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Agroecology for Europe (AE4EU)

Towards the development of agroecology in Europe

Deliverable report D2.3 – Toolbox for long-term ALL and RI

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List of Abbreviations

AE Agroecology

ALL Agroecosystem Living Lab

AELL Agroecology Living Lab

ENoLL European Network of Living Lab

FAO Food and Agriculture Organization of the United Nations

LL Living Lab

PAR Participatory Action Research

RI Research Infrastructure

SAGE Sage is a global academic publisher of books, journals, and library resources

SAT Sustainability Assessment Tool

TSS Transdisciplinary Sustainability Science

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H2020

Agroecology for Europe

Executive summary

The Living Laboratory is a methodology for multi-actor initiatives and a burgeoning field of research, rapidly finding applications in diverse contexts. Among the emerging concepts in this field is the Agroecosystem Living Laboratory (ALL), which is gaining prominence, particularly with the inception of the European Partnership on Agroecology Research Infrastructures & Living Labs, also introducing the closely related Agroecology Living Laboratory (AELL). Despite its increasing importance, there are few best practice guidelines or standardized methods for establishing, managing, and evaluating such initiatives.

The purpose of this deliverable is to provide tools and guidance on establishing and maintaining ALL/AELL and, to a lesser extent, research infrastructures (RI), with an emphasis on evaluation and field research. The first tool is a collection of existing methodologies relevant for establishing, co-creation, and evaluation of ALL, based on a literature review. . This review yielded a collection of tools, methods and frameworks drawn from transdisciplinary sustainability science, participatory action research, management/facilitation research, case studies from other types of living labs (urban, rural, nature-based-solutions LLs), agroecological/sustainability assessment frameworks, and interdisciplinary evaluation. We particularly highlight the significance of multi-level evaluation and explore the use of pre-established evaluation frameworks versus the co-design of evaluation parameters. We also discuss governance structures of ALLs, focusing on facilitation, integration, ethics, and power relations.

While existing concepts and tools that can be borrowed from other disciplines are suitable for several aspects of implementation and maintenance of ALL/AELL, we found that performance of ALL could be improved through specifically designed tools for evaluating and monitoring the outcomes in terms of transformation processes specific to agroecology. Therefore, we introduce ATP-in ALL (Analyzing Transformation Processes in Agroecosystem Living Labs), a novel tool/framework for assessing an ALL's contribution to the agroecology transition.

One of the main goals of implementing agroecology is to improve and maintain biodiversity in the agricultural landscape. We present a synthesis framework for determining the transition pathway and opinion spaces for biodiversity recovery across different landscape types and

farming systems, suggesting that landscapes which are at different levels of agricultural intensification will also require different trajectories for transition towards improved biodiversity targets.

We then discuss the practicalities of biodiversity monitoring and assessment with regards to ALL. We provide a simple scheme for optimizing sampling designs for biodiversity assessments at different scales (field to landscape level).

Lastly, the report summarizes several recommendations derived from the literature review and outlines the intended integration of the concept/tool collection on the newly launched AE4EU "Agroecology for Europe hub".

As the concept of ALL continues to gain traction, the methodologies and tools presented in this report will serve as a valuable resource for researchers, practitioners, and policymakers seeking to establish, manage, and evaluate ALLs. The emphasis on transdisciplinary collaboration, co-design, and comprehensive evaluation will help guide the development of more effective and impactful multi-actor agroecological initiatives.

1. Introduction

The Living laboratory methodology is a rapidly growing field of research as the concept is applied in novel contexts. The European Network of Living Laboratories (ENoLL) define the LL as *"…open innovation ecosystems in real-life environments using iterative feedback processes throughout a lifecycle approach of an innovation to create sustainable impact"*[1], and see LLs as mediators for innovation in field such as governance, energy and urban development. The LL approach is already well established in, e.g., urban or healthcare settings, but the approach is relatively new in sustainability and agricultural settings, and will require novel methodologies (Gamache *et al.*, 2020). The agroecosystem living laboratory (ALL) is a relatively novel concept (MACS, 2019). Agroecosystem living labs *"(...) are characterized by exceptionally high levels of scientific research; long innovation cycles with high uncertainty due to external factors; and the high number and diversity of stakeholders involved*" (McPhee *et al.*, 2021).

The initiation of the new European Partnership on Agroecology Research Infrastructures & Living Labs will use ALL to specifically tackle the agroecology transition as defined by FOA HPLE (2019) report and Gliessman (2016). The LL for agroecology transition (hereafter AELL) concept is very closely related to ALL, but with the principles of agroecology transistion as their main focus. Distinctive characteristics of AELLs are defined by the partnership in their draft proposal (SCAR-AE, 2022) as i) strong local embeddedness: AELLs are deeply intertwined with their local surroundings, creating a strong bond with the immediate community, ii) diverse origins: AELLs originate from a wide array of sources, ranging from individual farms to interconnected networks and communities and iii) varied and intensive knowledge generation: AELLs exhibit heterogeneity in the generation of knowledge and innovations, encompassing practical insights at the farm level and extend to broader policy implications. To quote the proposed partnership's description: *"…living labs are initiatives in which experimentation is conducted on real farms, in specific territorial and*

[1] https://enoll.org/about-us/

community contexts, with farmers and other actors involved from the beginning as equal partners in proposing ideas, testing them, improving them and promoting them further." In the AE context, LLs will push innovation coming from diverse actors while research infrastructures (RI) will provide tools, resources and methods of standardized large-scale data collection. The vision of the Partnership involves, ultimately, an evidence-based governance and policy making process which includes AE principles and supports socially and ecologically sustainable farming practices in the EU. This evidence and innovation is to come from LLs and RI. However, standardization of methods for initiating, organizing and evaluating such initiatives is still an ongoing process (Beaudoin *et al.*, 2022). In this document, we will use the term ALL from hereon, as it is used most in the AE4EU project.

With ALL taking center stage in EU science and policy making support, such methodology and streamlining is needed to overcome challenges faced by such initiatives. The LL concept has historically been interpreted in different ways geographically and across topics, which may lead to confusion for funders and for practitioners (Leminen and Westerlund, 2016). Attempts at standardizing the LL approach have been conducted by the ENoLL by applying the LL harmonization cube (Mulder, Velthausz and Kriens, 2008), but the ongoing shift in meaning of existing terms and increase in novel terminology persists as a challenge to common understanding. The ALL innovation cycle is defined as very long compared to other types of LL (McPhee *et al.,* 2021), meaning that ALL must be able to persist for long periods of time. Concerningly, the 'mortality rate' (e.g. ratio of initiatives not responsive/active) of LLs listed in the EnoLL database were around 40% after only a few years, which indicate that more stringency must be applied when establishing and maintaining LLs (Schuurman, 2015). The LL approach to stakeholder involvement and transdisciplinary knowledge creation/integration is a demanding process with diverse participants, and when key actors such as the researchers initiating the LL leave, the efforts to continue the LL often cease (Knickel *et al.*, 2019). To keep LLs "living" for the timeframes needed to see results from AE implementation (multiple years to decades) remains a significant challenge.

Similarly, agroecology is itself also a contested concept, which can involve a more narrow or wider scope of fields and topics. Agroecology encompasses ecological and social aspects in an integrated approach to sustainable farming, on the level of individual farms up to the food system, where widespread innovation and knowledge-sharing based on local conditions is integral. When establishing an LL that intends to move the current food network or current farmer practices towards a set of approaches that aligns with AE, there must be diligent energy put towards formulating what stakeholders see as success, and how achievements of the LL should be evaluated. The qualitative aspects of AE transition evaluation are already developed in several different indexes (e.g. FAOs 10 elements of Agroecology [2], 13 principles of Agroecology HLPE (2019)), but these indexes are yet to be applied to ALLs. Evaluation of LL is discussed in several recent studies, highlighting the difficulties in finding a one-size-fits all approach, and instead suggesting a mix of qualitative and quantitative approaches (Ballon, Van Hoed and Schuurman, 2018). The implementation of the LL approach itself thus require evaluation, as well as the outcomes of both 'soft' targets (e.g. social aspects) and AE related outcomes. The evaluation of an ALL must thus be multi-leveled.

Deliverable 2.3 aimed to design a "toolbox" for ALL and research infrastructures (RI) related to agroecology in order to provide guidance on how to establish and maintain such initiatives. As there already are many tools for project planning, management and assessment from other fields and disciplines, we first elucidate existing concepts and tools that can be applied in the ALL framework, based on a literature review and desk research. By reviewing what methods and concept are explicitly mentioned and put to use in the literature, we aim to provide recommendations on methods and concept that are useful for ALL practitioners, with a focus on establishment, co-creation and evaluation. We especially emphasize the importance of multi-level evaluation, and discuss the co-design of evaluation parameters. present a novel tool/framework for evaluating an ALL's contribution to the agroecology transition: Analyzing Transformation Processes in ALL (ATP-in-ALL).

Beyond existing concepts and methods, we identified a demand for new tools that are specifically designed for the needs of ALL with respect to evaluation of biodiversity impacts and success of the transformation towards sustainability. Biodiversity-enhancing measures and the resulting environmental recovery of biodiversity is one of the essentials of agroecological practices. In the survey of traits presented in AE4EU D2.2, biodiversity was the most common theme mentioned by initiatives (87%). Agroecological practices in farming

[2] https://www.fao.org/documents/card/en/c/I9037EN/

often depend on harnessing of ecosystem services, many of which, e.g., pollination and natural pest control, depend on insects and other invertebrates. A transformation towards AE practices hence involves supporting the organisms that provide those services. Thus, monitoring and evaluation of the effects of biodiversity-enhancing measures can be an integral part of ALL. As biodiversity science is the expertise of TI, we focus on the monitoring and evaluation of this feature of AE transition within the context of ALL, on farm and up to the landscape level. We first present a conceptual framework for "tailored pathways" to biodiversity recovery based on landscapes which are at different levels of agricultural intensification, which require different trajectories for transition towards improved biodiversity targets.

In order to confirm that the implemented AE practices have the intended positive effects on biodiversity at the landscape level, it is necessary to have a baseline assessment (pre-AE practice implementation) of the status of the chosen biodiversity indicator(s) followed by repeated monitoring during and after the initiative. Therefore, it is important to place sampling sites of the monitoring in the landscape in a way that provides a sample that is representative of the whole landscape and easily resampled at multiple time points. Here, we present schemes for optimizing sampling designs for biodiversity assessments at the level of agricultural landscapes. Finally, we summarize the recommended tools/methods based on our literature review and present our intended integration of the tool/method collection on the "Agroecology hub".

2. Toolbox: Recommendations and relevant tools, frameworks and methods for ALL sourced from the literature

We performed a scoping review in Web of Science (Table 1) of literature with the aim of finding tools, frameworks and methodologies applicable to ALL, not only under the banner of agroecology, or from the LL literature. We focused on the following criteria:

- Establishment: Action Research, Stakeholder sourcing
- Co-design/creation processes/ transdisciplinary cooperation
- Evaluation: LL functioning, social impacts, AE adoption, AE outcomes

- Tools available in English

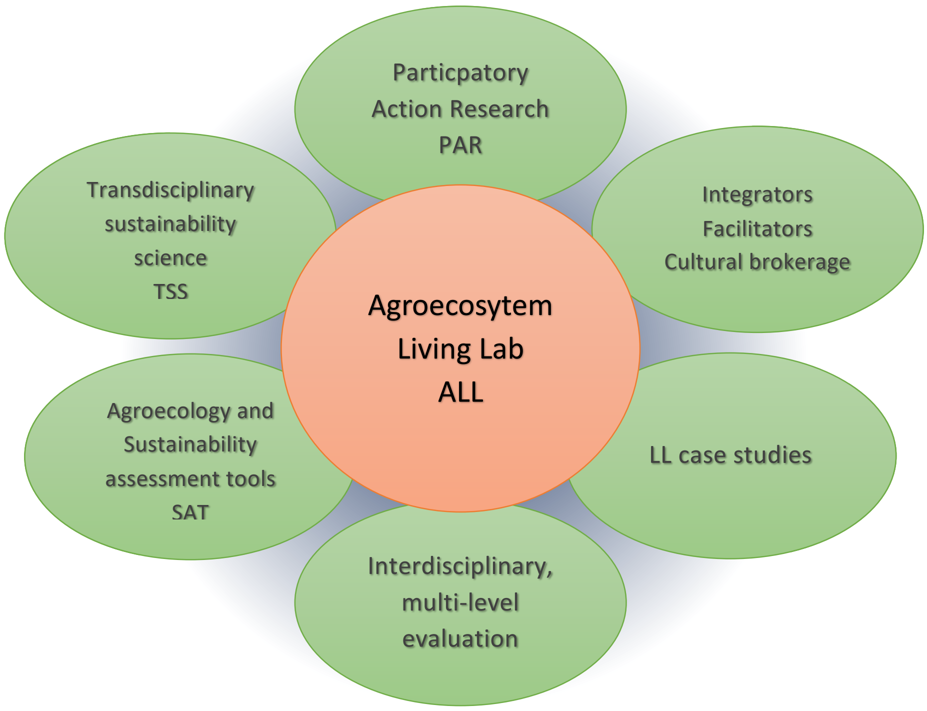
Out of 120 articles assessed, 44 were deemed relevant based on title and abstract, and the full-text was assessed. These articles were used as a source for relevant methods and tools, which were then followed up by citations in the respective articles. A significant amount of work has already been done within the LL concept across projects in the Horizon 2020 and Horizon Europe frameworks. A search query in the CORDIS database for “living lab” generates 139 projects from the two funding schemes within natural, social and agricultural sciences. Six projects (UNALAB, ROBUST, UNISECO, LIFT, Engage2020, ALL-Ready) contained deliverables, publication or tools relevant to ALL.

Table 1. Literature searches in Web of Science and Cordis database

Source	Search query	Number of documents	
Web of Science Core Collection	(”living laboratory” OR ”living lab” OR "research infrastructure" OR transdisciplinar*) AND (guideline* OR monitor* OR evaluat* OR "case study" OR co-creation OR co-design OR co-learning OR management) AND (sustainability OR nature-based solutions OR "rural development" OR "ecosystem services" OR "ecologic intensification" OR "sustainable farming" OR "high nature value farming" OR "organic farming" OR "regenerative farming") NOT (healthcare OR patient OR “digital health”)	N = 120 articles assessed	N = 44 selected
Other Sources		N = 14 articles	

CORDIS database	contenttype='project' AND /project/relations/categories/euroSciVoc/code='/27','/23','/29' AND ('living lab')	N = 159 Projects assessed	N = 6 projects selected

We also used Connected Papers search tool [3] to find papers related to those we deemed presented relevant methodologies. The synthesis from the reviewed documents resulted in a shortlist of methodologies/frameworks and tools, as well as an overall synthesis of the process of establishing, running and evaluation of ALL. A number of main categories from the literature were identified, drawing from transdisciplinary sustainability science (TSS), participatory action research (PAR), management/facilitation research, case studies from other types of living labs (urban, rural, nature-based-solutions LLs), agroecological/sustainability assessment frameworks and interdisciplinary evaluation (Figure 1).



[3] https://www.connectedpapers.com/

Figure 1. A schematic illustration of the main literature fields from which the review gathered tools and methodologies suitable for the ALL framework.

2.1. Recommendations for establishment and maintenance of an ALL

We present the results of this review in the following subsections, listing methodologies presented in reports or scientific publications or as online tools. We have sourced methodologies, frameworks and tools that are relevant for the initiation and maintenance phase of an ALL. Since the process of LL initiation is so variable, we leave these tools here as a source of inspiration, rather than a step-by step guideline for LL establishment. We include examples from case studies taken from the literature to discuss problem areas. We then discuss governance structures of ALL based around facilitation/integration, ethics and power relations. In total, a list of 20 such tools/frameworks/methodologies were collected. In addition to listing and describing these tools, we also provide recommendations for further development of the ALL approach.

2.1.1. Transdisciplinary research methodologies

The LL approach contains transdisciplinary collaboration at its core according to ENoLL[4]. Transdisciplinary research in its simplest form refers to researchers and practitioners from various fields working together to solve complex problems. Other synonyms such as participatory approach or joint knowledge production all refer to an approach containing co-creation, capacity building and consensus-forming among diverse stakeholders. Also agroecology and the transformation of the food system is transdisciplinary in its nature; "*To fully embrace the systems approach and a holistic view, future agroecology research needs to include much more interdisciplinary and transdisciplinary work and consider multiple entry-points and transition trajectories, in particular including social, cultural, political and economic issues*" (Wezel *et al.*, 2020). In the AE context, the transdisciplinary collaboration between farmers and researchers is essential, since only farmers can describe the problems they face in their practice, while researcher must communicate to farmers what problems they may or may not have capacity to aid in solving (Hoffmann, Probst and Christinck, 2007). The proposed ALL approach has many things in common with transdisciplinary sustainability

[4] https://enoll.org/about-us/

science (TSS). One pivotal characteristic of TSS is its capacity to transform identified sustainability challenges into research issues or questions suitable for scientific inquiry, while also involving non-scientific knowledge production and applies recursive, collaborative problem framing approach (Ruppert-Winkel *et al.*, 2015). Addressing intricate sustainability challenges necessitates involvement of diverse knowledge communities to ensure insights from all disciplines and stakeholder groups associated with the issue. Secondly, researching potential solutions extends beyond problem analysis, as it requires the generation of knowledge that can guide the transition and intervention strategies. Thirdly, collaborative endeavors involving both researchers and non-academic stakeholders may enhance the legitimacy, ownership, and accountability for both the problem itself and the available solution options. These sentiments are echoed in the ALL approach.

Design principles for transdisciplinary research in sustainability science

In a much-cited paper, Lang et al. (2012) presents a conceptual model of an 'ideal type transdisciplinary research process', designing a set of principles and discuss their implementation in practice. They provide a set of design principles for transdisciplinary research in sustainability science and related guiding questions and a list of empirically derived challenges and exemplary coping strategies.

2.1.2. Participatory Action Research (PAR)

A concept that often comes up in the LL literature is Participatory Action Research (PAR). The SAGE Encyclopedia of Action Research defines it as a family of approaches that integrate theory and action with a goal of addressing and finding solutions to important issues together with those who experience them. It is closely related to notions of co-design and co-learning, and is practiced in diverse fields such as education, healthcare and public administration. However, in agroecological case studies, participatory methods are still under-represented (Sachet *et al.*, 2021). Central to PAR is the “action research spiral”, consisting of ongoing iterations of planning-acting-observing-reflecting-replanning (Kemmis, McTaggart and Nixon, 2014). This “self-reflexive spiral” takes place within individual participants but also in a group as a whole. Ultimately, the iterative approach aims to align the interests of the group as a whole, and to constantly re-evaluate what the best outcome can be for all participants, and what actions should lead there. Central to the planning and execution of such initiatives is good communication, trust and collectively agreed-upon protocols for handling personal information and disseminating results.

The Action Research Planner

This book by Kemmis et al. (2014) contains a large section with resources on the ethics of PAR (consent, trust building, conflict mitigation). It is advisable to draft a document based on PAR Group Protocols: Ethical Agreements for Participation in Public Spheres. In such a document, it is explicitly made clear what minutes of meetings will be saved and/or made public, who is responsible for taking such minutes and the level of anonymization of participants. One person is also designated as mediator in the case of interpersonal conflicts. Furthermore, recommendations on documentation (journaling, gathering evidence, interviews etc.) and reporting are provided.

The Action Catalogue

An online decision support tool[5] for selecting type of collaborative model based on project needs. Developed by the EU funded project Engage2020, it is directed at those wanting to conduct inclusive (or participatory) research.

2.1.3. Stakeholder sourcing, methods of co-creation

Closely tied to PAR, the stakeholder sourcing, alignment and co-creation are central to LL. When and how should stakeholders be involved? When and by who should the scope/theme of the LL be determined? The focus on the particular LL can be a pre-determined by an initiator (usually an academic entity), where the problem addressed is formulated by a single initiator, and stakeholders/actors and users are sourced and recruited around a particular theme. In the case where an initiative start in response to a specific funding call, the funders and the academic personnel with experience in writing grant proposals by necessity lead this stage, and thus hold power over the initial setting of the agenda (Fritz and Binder, 2020), something that is not fully conductive to the LL concept of co-creation. But the agenda-setting can also commence the other way around, where actors in e.g. a specific region are brought together and the issues that are to be addressed by the LL are formulated together in an

[5] http://actioncatalogue.eu/about [at 2 October 2023]

iterative process. In the D2.2 survey conducted on agroecological initiatives (ALL and other types), the majority of initiatives (77%) claimed the project objectives can evolve significantly over the course of the project. Hvitsand *et al.* (2022) describes a process where researches started out by defining a "system of interest" from which to start selecting actors (in this case production and marketing of organic vegetables). Groups of potential actors were invited to join a series of workshops in which the "problem space" was clearly defined and actors were then invited to join the ALL based on their relationship to the problem. In another ALL case study focusing on long-term experiments in agroforestry, Ciaccia *et al.* (2020, 2021) describe the initiation of an ALL for the region in three steps. First, academics initiated the LL by forming a 'researcher platform', who then requested a cultural broker to aid in sourcing food system actors in the region (farmers, policy makers etc.). The 'researcher platform' and the 'actor platform' together formed the 'stakeholder platform'. The researcher platform was tasked with identifying a set of topics relevant to the study system (importance at local/farm scale, feasibility), after which the actor platform was invited to weigh in on what topics were most relevant to them. This demonstrates an iterative approach already at the problem formulation stage (Ciaccia *et al.*, 2021), where all actors have a say in what topics are to be addressed by the LL. In a project focused on social learning in regenerative farming, (Luján Soto *et al.*, 2021) collaborated with a pre-established farmer organization based in a region troubled by land degradation and initiated a project to foster social learning between practitioners, in a local agenda-setting based on the mandate of the farmer's association.

Tools for these foundational stages of co-creation, co-design and co-learning processes are widely available. In essence, co-creative exercises can be applied in every stage of the LL process. They are ideally performed in person, where participants are allowed to write and discuss around a given theme, or around a looser brainstorming framework. There are several online tool collections for setting up co-creative workshops and taking stock of the output of these workshops and feedback cycles.

UNALAB Tools for Co-creation

Originally designed with urban LL and the implementation of nature-based solutions in mind, the UNALAB website[6] provides a number of simple to complex exercises for guiding discussion when finding common needs, design action plans and evaluate participant's reactions to proposed solutions. Many of these hands-on exercises are meant to be performed in a group setting in person but can also be adapted to a digital environment.

RAIN platform

The RAIN platform[7] was initiated by the LIVERUR project, funded by the EU to support rural livelihoods through innovation. The platform is business-focused in that it presents methodologies such as SWOT analysis and Business model canvases. These tools can be useful during the co-creation process in the ALL setting, especially in relation to novel market innovations.

ALL-Ready capacity building course

The ALL-Ready project was initiated to support the establishment of an ALL pilot network across Europe. As part of this goal, a capacity building platform[8] was initiated and a series of lectures on LL imitation, co-creation, innovation and facilitation, available free of charge.

Framework for Agile Living Labs (FALL)

Many traditional LL frameworks are focused on product development that are to be adapted to the need of a "user". This may also be the case in an ALL, where e.g. digital tools for aiding practitioners in AE implementation (e.g. Occitanum LL). In this context, Agile LL techniques based on SCRUM can be useful (Schwaber, 1997). Developed by IMEC[9], the Agile LL concept and guidance scheme is available online [10]. Agility in this context means integrating

[6] https://unalab.enoll.org/

[7] https://rainplatform.wtelecom.es/

[8] https://www.all-ready-project.eu/agroecology-living-labs-1-1.html

[9] https://www.imec-int.com/en

[10] https://eu-macs.eu/wp-content/uploads/2018/06/20180425-FALL-infographic.pdf

new information during a project's lifetime, taking user input into account when developing prototypes.

Multi-actor project guidance

UNISECO was a Horizon2020-funded project on socio-economic and policy drivers for uptake of agroecological methods. The project website [11] contains a collection of resources aimed at initiative leads and a collection of case studies.

2.1.4. Governance of ALL: Facilitation / Cultural brokerage

To operate effectively, ALLs will demand robust meta-governance and well-coordinated activities (SCAR-AE, 2022). The governance structure of ALL will be varied across initiatives, as they can manifest at various scales, from farm-level initiative (potentially involving a network of farms), as an overarching landscape-level approach, or even at a regional scale (see e.g. Agroecological Territories, AE4EU D2.4[12]). In the survey conducted in AE4EU D2.2 [13], governance methodologies were often multi-scaled/mixed (54% of ALL) when compared to other types of initiatives, which were more likely to be top-down managed compared to ALL (67% vs 31%).

A defining feature of ALL noted in the examples in McPhee *et al,*. (2021) is exceedingly large number of participants (up to 130 representatives) and diverse actor categories, when compared to other types of LLs. Increased diversity of actors was also noted as a feature of ALL in comparison to other research-oriented initiatives in AE4EU D2.2[14]. With such features, the demand for robust governance structure and personnel devoted to the operation of such structures is of the greatest importance. Aside from general project management tasks (event planning, funding, keeping minutes etc.), a key governance task for such personnel would be as facilitators guiding the co-creation process. The use of facilitators/cultural brokers in developmental transdisciplinary research is well established. In the framework of

[11] https://uniseco-project.eu/resources

[12] https://zenodo.org/communities/ae4eu/

[13] https://zenodo.org/communities/ae4eu/

[14] https://zenodo.org/communities/ae4eu/

ALL, cultural brokerage between researchers, farmers, industry and policy makers can be crucial for their success. In their partnership draft report, SCAR-AE (2022) point out the lack of trained facilitators with appropriate knowledge on AE and co-creation as a barrier to the LL approach. In a recent document by AE4EU's sister project ALL-ready D4.1[15], the challenges when working inter- and transdisciplinary were addressed both by initiative leads and by funding bodies. The importance of facilitators for trust-building between participants from different disciplines, but also between e.g. generations of farmers were deemed important. Facilitators ability to encourage participation, especially of farmers without strong prior interest in AE and other non-institutional smaller actors, is also highlighted. Hoffmann *et al.*, (2022) describes facilitators as 'integration experts' in transdisciplinary projects the administrate, manage, advice and evaluate the transdisciplinary process. The specific skillset required for these multifaceted tasks are distinctive enough to be designated a specific professional title, and specific standards curricula for their capacity building should be created (Hoffmann *et al.*, 2022). Placing early-career scientists from e.g. sustainability science or from a policy or natural science background in the position of manager/facilitator in transdisciplinary projects (including LLs) is suboptimal from the perspective of the researcher (high risk of insufficient output, long cycles), and from the LL participants (not enough time for trust-building). The facilitation of such initiatives should instead be professionalized and/or be the responsibility of later-career academics, with broader experience and safer employment situation (Rogga and Zscheischler, 2021).

2.1.5. Governance of ALL: Ethics and power relations

Fritz and Binder (2020) discuss power relations between funders, researchers and practitioners in a TSS setting. In TSS projects, practitioners have described researchers as "advisors, facilitators, organizers, or as distant observers or even "unpleasant evaluators" (Fritz and Binder, 2020). The researcher can also be seen as an 'other' by practitioners, and general issues with assumptions and lack of common language can create situations in which communication is hard. Unequal distribution of time and resources will always produce power

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[15] https://zenodo.org/records/7105206

dynamics between researchers (hired to participate/lead) and practitioners (volunteering to participate outside of their normal workload). In interviews, a frequently mentioned issue among LL leads was difficulty encouraging farmers to participate, especially those without prior interest in AE (ALL-Ready D4.1[16]). Financing of research-related activities for farmers may encourage more diverse participants. Consequently, the practitioners (e.g. farmers or other food system actors in the case of ALL) hold power in the sense that they can choose to withdraw at any time if an initiative is not developing in a desired direction (Fritz and Binder, 2020). On the other hand, researchers are often explicitly hired to work on a project, or are dependent on the output for their own career, their intrinsic investment in the project is large, and they may be more motivated to solve conflicts and try to make compromises (Rogga and Zscheischler, 2021). Since ALL often deal directly with people's livelihoods (e.g. farmer's income), other considerations must be taken that i.e. in an Urban LL where citizens/inhabitants may be affected by an intervention, but do not themselves take on financial risk. Thus, the perceived and actual 'risks' vary for different actors in an ALL, and this must be taken into consideration.

2.2. Recommendations on Monitoring and Evaluation of ALL

The LL framework is an offshoot of transdisciplinary research methodologies. As transdisciplinary initiatives, they will also need inter/transdisciplinary methods of evaluation. As of yet, there are no widely harmonized methodologies for evaluating LLs (Bronson, Devkota and Nguyen, 2021). Traditionally, LLs have often centered on innovation and product development, where co-design strategies often lead to higher-quality products (e.g. adapted to user needs), but also come with increased costs and time spent compared to other innovation methods (Dell'era, Landoni and Gonzalez, 2019). In the ALL setting, guided by the principles of agroecological transition, project output is rarely centered on a singular technical innovation or a product to be put to market (Gamache *et al.*, 2020). Thus, evaluation criteria related to innovation speed and prototype-to-market measures are less relevant in this context (e.g. Ståhlbröst, 2012). The diversity of methods proposed for evaluation (who

[16] https://zenodo.org/records/7105206

evaluates, what is evaluated, how are the results used) and their lack of standardization is an outstanding problem in sustainability-focused LLs (Beaudoin *et al.*, 2022).

In its nature the ALL operates on multiple levels (social up to the agroecosystem level), with long innovation cycles and high uncertainty, with the ultimate goal of high-level impact on the food-system scale, thus requiring exceptionally detailed levels of evaluation on multiple scales (McPhee *et al.*, 2021; Beaudoin *et al.*, 2022; SCAR-AE, 2022). The evaluation of an ALL (especially one focused on AE transition, AELL) must thus be “nested”. Here, we suggest a four-level view on ALL evaluation. First, the inner workings of the transdisciplinary effort, the organization, effectiveness etc. of the LL activities themselves should be evaluated. Secondly, the impacts of said LL activities are to be evaluated. In the framework of agroecology, impacts may be both internal (e.g. changing of mindset, increased network, increased co-learning), or external. Practice adoption, impacting agricultural on-farm practices, economic opportunities, consumer behavior, and legislation will, ultimately, lead to AE outcomes, e.g. improved biodiversity, soil parameters, water use, carbon sequestration, diversified markets etc. We herein suggest recommended evaluation tools based on the four levels: 1. LL functioning, 2. Social impacts, 3. AE adoption and 4. AE outcomes (Figure 2).

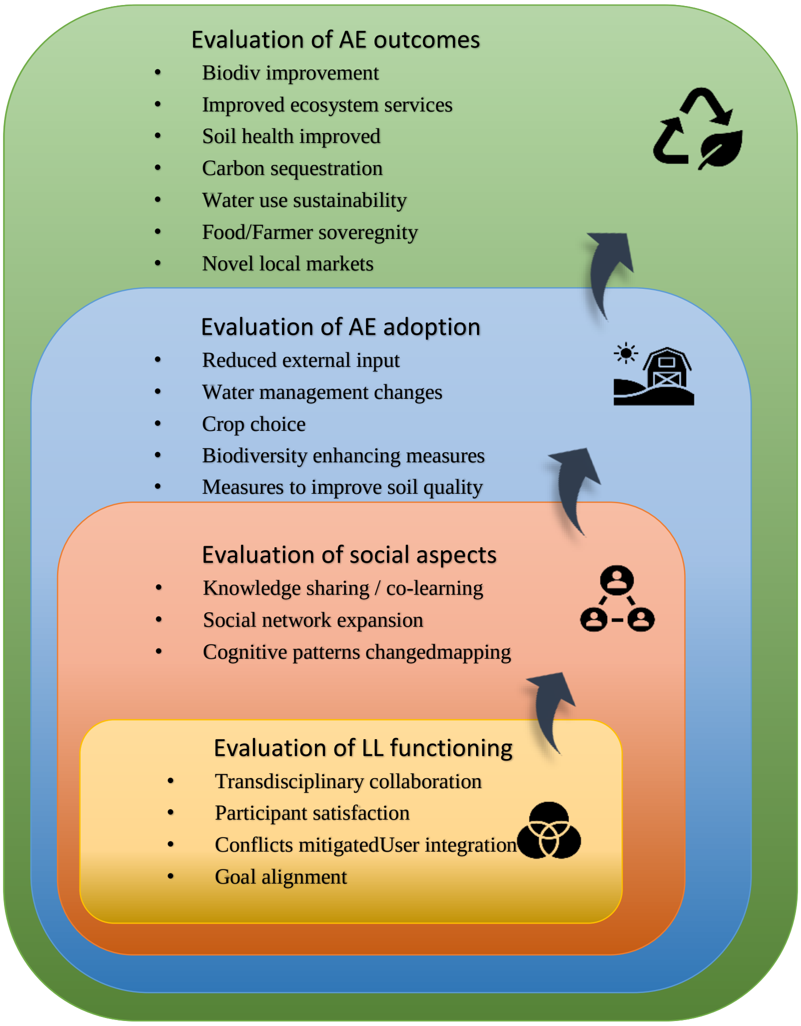

Figure 2. A schematic illustration of the four levels of ALL evaluation (LL functioning, social aspects, AE adoption and AE outcomes) with examples of desired outcomes which can be assessed for each level based on the literature review.

The definition of the evaluation objectives is a stage at which the scope and boundaries of the data to be collected are set. What measures are to be evaluated depend upon the interest of all stakeholders, a realistic sampling effort in terms of time and resources, and the expertise of the evaluators. In the iterative approach characteristic of LLs and of PAR, the input from multiple stakeholders, and the selection of evaluation endpoints that are relevant to most stakeholders, is essential.

In this section, we present a selection of tools relevant to the four levels of ALL evaluation presented in Figure 2; evaluating LL, Social impacts of LLs, evaluation of AE adoption, and evaluation of AE outcomes. For an introduction to a newly developed evaluation framework for ALL, see section 3. of this deliverable.

2.2.1. Characterizing the current state and the potential for AE adoption

The transition towards agroecology may look different depending on what type of farming region and landscape the ALL focuses on. No matter the questions addressed by the ALL, the baseline characteristics of the system must be determined early in the process and a tailored path towards transformation must be agreed upon, so that one can select suitable indicators to evaluate (Sietz *et al.,* 2022). This is true for all AE parameters – traits like economic diversification, input reduction or water management potential all depend on the properties of the system at hand. The first step in determining realistic goals for an ALL is to collectively with all stakeholders determine the current baseline state of the system and its individual path to transformation.

Tools/frameworks aimed at assessing agroecological or sustainability performance of farms tend to cover a wide selection of criteria in both economic, social, ecological, governance and financial areas, and are designed to capture the state of a farm at a specific moment in time. Synthesized in Chopin *et al.*, (2021), at least 120 such sustainability assessment tools (SATs) were gathered from the literature. Assessment schemes were grouped into five categories (long-term monitoring, ex-ante assessment with bioeconomic model, indicator-based, consultation-based or participatory assessment), ranking them after level of stakeholder involvement. The participatory assessment frameworks were the least common, while top-down assessment (i.e. a set framework conceived to generate general and comparable results between farms) are the most commonly used. In the ALL setting, the implementation of participatory assessment versus top-down, pre-established SAT frameworks for evaluation may present a dilemma, as increased participation is a core concept of the LL practice, while increased participatory forms of evaluation may create diverse measures between initiatives, making analysis of e.g. ALL clusters or ALLs between regions much more complex. In order to make the results from ALLs comparable between regions and assessed against other forms of innovation strategies, it is therefore desirable for initiatives to use pre-existing frameworks for evaluation. However, In the ALL setting, it is also relevant to not present one tool as a ready-made, but to apply co-design principles when deciding what indicators are relevant to all participants (Namirembe *et al.*, 2022). Even without the participatory perspective, there is no one-size fits all for agroecology evaluation, and there are always trade-offs between SATs in terms of scope (level of assessment e.g. farm, sector, product) and precision (i.e. measurement resolution) (Schader *et al.*, 2014). Thus, several tools can be combined when necessary, to cover a specific constellation of sub-themes, e.g. as presented in Landert *et al.* (2020). There, several tools were combined to produce an in-depth assessment of both ecological and economic farm performance.

We would thus recommend:

- the use of pre-established SAT (Sustainability Assessment Tools) frameworks to evaluate baseline AE performance at the desired scale (field, farm, region, food system) an in the desired area (environmental, economic….)
- but to allow for a co-creative selection of criteria from one or several such tools to tailor to the ALLs needs.
- The SAT framework should be applied at the start of the ALL activity, and at a pre-determined evaluation stage far enough into the future that the desirable change realistically could have taken place.

This approach would necessitate the participation of personnel knowledgeable in the use and functioning of the selected SAT tools, enough time to share the knowledge with other stakeholders, and the facilitation of co-creative sessions when selecting which indicators to work with. The indicators used in these tools can also serve as an inspiration when guiding what tangible changes in on-farm practices the LL should focus on.

Here, we present free for use, pre-existing SAT tools for assessing Agroecological implementation in farming systems. Other frequently used sustainability assessment tools such as RISE (Response-Inducing Sustainability Evaluation) [17] is not included, as it requires a license.

<u>OASIS tool</u>

The OASIS (Original Agroecology Survey Indicator System) tool (Peeters et al. 2021) is developed by Agroecology Europe in an effort to provide tangible goals for farmers who want

[17] https://www.bfh.ch/en/research/reference-projects/rise/

to transition to AE. Based on Gliessman's (2016) levels of transition to AE, the tool is designed around five dimensions: AE farming practices, Economic viability, Socio-political aspects, Environment and Resilience. The indicators in each dimension are designed to measure the level of implementation of AE on individual farms. The process involves an independent assessor gathering data from farmers through interviews and/or visits, and subsequent feedback from farmers after the assessor presents first results. The OASIS tool is currently only available through Agroecology Europe and can be learned in detail through their training.

LIFT Typology tool

Developed in the EU-funded project LIFT- Low-Input Farming and Territories, the LIFT Typology Tool aims to classify individual farms into six defined categories along a sustainability gradient ranging from standard farming to agroecology (Rega et al. 2022). Based on data from the European Union's Farm Accountancy Data Network (FADN) protocol, it uses a model based in the R language into which users can input their own data online[18]. It consists of a set of agri-environmental performance indicators covering the subthemes technical-economic, environmental, private-social and employment effects of uptake of (agro)ecological practices. The tool allows for comparison between chosen farms and "type" farms for the respective categories, based on the FADN dataset, thus creating a baseline from which increasing uptake of sustainable farming practices is measured.

TAPE - Tool for Agroecology Performance Evaluation

The TAPE tool (Mottet *et al.*, 2020) was developed by FAO in 2019 and is designed to evaluate on-farm level of agroecological practices. It is meant to be applicable globally, mainly at the farm/household level, but will also take regional, enabling factors into account. It assesses Governance (e.g. land rights), Economy, Health and nutrition (pesticide exposure), Society (Gender equality, youth employment) and Environment (agricultural biodiversity and soil health). The tool is related to the Sustainable development goal (SDG) indicator system, also developed by FAO, and on the 10 elements of Agroecology. Some indicators may not be relevant in the European context, or the farm-level assessment may not be relevant to what a

[18] https://agroecology.app.inrae.fr/

specific ALL wants to achieve. Since the co-design process is to be implemented, selection of criteria from TAPE can be directed by the users (Namirembe *et al.*, 2022).

Cool Farm Tool (CFT)

Originally designed to assess greenhouse gas emission on individual farms, it is a decision-making for farmers who want a more sustainable practice (Hillier *et al.*, 2011). The Cool Farm Tool is Designed by the Cool Farm Alliance available online[19] and is designed to use input that farmers have readily available without the aid of experts. In 2016, a biodiversity module was added to the tool. Based on the Gaia Biodiversity Yardstick. It rates biodiversity-enhancing measures using a simple point-system for different groups of organisms. It also has a feature for blue and green water footprint calculation. Currently, the tool's metrics are adapted to temperate and Mediterranean biomes.

SMART - Sustainability Monitoring and Assessment RouTine

The SMART (Sustainability Monitoring and Assessment RouTine) was developed by the non-governmental association Research Institutes for Organic Farming, FiBL. It is a comprehensive assessment tool for individual farms based on the Sustainability Assessment of Food and Agriculture systems (SAFA) guidelines [20]. It includes indicators for governance, environment (including soil and biodiversity parameters), economic factors and social well-being, and the adherence to the objectives are ranked on a five-level scale. The tool does not explicitly mention agroecology, but the overall thematic of the tool lies very close to i.e. TAPE.

ACT – Agroecology Criteria Tool

Agroecology info pool[21] is run by the Biovision project. There are three tools developed, targeting initiatives/policy (ACT), farms (F-ACT), businesses (B-ACT) and enterprise (ACE) s respectively. The tools utilize Gliessman's 5 levels of food-system transformation (Gliessman, 2016) and FAO's 10 elements. The methodology illustrates a continuum of agroecology transition and aims to place an initiative/business/farm on this continuum. ACT

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[19] https://coolfarm.org/the-tool/

[20] https://www.fao.org/nr/sustainability/sustainability-assessments-safa/en/

[21] https://www.agroecology-pool.org/tools/

can be used as a design tool to guide initiatives to engage with the most pressing agroecological elements. However, ACT is not evaluating impacts of specific interventions.

2.2.2. Evaluation of LL functioning

In a recent review, the evaluation of LLs was found to be diverse in method and scope, and the case study approach was found to be the most common method of LL evaluation (Beaudoin *et al.*, 2022). Most studies used a qualitative approach (e.g. interviews, surveys with open-ended questions).

ASIRPA-RT – Real-Time Socio-Economic Analysis of the Impacts of Public Agricultural Research

Adapted from Research Impact Assessment models based on theory of change, ASIRPA is a continuous monitoring tool to design and guide an impact pathways to specific goals, revise these goals and monitor a projects position on the pathway (Joly, Matt and Robinson, 2019). ASIRPA is currently being adapted to the context of ALL impact evaluation.

Evaluation of LL as boundary spanners in innovation

Van Geenhuizen (2018) proposes a continuous evaluation framework integrated in the work plan of LLs. The approach uses inputs, influences beyond control, learning and networking processes, and intended outcomes and unintended outcomes. The proposed evaluation framework includes a system approach and a focus on participatory evaluation. A set of basic questions to be addressed include alignment of processes (plans and budget), integration of user feedback, alignment of actors in goals, and openness to attract partners relevant to the initiative's implementation.

Transdisciplinary Co-Learning tool

In the Horizon 2020-funded project ROBUST[22], a monitoring/evaluation tool for transdisciplinary collaboration was developed (Knickel *et al.*, 2019), aimed at multi-actor, transdisciplinary teams. The tool includes 44 indicators across four dimensions (context, approach, process, outcomes). The framework is based on reflexive approaches (discussion-based), around a set of indicative guiding questions. Knickel *et al.*, (2019) found that there is

[22] https://rural-urban.eu/

a gap between what transdisciplinary approaches can bring "on paper" and how well it is implemented in practice, and thus this framework could aid in finding deficiencies in how knowledge is shared, how well different stakeholders are accommodated and their personal perceived benefits of the collaboration. When considering the psychological and social challenges innate in transdisciplinary work, continuous discussion and reflection together to develop a common understanding, is essential for building trust between actors. On the other hand, such exercises can be time-consuming, and can be perceived as too large or complex. Having a framework for discussion at the start of an initiative and at pre-determined intervals, but not letting it take up too much time, should help align diverse stakeholders in an effective collaboration (Knickel *et al.*, 2019).

Reflexive assessment of Evaluation of transdisciplinary

More of a conceptual framework than a tool, Hubeau *et al.*, (2018) suggest evaluating transdisciplinary collaborations in agri-food systems (of which ALL/AELLs can be regarded as a subtype) based on the context, process and outcomes of the approach. Based on Blackstock et al. (2007), the assessment framework uses the concepts of bounding, focus, timing and purpose to pinpoint what part of the co-creative process should be evaluated, when and why the evaluation should take place, i.e. should the evaluation take place ex-ante, ex-post. Methods used include analysis of documents (minutes of workshops and meetings etc.), surveys and semi-structured interviews of participants in the initiative. 'Context' includes the governance structure, relationships and attitudes between stakeholders' pre-activities. 'Process' evaluation includes conflict resolution and number of conflicts, level of representation, perceived legitimacy among actors, internal and external communication, transparency and stakeholder influence. Finally, 'outcomes' refer to capacity building, impact on learning, perspectives and social capital. The method requires a team with experience of social science methodologies in order to synthetize the output from interviews and surveys, and the study presents the output of such an analysis, resulting in 12 detailed lessons learned for transdisciplinary research, that can be used in the design of further such initiatives.

2.2.3. Evaluation of social impact of LL activities

Social or "soft" outcomes, such as increased social capital and knowledge exchange can be some of the most valuable to individuals participating in LL activities. New valuable relationships, acquisition of new knowledge and opportunity to address important issues were reported as important positive benefits by LL participants (Hubeau *et al.*, 2018; Knickel *et al.*, 2019). In the ALL context, facilitation of knowledge sharing between farmers directly can be a significant contribution, as agricultural knowledge networks tends to be centralized (i.e. certain organizations/individuals are central to distributing knowledge) and social co-learning can lead to convergence in beliefs between diverse actors (Lubell, Niles and Hoffman, 2014). Studies have found a highly significant association between network density and the average intensity of adoption among small scale farmers (Monge, Hartwich and Halgin, 2008). Changes in a social networks and knowledge acquisition can thus be a significant output of an ALL and require independent evaluation and monitoring.

MEPPP - Monitoring and Evaluation of Participatory Planning Processes

This qualitative framework conceived by Hassenforder *et al.*, (2016) is not specific to LL initiatives, but to all forms of participatory, multi-actor initiatives. The framework aims to simplify setting up a framework for monitoring and evaluating the outputs of an initiative, and uses a step-wise pipeline (describing-clarifying-variable definition-method development-analysis-reporting). The framework targets both “outputs”, such as actions and agreements, and “outcomes” that are less tangible, such as learning, behavioral changes, or social networks.

Social Network Analysis

A common method taken from social sciences, SNA abstracts interpersonal or inter-organizational relationships into a network structure of nodes (people/actors, entities) and relationships to one another (Wasserman and Faust, 1994). They are visualized in “sociograms”, allowing for quantitative evaluation of changes in networks of information and knowledge-sharing. SNA allows for comparing the level of centrality (i.e. how centralized is knowledge sharing) and homophily, e.g. to what extent similar or diverse actors share knowledge with each other. A brief step by step guide can be found at the UNISECO project homepage [23].

[23] https://uniseco-project.eu/resources

Fuzzy Cognitive Mapping (FCM)

Fuzzy cognitive mapping is a procedure to involve stakeholders (individuals or groups) in research or management processes and a method to extract and analyze different kinds of knowledge about complex systems and reveal changes in knowledge and perception. Based on interviews performed before and after the implementation of a program, in this case ALL activities, the method aims to capture changes in participant's perceptions, e.g. perception of perceived benefit of AE practices (Luján Soto *et al.*, 2021). A participant is asked to explain their understanding of, and rate the strength of relationships between concepts, and this is then revisited after initiative activities has taken place. The online software tool FCMapper version 1.0 [24] was developed by Wildenberger (2010) and is a semi-quantitative tool for assessing changes in perception and social learning. The tool can be used to create collective maps based on assessments of individuals, to calculate statistical changes in participant's understanding of relationships between concepts and the relative importance of different concepts. A set of best-practice guidelines for FCM can be found in Olazabal *et al.*, (2018).

2.2.4. Evaluation of AE adoption

To emphasize the change-oriented aspects of ALL and their ultimate goal to support the agroecological transition, the achievements, or lack thereof, in moving farming systems towards increased sustainability must be evaluated in detail (McPhee *et al.*, 2021). After an ALL is established, with the problem statement and conceptual framework defined jointly by participants, a discussion on what desirable change the initiative will aim toward must take place, and what assessment endpoints are suitable to evaluate that change. In the third level of ALL evaluation – "Evaluation of novel adoption", farm-level sustainability assessment tools (SAT) are central.

In this section, we encourage initiatives to work with some of the tools listed in section 2.2.1. (e.g. following up with the same indicators used to characterize the state of the farming system). Those frameworks are not specifically adopted to ALL, but it is encouraged to use pre-defined indicators instead of developing unique ones. In the future, frameworks specifically adapted to ALL are to be developed.

[24] http://www. fcmappers.net/joomla

2.2.5. Evaluation of AE impacts: Biodiversity

There are many potential impacts to be measured in an ALL setting, with varying levels of complexity. Here, we choose to discuss the challenges with assessing biodiversity changes of AE activities. There is a negative relationship between farming intensity (with decreased landscape complexity and increased inputs) and biodiversity in the landscape (Pilling, Bélanger and Hoffmann, 2020). One of the goals for the AE transition is to move farming systems towards a more biodiversity-enhancing practice, without unrealistic decreases in productivity (Wezel *et al.*, 2020). In section 4 and 5 of this document, we present a conceptual framework for biodiversity recovery pathways, and a methodology for monitoring biodiversity changes.

3. New framework for Evaluation: ATP-in-ALL

Analyzing Transformation Processes within Agroecosystem Living Labs (**ATP-in-ALL**) is a management tool based on a qualitative approach made to monitor and evaluate transformation processes generated by actions and outcomes within Agroecosystem Living Labs (ALL). The tool consists of the application of diverse qualitative methods to capture, identify and track a set of **enabling factors** and **key components of transformation**, that can explain and relate to fundamental changes in the way people act, think and organize themselves within the lifespan of the ALL, and how these changes can contribute to transform the agri-food systems.

The theoretical framework used to develop the ATP tool was based on an integrative literature review to identify and compile the main principles of the concepts "Living Lab" (McPhee et al., 2021; Schäpke, Bergmann, et al., 2018; Schäpke, Stelzer, et al., 2018; Schneidewind et al., 2018), "Transformation and Transition Research" (Anderson et al., 2019; Fazey et al., 2020; Feola, 2015; Geels, 2002; Geels & Schot, 2007; Loorbach et al., 2020; Patterson et al., 2017), and "Agroecology" (Barrios et al., 2020; Gliessman, 2016; Runhaar, 2021; Wezel *et al.*, 2009, 2014, 2020). Once the main elements of these concepts were identified, a classification and definition of potential key components to be included in a tool were selected and discussed with experts in an iterative process until a list of ten (10) enabling factors and ten (10) components were finally included in the ATP-in-ALL tool (Figure 3).

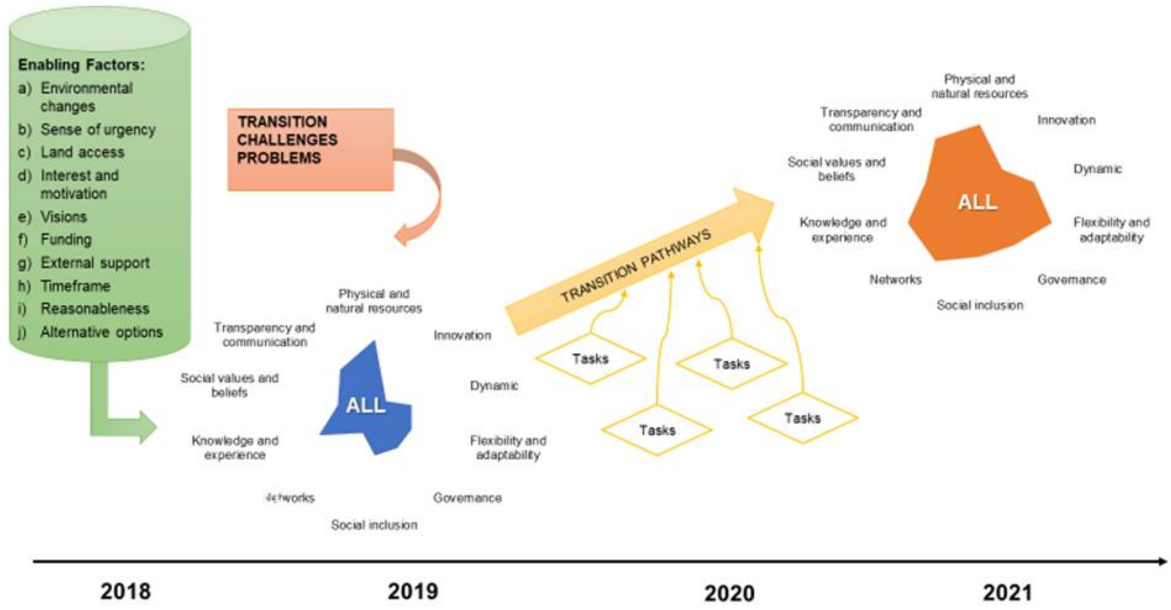

Figure 3. Schematic illustration of the ATP-in-ALL tool structure. in order to monitor and evaluate the changes achieved by the tasks implemented in the initiative.

To use ATP as a monitoring and evaluation tool, it is recommended that a facilitator (researcher with experience in qualitative methodologies and analysis) collects the necessary information through interviews, workshops or other methods with the LL coordinators. The process of using ATP is as follows:

Step A: Describing enabling factors (pre-conditions).

The enabling factors are external and internal conditions that are used to describe the history, initial environmental and socio-economic conditions, motivations, constraints, obstacles, and expectations, which operate as barriers or triggers of the ALL. The factors proposed are environmental changes, sense of urgency, land access, interest and motivation, visions, funding, external support, timeframe, reasonableness, and alternative options (future markets). In figure 3, the enabling factors are presented in the green column at the right, these factors were identified and selected based on a literature review (as mentioned above) and consultation with experts. These factors were selected considering the effect of them in the decision process, opportunities presented, and capacity to “mobilize” actors to be engaged with the LL. The first step in evaluating the LL is to describe the internal and external conditions under which the it was established, referring to the enabling factors, e.g. describing what are the sources of funding, whether there are institutions or extension and advisory bodies supporting the LL, whether the land is owned or rented, whether there is one or several events that will generate pressure for change in a short time (pandemic, political change, extreme weather event, etc.).

- **Environmental changes**: these are trigger events, external pressure, or unexpected disturbances on the macro level, such as political, economic, social or biophysical. e.g. COVID pandemic, New Common Agricultural Policy (CAP), climate protest movements, inflation.
- **Sense of urgency:** this is strongly linked to environmental changes but includes the ratio of time pressure/actors respond to solve a critical problem or address specific situations, which can be vital. It includes events with a clear deadline and specific consequences if there are no reaction e.g. fire, flooding, pest infestation.
- **Land access (tenure)**: These are the conditions of land tenure, access to land, and spatial planning. It is based on the premise that uncertainty in land use and land tenure conditions leads to limited decision-making capacity of stakeholders to implement fundamental changes in physical conditions (at farm or landscape level). e.g. leased or owned land, common land, zonification such as conservation or Utilized agricultural area (UAA) (arable, grassland, etc), middle or long-term infrastructure projects (highways, city planning, etc).
- **Interest and motivation:** refer to local actors' attitude and willingness to participate, reflected in expectations, and contributions (tangible and intangible) for the ALL, e.g innovative character, previous experiences in projects, compensation measures, and time available.
- **Visions:** refer to initial ideas, wishes or expectations of actors that can be translated into possible future scenarios, e.g. organic farming certification, agroecology approach and practices, precision agriculture, landscape configuration, and political power.
- **Funding:** refers to economic sources, and financial stability during and after the ALL, e.g. private, public or mixed funds, self-standing, autonomous, donations, etc.

- **External support:** refers to the local presence, availability, and access to institutions, advisory agents, start-ups, think tanks or other stakeholders (non-academic) with knowledge, experience, and infrastructure that can contribute to the processes, e.g. extension services, consultancies, peers, cooperatives, etc.
- **Timeframe**: includes the projection, availability, and management of time, considering that initiatives designed for short-term changes and impacts are not favorable to establishing long-term engagement between actors and activities. e.g. Action plan (time and resources distribution)
- **Reasonableness**: refers to common understanding of the functioning full of the ALL (inputs, activities, outputs, outcomes) which is sufficiently logic and clear to be understood by all participants/actors, so that almost everyone within the initiative can explain what they are doing and for what, e.g. slogan, motto and catchphrases.
- **Alternative options (markets)**: refer to available options to promote new or different markets with the potential to create an alternative socio-economic future, aligned with the visions of actors within the ALL, e.g. identification of potential suppliers, distribution chains, customers. This can be achieved by market studies for products, scenario analysis for policy changes, and study of potential impacts for social innovations.

Step B: Tracking activities and transformation potential.

Once the Labs are established the next step will be monitoring the performance and transformative changes generated by the actions, interventions, activities or tasks conducted within the ALL. The **key components** described in table 2 are tangible and intangible elements that can be a source of change or a subject that change as consequence of the actions, interventions, activities or events occurring in the ALL. The selection and description of the components were based on the literature review and consult with experts as well, following these questions: what is transformation? Which elements defined a transformation on a system? How consistent are these elements in order to be applicable to any type of ALL and conditions?

The ten (10) components of transformation were selected, identified and clustered within three (3) dimensions of change that represent a transformative change in the way people think, act and organize themselves to produce sustainable outcomes (Patterson et al., 2017). In the **thinking dimension**, the cognitive and relational aspects of the actors in the ALL are represented by 3 components: 1) Transparency and communication, 2) Knowledge and experience, and 3) Social values and beliefs. In the **acting dimension**, functional and structural aspects are represented by 4 components: 4) physical and natural resources, 5) Innovation, 6) Dynamic, and 7) Flexibility and adaptability. Finally, in the **organizing dimension** structural and relational aspects can be monitored by the components of 8) Governance, 9) Social inclusion, and 10) Networks. In Table 2, a brief description of the proposed definition of each component is presented.

Table 2. Brief description of the components of transformation to be monitored.

Component	**Short description of the component[25]**	**Dimension of change**
Transparency and communication	Transparency = process of being open, honest, and straightforward about topics and operations. Communicative = the ability to share, exchange, and discuss key issues.	Thinking
Knowledge and experience	Knowledge = theoretical or practical understanding of a subject. Experience= an event or occurrence which leaves an impression on someone.	
Social values and beliefs	Social values = standards to define personal goals and the nature and form of social order in a collective. Beliefs= something that is accepted, considered to be true, or held as an opinion.	
Physical and natural resources	Tangible items within a physical space and time. Includes all living organisms (crops, animals) as well biotopes and resources as soil and water.	Acting
Innovation	the practical implementation of ideas that result in the introduction of new goods or services or improvement in offering goods or services	
Dynamic	a force that stimulates change or progress within a system or process.	

[25] The description based on generic definition of the terms and inspired by the review.

Flexibility and adaptability	Flexibility = ability to change or be changed easily according to the situation can be more immediate and situational. Adaptability = the capacity to be modified for a new use or purpose often implies anticipating and planning ahead to allow for contingencies.	
Governance	process of making and enforcing decisions within an organization or society.	Organising
Social inclusion	Is how well the contributions, presence and perspectives of different groups of people are valued and integrated into an environment.	
Networks	a social structure that exists between actors—individuals or organizations. Indicates the way that people and organizations are connected through various social familiarities, ranging from casual acquaintance to close familial bonds.	

Methodology of ATP-in-ALL

Using qualitative methodologies such as interviews, workshops, and storytelling the facilitator seeks to collect data about activities, inputs, perceptions, expectations, and outputs conducted within the ALL with the coordinator(s).

Step A: A facilitator (or external evaluator) perform a workshop with the coordination team to describe the initial conditions of the ALL. Storytelling is recommended as a method to collect data. The data will be processed following Qualitative Content Analysis (QCA) methodologies and summarized in a table where all the enabling factors will be described it.

Step B: In a second workshop, the facilitator and coordination team will list and describe the main activities, actions, interventions or tasks performed within the ALL, using the summary template (Figure 4). The purpose of the template is to identify the most relevant changes (outputs, outcomes) for the actors and relate them to specific activities or events carried out within the ALL, in order to subsequently assign a value (number) that reflects the degree of satisfaction of the actors with the changes generated, to fill out the form, it is recommended:

Step 1: Identification of the LL and respondents.

Step 2: List the main activities, with approx. date (month/year) in the blue columns.

Step 3: Named the main outputs and outcomes generated by that activity which are compatible with the component definition, in the red rows (corresponding to each activity).

Step 4: Assigned a score according to Likert scale for the output/outcome achieved (under the red row) corresponding to a "satisfaction assessment" of the outputs and outcomes. This assessment could be conducted by several actors on the ALL, not only the coordinators.

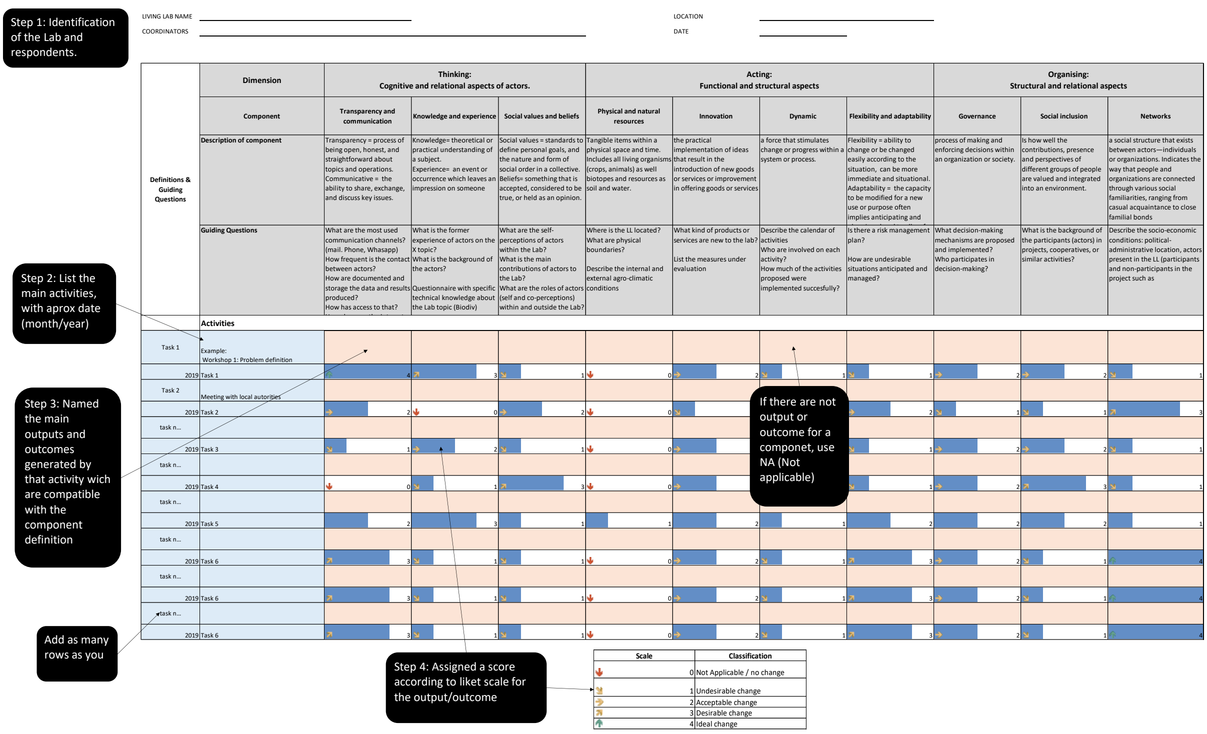

Figure 4. Example of the evaluation matrix design of the ATP-in-ALL tool.

To design the satisfaction scale, it is necessary to identify stakeholders' expectations and expected results proposed in the project formulation process (ALL) if applicable. If there is no previous reference of expectations regarding the ALL and its products, they can be generated at any stage of the life of the ALL, by conducting participatory co-creation workshops or interviews with ALL stakeholders. We propose a Likert scale from 0 to 4, where 0 means no changes, 1 stands for undesirable changes, 2 acceptable, 3 desirable and 4 means ideal changes. Using the numeric scale facilitates the visualization of results in graphs, or via basic calculations such a sum or percentual (%) estimation of change. This is an iterative process to be used "constantly" for the coordination team to help them make decisions about resource management (monitoring) or to report to funders, or other stakeholders about products, outputs, and results generated (evaluation).

With ATP-in-ALL, we want to promote the use of monitoring and evaluation as an internal mechanism for improved communication between actors, appropriation, recognition, awareness and self-reflection of outcomes and impacts of the ALL. On the other hand, with ATP-in-ALL we expect to contribute to the Network of Agroecosystem Living Labs with an evaluation methodology able to respect the particularities of each LL, and from this perspective support the transition towards Agroecology systems.

4. New framework for tailored pathways for Biodiversity recovery

Before success of biodiversity friendly transition can be evaluated, there should be a target defined against which the level of success achieved could be measured. Systematic understanding of the ways in which agriculture and farmland biodiversity interact is a cornerstone to address this question. Landscapes which are at different levels of agricultural intensification will also require different trajectories for transition towards improved biodiversity targets, i.e. have different 'option spaces' and require 'tailored pathways' to recovery. For such targeted approaches of transition, we developed a synthesis framework aimed at supporting the EU Partnership on ALL and RI in its vision to establish an effective European network of LL. The framework is presented in full in Sietz et al. (2022) and its application to ALL is summarized below.

Conceptual framework of tailored pathways

Empirical evidence shows a strongly declining relationship between agricultural production and farmland biodiversity (i.e. all species that live in and around agricultural land and provide ecosystem services) which can be illustrated as S-curve (Fig. 5a). It depicts a gradient ranging from extensive land use (e.g. low livestock density, no tillage Fig. 5a and example in Fig. 5b) in complex landscapes in which agriculture is embedded in a semi-natural habitat matrix, to intensive land use with high external inputs and large shares of agricultural land in structurally simplified or cleared landscapes.

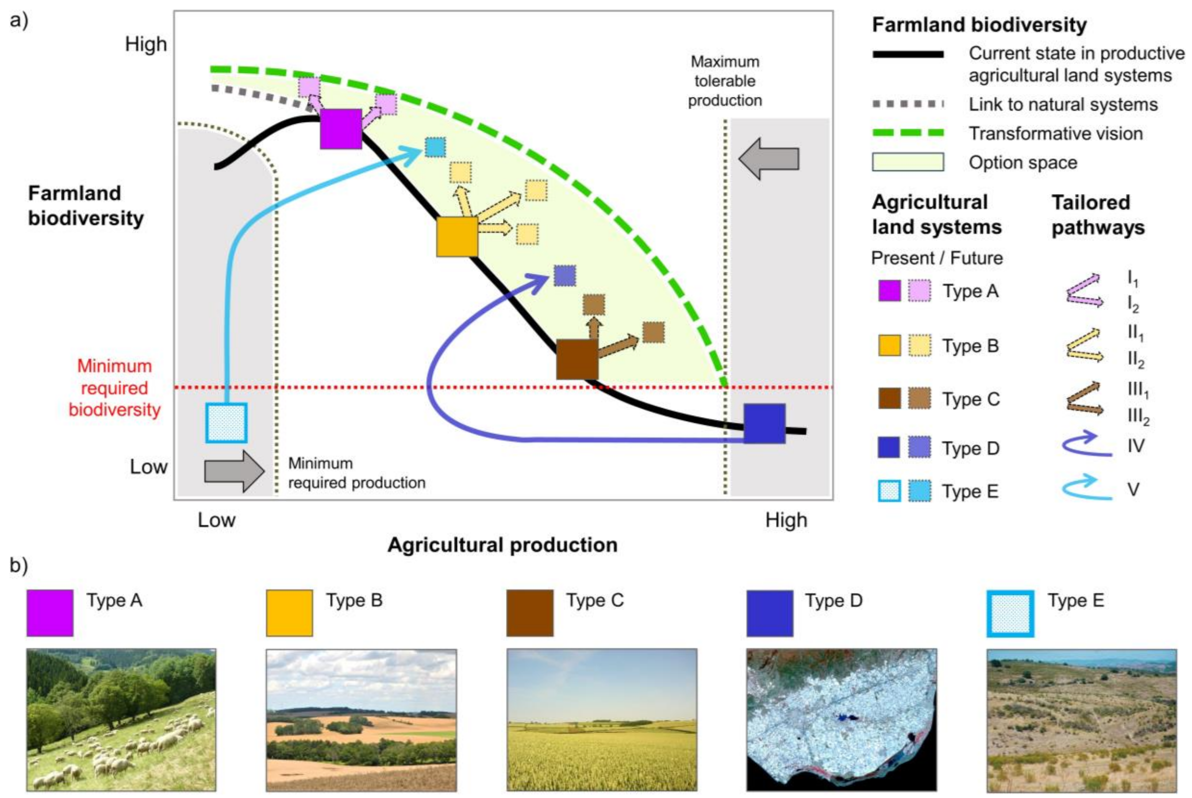

Figure 5 Synthesis framework to guide the development of the European network of living labs and research infrastructures. a) S-curve depicting the current relationship between agriculture and farmland biodiversity and option space between current relationship and transformative vision. Examples of farming system types are given together with possible future locations in option space and tailored pathways to reach these locations. Boxes with solid borders indicate present conditions of agricultural production and farmland biodiversity in various types of farming systems. In contrast, boxes with dotted borders represent possible envisaged conditions in the future. b) Photographs presenting real-world examples of farming system types. These include low-intensity sheep grazing in structurally complex mountainous landscape, southern Germany (Type A), medium-intensive crop production in diverse landscape with forest remnants, southeastern Germany (Type B), high-intensity cereal cropping in very simple, homogenised landscape, England (Type C), very intensive

horticultural production in severely disturbed landscape due to massive greenhouse constructions and agrochemical inputs, southeastern Spain (Type D) and abandoned land accompanied by severe soil erosion and land degradation, southern Portugal (Type E). (Photo credits: Type A – Sebastian Klimek, Type B – Diana Sietz, Type C – Jens Dauber, Type D – NASA/GSFC/METI/ERSDAC/JAROS, U.S./Japan ASTER Science Team, Type E – Pedro Cortesao Casimiro).

Extensively used farming systems that have well-structured landscapes and maintain high biodiversity resemble the conditions in the upper part of the S-curve. Here, abandonment can decrease farmland biodiversity (see lower branch of the S-curve in upper left-hand corner, Fig. 5a). Hence, extensive farming needs to be maintained to avoid this degrading branch pointed out by a functional space called 'minimum required production'. Yet, abandonment may also increase farmland biodiversity to some extent linking to natural or rewilded landscapes (see dotted branch in upper part of the S-curve, Fig. 5a). In contrast, intensively used farming systems that maximise production of few often calorie-rich, but nutrient-poor crops rely on substantial external inputs of synthetic fertilisers and pesticides, at the expense of farmland biodiversity (see lower part of the S-curve, Fig. 5a and example in Fig. 5b). While some degree of degradation may be reversed, very strongly degraded farming systems that persistently lost key functional species and propagule sources may resist recovery. This indicates a 'minimum required biodiversity' threshold (see red dotted line, Fig. 5a) below which restoration demands significantly more efforts or may even become impossible. In view of the risk of depleted farmland biodiversity, restoration potential needs to be maintained translating in a 'maximum tolerable production' level (Fig. 5a).

The broad policy objective to re-enhance farmland biodiversity presents a vision that transforms the strongly declining relationship between agricultural production and farmland biodiversity (see green dashed line, Fig. 5a). This transformative vision implies that at a given level of agricultural production, farmland biodiversity increases. The area between the current relationship and the transformative vision indicates the **option space for transformative change** (see light green area, Fig. 5a). For example, wider crop rotations, establishing wildlife habitats at field edges and managing service-providing species essentially contribute to intensify ecological processes in more intensively used farming systems with low farmland biodiversity (see Type C, Fig, 5a). In contrast, mixed grazing of cattle and sheep can simultaneously enhance farmland biodiversity and livestock production in extensively used farming systems that still contain high biodiversity (see Type A, Fig. 5a). In short, different starting points will require different targets and approaches for achieving biodiversity recovery, and that recovery looks different between landscapes.

Biodiversity targets can for example focus on "intrinsic biodiversity", i.e. protecting rare and endangered species from local extinction. This trajectory is suitable in landscapes with already mixed and high-nature value farms, such as those with extensive grazing of semi-natural grasslands, where the conservation of e.g. rare grassland plant and invertebrate species might be in focus (see Type A, Fig. 5a). In more intensely framed landscapes, a focus on enhancing functional, ecosystem-service providing biodiversity may be of higher priority. Thus, the overall goal of the biodiversity-enhancing measures may differ between types of landscapes, and must be assessed with adequate measures.

Application to ALL

Firstly, the current position of a living lab can be analysed along the S-curve (see example boxes with solid borders, Fig. 5a). This allows to contextualise the ALL in a broader perspective considering the full gradients of agricultural production and farmland biodiversity. Secondly, the factors and processes that drive the current status of farmland biodiversity including the composition and configuration of agricultural landscapes and intensity of agricultural production need to be examined. This helps to clarify specific ways in which agriculture and farmland biodiversity interact in a given ALL. Thirdly, depending on the current interplay between agriculture and farmland biodiversity, possible future locations can be defined for an ALL in the option space for transformative change (see boxes with dotted borders, Fig. 5a). The envisaged locations of future farming systems imply various changes in agricultural production and farmland biodiversity. Co-design is essential to reflect and balance different stakeholders' expectations, demands and preferences as well as the specific social-ecological context in which a living lab is embedded. Fourthly, transformation pathways can be defined to link the current and envisaged future positions (see tailored pathways, Fig. a). These pathways need to be tailored to the characteristics of current farming systems. Targeted farming approaches using AE can be tested in the ALL to underpin the tailored pathways with contextualised management approaches.

Recommendations to ALL:

- Determine current position of a farming system along S-curve

- Evaluate drivers of current status of farmland biodiversity
- Co-design envisaged location of future farming system
- Co-design associated transformation pathways linking the current and envisaged positions

5. New recommendations for Biodiversity Monitoring

Enhancement of biodiversity in agricultural landscapes is a vital aspect of transition towards sustainable agriculture, e.g., in the frame of the EU biodiversity and farm-to-fork strategies. Besides protection of biodiversity, the ecosystem services provided by species in agricultural ecosystems, such as pollination and pest control, are important for sustainable agricultural production. Therefore, the aim of increasing biodiversity at the landscape scale is an important way forward for agroecological transition of farming (Landis, 2017; Petit *et al.*, 2023) and, in the light of the mentioned EU strategies and the aims to substantially reduce pesticide use and increase organic farming area, this is likely to become even more prominent in future ALL and comparable landscape labs and territorial initiatives.

If enhancement of biodiversity and related ecosystem services is among the aims of an ALL, it is crucial to monitor the development of suitable indicators, e.g., species richness and abundance of species groups that provide ecosystem services or population density of umbrella species, in a scientifically sound manner, so that the effectiveness of the alternative agricultural practices can be assessed and quantified. The monitoring should include an account of the status quo before alternative practices are implemented (baseline assessment) and be continued at regular time intervals during the transition process., regardless of what the goal or pathway to biodiversity recovery is (see section 4).

A valid monitoring that allows to corroborate and to quantify the enhancement of biodiversity requires thorough planning with respect to the selection of suitable biodiversity indicators, the sampling methods and the spatial design of sampling sites. It is crucial to devise a sound monitoring scheme at the beginning of the project because the data need to be collected in the same fashion at every time step, e.g., every year or every other year, in order to be comparable over time and, thus, to allow for assessment of biodiversity development.

The goal of biodiversity-oriented ALL should be to increase biodiversity throughout agricultural landscapes, not only locally. Therefore, it is important to place the sampling sites in the landscape in a way that provides a sample that is representative of the whole landscape, which requires careful consideration. In the following section, we provide recommendations and guidance, on which indicators of biodiversity may be useful, how these can be sampled, and how a representative spatial sampling design can be achieved.

Choice of indicators of biodiversity and sampling methods

As complete accounts of biodiversity, including all organisms and habitats, are not feasible, it is necessary to select some suitable indicators or proxies that can be sampled with reasonable effort and that are representative of overall biodiversity in the landscape. Currently, there are a myriad of biodiversity indicators for farmlands developed. A recent review on methods of evaluating agri-environmental schemes for biodiversity found that vascular plants in grasslands dominate as bioindicators, but that the diversity of indicators is large (Elmiger *et al.*, 2023). The choice of indicators/ proxies is not an easy task and may depend on specific aims of the ALL as well as on available expertise.

Common approaches to assess biodiversity at landscape level are i.) sampling of some few umbrella species, whose presence indicates a good state of overall biodiversity, e.g., farmland birds or red-list species, and ii.) sampling of certain taxonomic or functional groups of species that appear particular relevant with regard to the targets of the project, e.g., providers of ecosystem services. For suggestions on indicators of biodiversity see Table 3.

Table 3. Examples of common indicators of biodiversity for specific project targets and suitable sampling methods.

Indicator	Project targets	Suggested sampling method
Wild bees	Pollinators	Pan traps
Hoverflies	Pollinators, pest control agents	Pan traps
Carabids, spiders	Pest control agents	Pitfall traps
Vascular plants	Overall biodiversity	Quadrat/ transect sampling
Red-list species	Nature conservation	Depending on species

Recommendations for spatial sampling designs

Samplings of biodiversity indicators/ proxies in ALL should be representative at the landscape level. In this regard, two questions arise: i.) How should the sampling sites be spatially distributed in the landscape and ii.) how many sampling sites are required to get an accurate estimate of landscape-level biodiversity?

The placement of sampling sites may have substantial influence on biodiversity estimates as agricultural landscape are comprised of various land-use types and semi-natural habitats that differ in species richness and composition. The heterogeneity of spatial distribution is particularly pronounced in organisms that show limited mobility, such as small flightless invertebrates, but also more mobile organisms, such as pollinators, usually are not equally distributed in a landscape.

Several spatial sampling designs have been proposed to estimate measurement parameters at landscape level, including random, systematic, i.e., grid-based, and stratified schemes (Table 4). We assessed the accuracy of various spatial sampling designs for estimating the species richness and abundance of less-mobile invertebrates at landscape level using carabids as a model species group in a simulation study (Thiele *et al.*, 2023).

The results showed that grid-based sampling designs are generally suitable for assessing the overall abundance and species richness of ground-dwelling arthropods. They ensure a good spatial distribution of sampling sites throughout the landscape and, thus, are preferable to simple random sampling, particularly at moderate sample sizes. In case that sound prior knowledge of the local species composition and richness of the different habitats in the landscape is available, area-proportional stratified random sampling, based on a habitat map, yields more precise estimates of overall abundance and should be preferred. If only species richness, but not abundance, is to be assessed, simple stratified random sampling is better than other sampling designs.

Table 4. Descriptions of spatial sampling designs (cf. Wang *et al.*, 2012).

Sampling design	Description
Random	Sampling points are placed randomly within the landscape
Systematic random	The landscape is superimposed by a regular grid and each grid cell receives one (or multiple) sampling points that are placed randomly
Systematic regular	Grid-based as above, but all sampling points have the same X and Y offset from the centre of the grid cell
Systematic unaligned	Grid-based as above, but the X offset from the centre of the grid cells is constant within each row while the Y offset is constant within each column of the grid
Stratified random	Each land-use/ habitat type receives the same number of sampling sites, which are placed randomly within the area of the respective type
Area-proportional stratified random	Each land-use/ habitat type receives a number of sampling points proportional to its area in the landscape, which are placed randomly within the area of the respective type

Altogether, we recommend systematic (grid-based) sampling designs for biodiversity monitoring in ALL as a rule because they can easily be implemented, do not require sophisticated expert knowledge of the species' communities of all habitats, and achieve good estimates of both abundance and species richness. Regarding sample size, 25 sampling sites in a landscape of 4 km² appear to be optimal with respect to the relation of effort and accuracy when investigating ground-dwelling arthropods (Thiele et al. 2023). At least, 16 sample sites should be investigated in order to yield good results. Grid-based sampling with 25 sampling sites per landscape (of 1 km²) has also been recommended for pollinators (Scherber, Beduschi and Tscharntke, 2019). Therefore, it can be used as standard sampling design for assessing the diversity of all invertebrate species groups in ALL.

Grid-based sampling designs can be implemented with free open-source software, e.g., Quantum GIS [26] (QGIS) and the statistical computing software R [27]. A workflow for systematic spatial sampling is described in the training manual of QGIS [28], in module 14. Regarding R, systematic and stratified spatial sampling is provided, e.g., in the package *spatstat.geom* (Baddeley et al. 2015).

Recommendations for biodiversity monitoring in the ALL context

In the context of biodiversity monitoring, a highly technical process requiring expert personnel, the co-creative aspect of LL may have to be down-prioritized in favor of using robust and widely implemented methods. Reproducible and harmonized methods are already being compiled by research infrastructures in Europe, such as EuropaBON and its list of Essential Biodiversity Variables[29]. A future EU Partnership on ALL must thus collaborate closely with competencies in biodiversity monitoring in the EU. Biodiversity monitoring will always require the expertise of various researchers, conservation consultancies or citizens well versed in taxonomy of the species groups of interest or, alternatively, resources for more technically advanced monitoring, e.g., meta-barcoding. The length of an ALL scheme also determines what indicators are reasonable to expect change in. The funding time, funding size and available expertise of the ALL may determine which measures of change are possible to assess.

6. Conclusion on toolboxes for ALL

Here, we have presented some aspects of the ALL methodology, and concepts central to it based on existing literature and on novel research. It is apparent that the ALL approach can use insights and frameworks already developed in the context of TSS, PAR and SATs.

The following recommendations were derived for ALL establishment, co-creation, transdisciplinary research:

- Professionalize the role of a facilitator/integrator of ALLs.

[26] https://qgis.org

[27] https://www.r-project.org/

[28] https://docs.qgis.org/3.28/en/docs/training_manual

[29] https://github.com/EuropaBON/EBV-Descriptions/wiki

- Create a curriculum for such a role and potentially a system of certification, as already exists in project management.
- Emphasize capacity building for facilitators/integrators of ALL, whose main responsibility is project coordination and brokering, rather than to put this task on researchers who may lack the correct skillset. Avoid placing early-career scientists in the role of manager/facilitator.
- Aim to make this role attractive in terms of job security/salary, to encourage consistency of personnel across longer initiatives.

For the project governance and ethics, we recommend:

- A system of monetary compensation for practitioners in LLs should ideally be included in funding calls and in budgets.
- Allow practitioners to decide what time commitment is reasonable to them, do not waste their time on sub-optimal meetings etc., since the time spent on LL activities
- Acknowledging and discussing risks as perceived by all stakeholders
- Full consent must be accrued from all participants of the ALL before any information/minutes can be collected/disseminated or stored (see Kemmis et al. 2014).

A particular focus was put on evaluation. We believe that emphasizing the importance of thorough evaluation, as we have previously found deficiencies in monitoring efforts among LLs (D2.2, . An integral part of the evaluation process is to determine the baseline assessment of the system in question (Figure 6). Here, we recommend the use of existing agroecology frameworks. With the significant effort needed to properly evaluate the process and outcomes of ALLs, the need for capacity building and recruitment of people holding knowledge of social science methodologies, AE evaluation methodologies and collaboration with farm economists, soil ecologists, biomonitoring expertise etc. is potentially enormous.

The four levels of evaluation needed for the ALL which became apparent through our review clearly demonstrates the not only transdisciplinary, but also interdisciplinary nature of the ALL, with social and natural science aspects requiring integration into the overall steering of the LL. As previously pointed out by the European Partnership (SCAR-AE, 2022), the potential synergies between ALL and research infrastructures (RI) become apparent when such close collaboration with highly skilled personnel is called for.

Table 6. Description of the four levels of ALL evaluation and monitoring with advise/conclusions based on the literature review.

Levels of ALL evaluation	**Examples of indicators for the level**	**Recommendations**
Evaluation of AE adoption	• Reduced external input • Water management changes • Crop choice • Biodiversity enhancing measures • Measures to improve soil quality	· The use of pre-established SAT (Sustainability Assessment Tools) frameworks to evaluate baseline AE performance at the desired scale (field, farm, region, food system) an in the desired area (environmental, economic….) is recommended.
		· Allow for a co-creative selection of criteria from one or several such tools to tailor to the ALLs needs.
		· The SAT framework should be applied at the start of the ALL activity, and at a pre-determined evaluation stage far enough into the future that the desirable change realistically could have taken place.
Evaluation of AE outcomes	• Biodiversity improvement • Improved ecosystem services • Soil health improved • Carbon sequestration • Water use sustainability • Food/Farmer soveregnity • Novel local markets	· Rely on current RIs for methodology and competence (e.g. EuropaBON for biodiversity monitoring)
		· Include a realistic budget for trained personnel to carry out such monitoring
		· Explore collaborations with local universities/vocational training centers

		· The funding time, funding size and available expertise of the ALL may determine which measures of change are possible to assess
Evaluation of Social impacts of ALL activities	• Knowledge sharing / co-learning • Social network expansion • Cognitive patterns changed mapping	· Outcomes that are less tangible, such as behavioral changes, new valuable relationships, acquisition of new knowledge are important benefits of ALL activities, and may lead to increased AE adoption.
		· Social network analysis and Fuzzy cognitive mapping are ways to assess changes in relationships and in knowledge exchange/integration among stakeholders
		· Personnel with experience in social science methodologies are needed to assess such endpoints.
Evaluation of ALL functioning	• Transdisciplinary collaboration • Participant satisfaction • User integration • Goal alignment	· The transdisciplinary process in an LL should be monitored and evaluated, to mitigate psychological and social challenges innate in transdisciplinary work.
		· Evaluating LL functioning is necessary to find deficiencies in governance, communication, decision-making processes etc.
		· Semi-structured interviews, analysis of minutes and project documentation are possible methods, which require knowledge in social science methodologies to perform and interpret.
		· Such evaluation ca be performed together with a facilitator/integrator, who would have overview over all actors and activities in the ALL.

Another essential aspect is the complex question of integrating the demand for scientific excellence and relevance to practitioners (Ruppert-Winkel *et al.*, 2015). What evaluation activity is in the interest of diverse actors from research and policy, and for practitioners? How does one build consensus around the endpoints to be evaluated, and the intensity of the monitoring effort? These questions weave in to ethical aspect of the LL, and of transdisciplinary, multi-stakeholder research more broadly, since involving stakeholder in activities that in the end cost more for them than what they bring (through e.g. excessive monitoring/data collection) will lead to decreased motivation to participate. There will be considerable strains when deciding on indicators, as different actors' interests will lead to different hierarchies of relevance, which is also where power dynamics may come into play (Fritz and Binder, 2020).

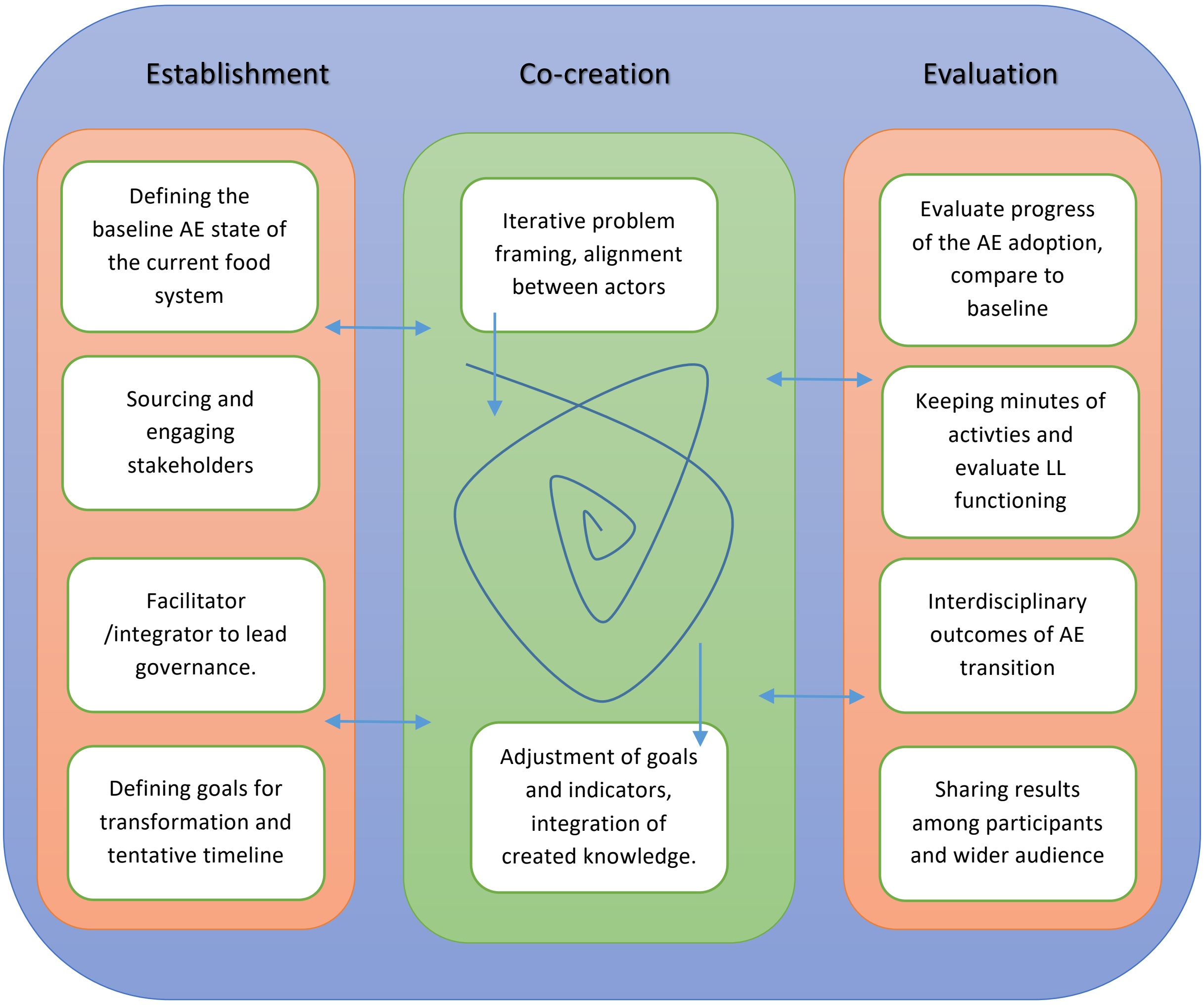

Figure 6. Schematic representation of the establishment, co-creation and Evaluation stages of an ALL, as described in this report.

To further lead the development of evaluation methodologies for ALL is a key task of the European Partnership. With ATP-in-ALL, we aim to produce a novel tool that encourage evaluation through self-reflection and better communication within the initiative, based on the specific constraints of the ALL. We encourage the ongoing development and prototyping of such tools, also through the help of the novel pilot network of living labs initiated in ALL-Ready.

The design of funding calls for ALLs must take into consideration that in comparison to other TSS projects, the LL approach is much more open-ended. A common definition for ALLs is needed for funding/policy purposes, but a pragmatic approach to delineation of what constitutes an ALL would be more helpful in order to capture the diversity of initiatives. If funding calls are too specific, or if the grant application process is lengthy and requiring extensive academic experience, then the agenda and the direction of the initiative is de facto already set before other actors have a chance to have an input on it, something that goes against the spirit of iterative co-creation at the heart of LL methodology. On the other hand, involving practitioners in the early stages of grant writing, where the funding is not yet secured may constitute an undesirable risks to practitioners in terms of time investment (Fritz and Binder, 2020) and would only attract highly motivated individuals. This presents a dilemma in terms of designing funding calls for LLs from the perspective of the European Partnership, and requires further expert input.

Capacity building for facilitators/integrator of LLs with specific knowledge of AE is also tantamount to their success (Figure 6). The ethics aspects common to transdisciplinary projects discussed in this report can be handled by people with specific leadership/management skills. We encourage the further professionalization of the facilitator role. This also plays into the use of evaluation tools targeted at the LL process itself, which require personnel with deep knowledge of all the aspects of an initiative.

			Establishment and functioning of LL					Monitoring and Evaluation			
Source	Name of Tool or Resource	Type	AE baseline assessment	Stakeholder sourcing	Co-design/ User Involvement	Governance	Transdis	LL functioing	LL social outcomes	LL AE implementation	LL AE impacts
	TAPE - Tool for Agroecology Performance Evaluation	Tool	X							X	
	SMART (Sustainability Monitoring and Assessment RouTine)	Tool	X							X	X
	Cool Farm Tool (CFT)	Tool	X							X	X
	Handbook for the Evaluation of Agroecology – GTAE	Tool	X							X	
	The Action Research Planner	Handbook, Methodology		X	X	X	X	X			
	The Action Catalogue	Tool, Online resource		X	X	X	X	X			
	UNALAB Tools for Co-creation	Tool, Online resource			X						
	RAIN platform	Tool, Online resource			X						
	ALL-Ready capacity building course	Methodology, Online resource		X	X	X					
	Framework for Agile Living Labs (FALL)	Tool		X	X	X					

Figure 7. Example of how the web page might look. The tool collection will be presented as a list and with a short description of each tool, and links to where website or scientific publication can be found. Tools sorted after what stage of the LL process they are relevant for (crosses).

There are myriads of aspects we have not touched upon in this review, for example methods for engaging citizens in living labs. This is relevant and requires future attention, since 32% of initiatives surveyed in AE4EU D2.3 reported citizen involvement in co-creation. The literature review and tool/method selection presented here indicates that many methodological and conceptual frame practices from TSS and PAR are highly relevant to the ALL and AELL contexts, perhaps more so than the more ‘classic’ living lab literature stemming from a business/open innovation perspective. We aim to publish a simple table containing the tools presented in section two onto the newly initiated Agroecology For Europe Hub [30], with links to respective tool/methodology provided (Figure 7). This will hopefully extend the reach of the content of this deliverable to people of various background who may be interested in initiating or participating in ALL and want to know more.

Although we have yet to formulate a “gold standard” for what an ALL should be, what methods it should deploy and how it should be evaluated across Europe, we believe that the tools presented herein will be helpful in the ongoing process.

[30] https://www.agroecology-europe-hub.org/

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