website: www.diverimpacts.net

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DiverIMPACTS is supported by the European Union's HORIZON 2020 research and innovation programme under Grant Agreement no 727482 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.00092. This communication only reflects the authors' view. The Research Executive Agency is not responsible for any use that may be made of the information provided.