SYSTEMIC CHANGE FOR SUSTAINABLE FUTURES

THEME 3. CAPACITY DEVELOPMENT TO SUPPORT SYSTEMIC CHANGE: APPROACHES, METHODS AND TOOLS

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AKIS / CO-CREATION

Typology for co-creative innovation approaches to strengthen innovation capacities in agrifood systems

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Abstract:

This paper sheds light on co-creation to innovate for agrifood systems' transformation with a focus to empower local communities. Unlike the traditional "technology transfer" model, where knowledge flows top-down, co-creation brings together farmers, researchers, NGOs, and others to collaboratively tackle challenges and develop solutions tailored to their specific context.

While successful in the past, the "transfer" model often misses the mark for small-scale farmers and fails to address broader social, policy, and institutional needs. Co-creation, especially when driven to innovation however, holds immense potential to improve access, affordability, and sustainability, ensuring no one is left behind.

However, this promising approach lacks a standardized analytical framework for implementation and scaling up. This paper aims to fill that gap by proposing a typology of 20 co-creation models, used worldwide, based on eleven criteria. The comparative analysis allowed for identifying five families of multistakeholder innovation approaches (MSIAs), MSIA applicability at diverse phases of the innovation process and suitability for farmer-centred innovations. The framework will guide practitioners to strengthen their co-creation capacities and boost participatory and co-creative approaches towards innovation for systemic change. For decision-makers, it can provide a compass on incentives' provision for co-innovation, according to the best-fit.

Keywords: multistakeholder innovation approaches, co-creation, innovation, agrifood systems

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Purpose

Multistakeholder innovation approaches (MSIAs) are increasingly seen as a promise to improve access, affordability, acceptance, inclusiveness, relevance to local conditions as well as up-scaling at early stages of the innovation generation. As an innovation per se, the MSIAs are new and many development organizations and local NGOs and sometimes private sector players are experimenting with different designs and contexts, promoting their own model. To fulfil the wide variety of functions and expectations as the innovation pathway that will leave no one behind, while addressing the issue of time sustainability and cost-efficiency, MSIAs have to be analysed, designed, facilitated and incentivised accordingly. While there is a scattered experience with MSIAs, no typology and a framework exist that can guide both policy makers and institutional leaders in achieving their agrifood system innovation goals, and practitioners in scaling up field innovations. As a result, MSIAs, with a few exceptions, are hardly in the radar of policies and institutions worldwide, farmers and communities cannot take a full advantage of them, hence co-innovate and scale up fast. This paper attends to merge this knowledge gap and serve as a reference for policy and decision makers to design and implement the right incentives and funding mechanisms, and practitioners to improve innovation projects, programmes and interventions, particularly in rural areas.

Design/Methodology/Approach

Twenty types of MSIA used in agrifood systems have been collected, studied and analysed in Table 1 according to the following criteria:
Innovation as a purpose: the participatory process does not impy it will end with an innovation but work towards an improved learning, community engagement, or business outcome.This criterion refers to the extend, in which innovations as a result (product, process or form of organisation) is targeted by the given MSIA, ranging from 1- very low; 2- low to middle; 3 - middle or neutral; 4 - moderate to high; 5 - very high;

(1) *Multidisciplinarity:* it refers to the number of different stakeholder groups and types of expertise typically involved or the availability of multistakeholder requirement, imbedded into the approach design. 1 would indicate a minimum of twodifferent groups, while 5 incicate an encaged community where diversity is fully represented.
(2) *Innovation pathway* (co-innovation vs. technology transfer) refers to the ability to harnese collective intelligence for innovation, ranging from 1 (very low) indicates a topdown technology transfer to an innovation created elswhere, to a fully equitable co-innovation 5 (very high).
(3) *Timeline of action: refers to a MSIA* capacity to support specific stages of the innovation process, such as 1 - beginning of the innovation process (ideation), 2 - experimatation, 3- first use, 4- upscaling or 5-combined.
(4) *MEL integration:* depicts the level of integration (from very low -1 to very high -5) of Monitoring, Evaluation and Learning (MEL) that helps the multistakeholder team keeping focus on producing an innovation, as a part of the design and implementation of the MSIA. It often positively correlates with the purpose criterion.
(5) *Duration:* the MSIA is designed for short or longterm interventions, ranging from a few days or hours to well established and stable partnerships (scale 1 to 5).
(6) *Networks:* availability of linkages and productive exchange among similar MSIAs that would augment the experiences and accelerate innovation, raging from absence of networking to well-established networks stimulating joint learning and shortening the innovation process.
(7) Other crieteria, used to analyse existing MSIA are as follows.
(8) Structure: refers to whether the given MSIA is a physical structure, virtual, or hybrid modus operandi.
(9) Level of action: communityor field, work across a value chain or national and international levels.
(10) Facilitation: The MSIAs require coordination of the numerous actors and facilitation of the innovation process leading to a tangible change. This criterion

looks at the type of stakeholder who typically steps in to provide facilitation, e.g. research, advisory services, business, farmers, others etc.

(11) Suitability for diverse gender and age groups, e.g. rural women, youth, intergenerational cross-fertilisation or neutral to specific audiences.

MSIAs have a history of implementation in very different, dynamic and evolving contexts, which represents a methodological challenge for their typology. Aiming at a practical typology tool that helps better design and appropriate usage of MSIAs in diverse contexts in agrifood systems' innovation, the authors have studied the specific MSIA genealogy and identified their most common features based on multiple use cases, either documented in literature or based on experience, acknowledging the huge diversity of MSIAs and the creativity when implemented.

Table 1. Multistakeholder innovation approaches

Approach	Definition	Reference
Farmer Flied Schools (FFSs)	Participatory education approach that brings together a group of small-scale food producers to solve production problems through sustainable agriculture. The FFS approach offers space for hands-on group learning, enhancing skills for observation and critical analysis and improved decision making by local communities.	FAO. (2019). Gallagher, K., (2003).
Farmer Business Schools (FBSs)	A curriculum-based participatory approach, developed by FAO to strengthen the capacity of service providers and farmers to transition towards market-orientation and "farming as a business".	FAO. (2015).
Dimitra clubs	Groups of rural women and men who decide to meet regularly to discuss the challenges they face in their daily lives, make decisions together and take collective action to solve community problems with their own means.	Adisa O. (2020).
Bootcamps or innovation camps	Intensive, hands on, experiential learning experience of short duration where students, youth or farmers exercise multiple design thinking concepts and define problems and design solutions. Example: Digital agriculture bootcamps	Dantan J. et al. (2018)
Science and Technology Backyards	In situ platform that connects the scientific community with the farming community to facilitate information exchange and innovation. STB is implemented in a series of local backyards where things happen and are addressed in real-time by researchers, students, advisors and farmers. STB became a science and technology dissemination platform in local communities. Science-based management technologies are brought by STB staff and discussed with leading farmers, the latter providing feedback, resulting in farm-applicable recommendations.	JIAO, X. et al. (2019).
Commodity-based platforms	Facilitated farmer group discussions and problem-solving around one commodity crop, value chain or common farmers' problem at a time. It can be considered as an innovation approach if the problem-solving has led solving more complex range of issues, assisted by a multistakeholder team and ultimately, to an impactful change, e.g. innovation commodity-based advisory platforms in Azerbaijan .	Aerni P et al. (2015).
Hackathons	Short-term events that gather farmers or business operators, developers and often scientists and engineers to create innovative ideas, pitch them and consequently, develop new co-operation opportunities.	Grande, S. (2024).
Thinkathons and ThinkLabs	Dialogues on emerging issues of importance, involving most often youth and other stakeholders, e.g. policy makers.	https://www.itu.int/metaverse/un-virtual-worlds-day/thinkathon/
Innovation incubators	Virtual or physical space aiming to stimulate the identification, germination, and piloting of promising innovative ideas to support the agrifood sector transformation through mentoring, services and capacity development; usually business oriented, lasting from months to 1 year.	Ozor N.(2013)
Innovation accelerators	Virtual or physical space aiming at contextualizing previously generated ideas and helping them materialize by resolving implementation barriers related to access to capital, technology and knowledge and scaling out. Usually short term.	Thornton P. et al., (2024).
Innovation lighthouses	Places for demonstration of solutions, training and communication. In the area of agriculture for instance, lighthouses will showcase practices that are exemplary in terms of providing sustainably produced, healthy food, feed or fibre as well as ecosystem services linking rural and urban communities. They will bring together land managers, advisors and citizens, the latter ones having an important role as consumers and drivers of practices in agriculture and the food chain.	Tiba, S. et al. (2020).

EIP Operational Groups	Intended to bring together multiple actors such as farmers, researchers, advisers, businesses, environmental groups, consumer interest groups or other NGOs to advance innovation in the agricultural and forestry sectors; operate through financed projects targeting field trials, pilots, joint working processes, short supply chain activities, initiatives for climate change adaptation and mitigation, collective environmental projects (EIP-AGRI Operational Groups – basic principles).	https://ec.europa.eu/eip/agriculture/en/eip-agri-operational-groups-%E2%80%93-basic-principles.html
Youth Food Labs	Provides a platform for teams of young innovators, researchers, and entrepreneurs to transfer their idea-stage solutions into a real business model through capacity development, mentoring and networking.	https://www.world-food-forum.org/innovation-lab/youth-food-lab/en
Innovation labs	Create, test and validate ideas against the public/farmers needs and the market realities. This leads to the practical implementation of concepts, turning ideas into tangible products or services.	
Living labs	Research concept, which may be defined as a user-centered, iterative, open-innovation ecosystem, often operating in a territorial context (e.g. city, agglomeration, region or campus), integrating concurrent research and innovation processes within a public-private-people partnership.	Lie R, Van Paassen A and Witteveen L. 2023.
Innovation Policy labs	Harnesses foresight, behavioural science and MEL to help co-create and implement innovative, evidence-based strategic solutions or removes barriers to innovation both at national and at decentralized levels in policy and strategy domains; develops evidence-based policies or decision-making solutions for addressing complex challenges in a cost-effective and efficient manner, driving systemic change	Williamson B (2015); FAO model: https://www.fao.org/countryprofiles/news-archive/detail-news/fr/c/1673592/
Innovation niche partnerships	MSIA that focuses on local stakeholders and their functional capacities to build a partnership for local innovation	Toillier A. et al. (2020).
Innovation platforms	A physical, virtual, or physico-virtual network of stakeholders which has been set up around a commodity or system of mutual interest to foster collaboration, partnership and mutual focus to generate innovation on the commodity or system.	Schut M et al. (2016).
Innovation agribusiness centers	It is a service and knowledge hub that coordinates all activities that contribute to the production, processing, marketing, distribution, financing and development of agricultural commodities and resources by bringing about innovative approaches	Lamb and Brower (2001).
Innovation hubs	Innovation hubs focus on developing innovative products, services and training in a specific area of their Innovation Community, taking targeted actions to help overcome key challenges in that field.	https://www.fao.org/in-action/global-network-digital-agriculture-innovation-hubs/en

Findings

1.1. Diversity in design and implementation

The *MSIA approaches vary greatly* and can support co-creation at different stages of the innovation process. Their common definition is presented in Table 1, while and the response to the selected criteria (1-7) are demonstrated in Figure 1. When level of action is considered, while most of the approaches were designed to work for field operations and require physical infrastructure, not many MSIAs (except digital innovation hubs and innovation policy labs at FAO) demonstrated impact at all levels and adaptability for virtual and hybrid modes. Connecting co-innovation with value chains and other agrifood systems is not always common and opens space for design improvement. Despite that often MSIAs are meant to be farmer-centred, farmers rarely take up the facilitation role. EIP operational groups, living and innovation policy labs, innovation niche partnerships, innovation hubs, FFSs, FBSs and Dimitra clubs are successful to engage diverse audiences, women, youth and tackle intergenerational cross-fertilization.

Figure 1. Optimizing innovation: where do diverse MSIAs shine?

3.2. *Five main MSIA families can be distinguished.*

Engagement and knowledge builders: This group includes MSIAs (FFSs, FBSs, Dimitra clubs, Thinkathons) that often do not have innovation as a specific target however can contribute to the innovation process by leveraging the capacities of farmers or other vulnerable groups to participate equally in co-creative processes and by mobilizing communities.

Platforms: The platform concept has been first uses in business to "sell to multiple users" and includes MSIAs such as commodity-based platforms, innovation platforms, innovation partnerships online innovation platforms. They are multistakeholder, provide practical solutions, business-oriented, inclusive, with high level of innovation output targeted and measured through MEL. Often networking among platforms is considered in their design.

Labs: the labs concept provides for a shorter duration MSIA focused on innovation through research, exploration, experimentation, and problem solving for a defined topic in a multistakeholder setting.

Boosting entrepreneurship and agribusiness innovation: This group of MSIAs includes bootcamps or innovation camps, for agripreneur beginners and starting businesses; incubators to form further the innovator and nurture the innovation idea, and accelerators to implement and scale. FBSs (on business) and hackathons (on technologies) have a distinct role to play in boosting entrepreneurship in rural environment as part of the innovation process.

Hubs that include innovation hubs, centres of excellence, agribusiness centres is an umbrella concept. In rural settings, hubs orchestrate the innovation process by providing innovation and knowledge brokerage among different actors, coordinate and advise on the use of other appropriate MSIAs, e.g. labs or platforms, build networks and partnership, and provide other services.

3.3. *Highest co-innovation potential*

Living labs, Innovation niche partnerships, Innovation policy labs, EIP Operational Groups and Innovation platforms have highest potential to bring about an innovation in rural setting that ensures access, affordability, acceptance, inclusiveness, relevance to local conditions, and up-scaling at early stages of the innovation process.

Practical Implications

Selecting the appropriate approach for a given context (learning, business, field co-innovation) is now easier with the MSIA typology. It stimulates cross-fertilization and approach combinations: experiences from different spheres (business, start-ups, development) allow hybrid methodologies to take place to fit better to the concrete conditions, maximizing the advantages and minimizing disadvantages of a single MSIA. For example, engagement and knowledge builders MSIAs can be integrated in the local innovation process to leverage the capacities of local actors to participate equally to other stakeholder groups in the co-innovation process; entrepreneurship MSIA can be combined with hubs to add up on the innovation services provided etc.

Furthermore, the findings suggest correlation between driving the co-creation towards co-innovation and the integration of MEL in the MSIA design and combined with other findings commented above, can drive the optimization of the methodology in projects, programmes and interventions towards more innovative, inclusive, impactful and farmer-centred innovations.

Theoretical implications

The theoretical implications of typologizing MSIAs in agrifood systems hold significant promise for advancing co-creation and co-innovation. By dissecting the various approaches based on their merits, we gain a deeper understanding of how they transcend purely participatory methods. This typology allows for the co-creation of knowledge and solutions that go beyond simple interaction, fostering true co-innovation between stakeholders. Additionally, by integrating MEL, the typology provides for time and resource optimization of multistakeholder settings, a critical limiting factor for private sector actors. By streamlining collaboration and resource allocation, these findings enable efficient planning and utilization of resources. Ultimately, the analysis of MSIA typologies reveals a crucial insight: to truly unlock the potential of co-innovation, we need innovative funding mechanisms that extend beyond traditional institutional frameworks. By exploring alternative funding models, we can accelerate the transformation of agrifood systems and unlock the full potential of multistakeholder collaboration.

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The role of the hub organisation in the emergence of Innovation Support Services Ecosystems: a social capital approach

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Abstract:
To foster innovation in Sub-Saharan African countries, both researchers and practitioners recognise the importance of coordination between providers of innovation support services, whose efficiency depends on each other's activities. However, collaboration may be difficult to initiate and maintain, which leads service ecosystems to having trouble to emerge or declining rapidly. These difficulties can be related to problems in implementing the social capital needed between the different member organisations of the ecosystem. The purpose of this paper is to explore how the hub organisation orchestrates the development of social capital of an Innovation Support Services Ecosystem (ISSE) to allow its emergence and functioning in the agricultural sector in the Global South. A case study analysis was conducted in three countries of Sub-Saharan Africa. We propose an integrative analytical framework of ISSE emergence combining the theories of orchestration of ecosystems and social capital. Thirteen elements of social capital have been underlined as crucial contributors to the emergence of ISSEs. While most of these elements have already been described in social capital literature, we propose adjustments to the three dimensions of social capital. We also disentangle the most crucial elements of social capital along the emergence path.

Keywords: Service Ecosystems, Innovation Support Services, Social capital, Emergence, Orchestration, Sub-Saharan Africa

Purpose

African agriculture confronts significant "grand challenges", requiring substantial innovation to overcome them. However, support services for innovation are fragmented among various providers, including farmer organizations, incubators, NGOs, and public services, posing difficulties for innovators in accessing them. To address this, greater complementarity and coordination among service providers are advocated, aiming to enhance interactions and collaborations to offset resource deficits in funds, human resources, and time necessary to support complex, multi-actor, and uncertain innovation processes. Such inter-organisational arrangements can take many forms and the concept of service ecosystems is particularly adapted to describe them.

Service ecosystems: The concept encompasses the relationships among interconnected actors, organizations, and institutions which play a role, whether direct or indirect, in generating and providing service value propositions (Vargo et Akaka, 2012)

Innovation Support Services (ISS): involve interactions between providers and beneficiaries to address emerging demands and co-produce solutions that foster innovation processes by facilitating access to resources, and enhancing innovation capacities (Mathé et al., 2016)

Service ecosystems are characterized by non-hierarchical mechanisms, generation of new relationships among participants, and a value proposition at the ecosystem level (Thomas et al., 2022). We call Innovation Support Services Ecosystems (ISSE) the service ecosystems providing ISS (Orbell et al., 2023). The Hub organization plays a central role in orchestrating relationships within these ecosystems (Iansiti & Levien, 2004; Moore, 1993).

The literature on ecosystem orchestration and related capabilities has primarily focused on innovation and business ecosystems. However, our context differs as the value created encompasses economic, social, and environmental aspects, with some ecosystem members being non-profit organisations. This leads to distinct value capture dynamics and reduced competition. Therefore, there is a literature gap regarding how a hub organisation can effectively orchestrate ecosystems with these characteristics.

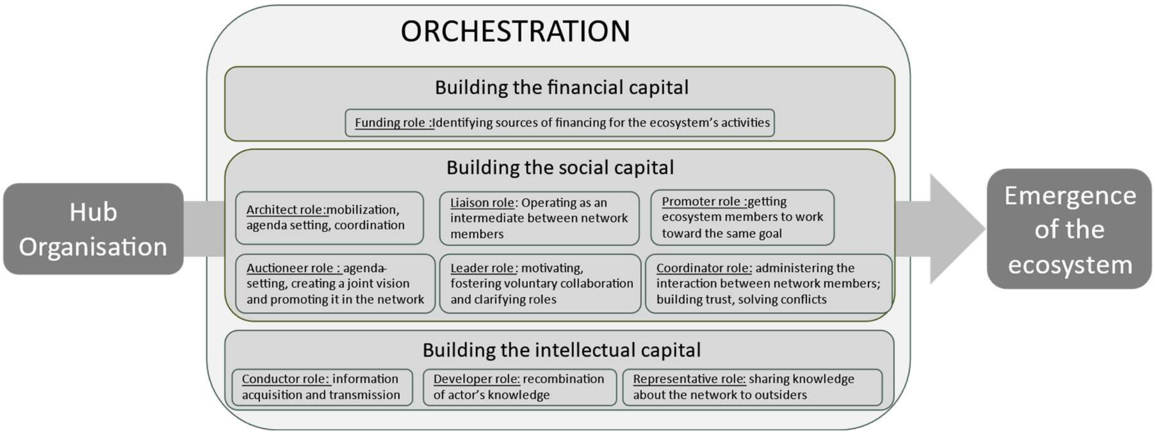
Although actors are conscious of the importance of collaboration in order to gain access to more resources (Nahapiet & Ghoshal, 1998), it remains difficult to initiate and maintain relationships, and ecosystems have trouble to emerge or decline rapidly. Social capital, encompassing structural, cognitive, and relational dimensions (Nahapiet & Ghoshal, 1998), is essential for coordinating collective action and facilitating ecosystem emergence (Koutsou & Vounouki, 2012). However, existing literature on social capital primarily focuses on business ecosystems in developed countries, leaving a gap in understanding how social capital is developed in ecosystems supporting agricultural innovation in the Global South.

This paper aims to elucidate how the hub organization orchestrates the development of social capital within ISSEs to facilitate their emergence and functioning in the agricultural sector of the Global South.

Design/Methodology/Approach

To analyse how the hub organisation contributes to creating the social capital of the ecosystem, we propose an integrative framework combining the theories of ecosystems orchestration and social capital.

Fig 1. Conceptual framework combining the theories of orchestration of ecosystems and social capital.



A case study analysis was carried out, based on three case studies of ISSE, aimed at supporting the implementation of new organic labels (via Participatory Guarantee Systems, or PGS) in Burkina Faso, Senegal, and Madagascar. The cases were selected to reflect varying degrees of emergence: in Burkina Faso, the ecosystem emerged and functions well; in Senegal, the ecosystem emerged but faces challenges in bringing together all relevant actors; and in Madagascar, the ecosystem has not fully emerged yet. PGS labels are umbrella innovations requiring several kinds of innovations: technical (techniques of organic farming, development of organic inputs), organisational (creation of cooperatives, associations, etc.), values chains (trading modes).

Seventeen semi-structured interviews were conducted between 2022 and 2023 totalling 829 min of interviews. The interview guide focused on two main themes: i) history and chronology of ISSEs emergence, and ii) orchestration of the implementation of the different dimensions of social capital by the hub organisation. Interviews were recorded and transcribed, and an abductive discourse analysis was conducted including both deductive coding (related to the three dimensions of social capital: structural, cognitive, and relational) and inductive coding to explore new factors influencing ecosystem emergence.

Findings

The study found that the creation of ISSEs differed among the cases studied. In Burkina Faso, an ISSE was formed by a coalition of NGOs advocating for agroecology, while in the other two cases, ISSEs were initiated by umbrellas of farmer organisations. This led to variations in ecosystem implementation: the first case exhibited more collaboration initially, while the others first developed the concept of PGS internally with their farmers before involving other actors. Social capital implementation appeared more successful in the first case. In the remainder of this section, we will present the most crucial elements of social capital explaining the emergence (or not) of the service ecosystems at each stage of emergence. Verbatims gathered in Table 1 illustrate either the contribution of the social capital element to emergence or how the lack of the element impedes ecosystem emergence.

At the early stage of emergence, ISSEs were characterized by non-collaborative organizations or just exchanging information (V1) with weak ties due to the few previous collaborations between them and intrinsic differences in working habits, culture, values

(V2) and timelines (V3). Frequent meetings (V4) will need to be propelled by the Hub organisation to build trust (V5), manage competition, and prevent opportunistic behaviour. Instability was high, with actors joining and leaving based on their interests (V6). A federating common vision (V7) was crucial to motivate involvement (V8), and the hub organization needed to establish its legitimacy (V9). Interviewees underlined past ties between members as a crucial favourable antecedent for the emergence of the ecosystem (V10) which is consistent with our previous observations: past ties enhance emergence of ecosystems because of the pre-existing social capital between some members.

As the ecosystem developed, certain elements of social capital remained important and continue to be fuelled by the actions of the hub organisation, such as co-creating a shared vision allowing to recruit and implicate new members. This common vision is also important to lower tensions between members (V11) that keep in mind the higher interest of the ecosystem. Strengthening ties between member organizations allowed to resist threats and shocks (V12). At this stage, it is becoming possible to see if the hub organisation implemented appropriate governance for the ecosystem or if it is too hierarchical (V13).

Once the ecosystem stabilized, most components of social capital existed, requiring limited efforts from the hub organization. However, maintaining favourable governance, managing tensions and competition, and sustaining or increasing joint actions remained important.

Table 1. Verbatim illustrating major elements of social capital in ISSE emergence

Element of social capital	N°	Case study	Verbatim
Share more than information	*V1*	MAD[1] = "failure"	Hub: "there is no really working exchanges [...] It's just exchange of information, invitations here and there"
Encouraging collaboration among organizations with diverse cultures and values.	*V2*	BF = "success"	Member: "There was a problem at the beginning, which did wound some sensibilities because we were criticised… At the beginning we were the only firm in the network, so other members saw us like the bad guys of the group, the ones who [only think about] making profit"
Shared timing and temporality	*V3*	MAD = "failure"	Hub: "We really are in a field logic, in a support logic. On the other side, they want to go fast, securing things legally rather fast"
Frequent meetings	*V3*	BF = "success"	Hub1[2]: "what matters is that each time we needed it, we made the effort the meet"
Trust	*V5*	BF = "success"	Member: "what makes it work is first questions of transparency, aspects of honesty and transparency.

[1] BF = Burkina Faso, successful emergence; SEN = Senegal, difficult emergence; MAD = Madagascar, no emergence yet

[2] In Burkina Faso, two different hub organisations took turns: first an NGO (Hub 1) and then the technical team of an association (Hub2)

			The first actors, the ones which initiated the CNABio ensured that others trusted them"
Stability of the ecosystem	*V6*	BF = "success"	Member: "They started together, and some left the train. Well not too many but some demotivated and left. Si the ones that are here today they are on the same page, this is why after all this time, they continue to hold together"
Federating vision	*V7*	BF = "success"	Hub2: "If we want to succeed in that process, all members must have a shared vision to really get to a success in the PGS functioning. And this vision was really centred on improving living conditions of the producers, contributing to develop agroecological production"
Motivation	*V4*	BF = "success"	Hub1: "I was really convinced, and I put all my energy in it, to make it work and the fact that I was really engaged, it animated all the people of good will around and we really got a united team, working together without hidden agendas"
Internal legitimacy	*V9*	SEN = "difficult"	Member: "In theory everyone should recognise Fenab as the central actor for this kind of development in Senegal. Everyone should collaborate with them. But for now, not everyone aligned to the directives and practices of Fenab"
Past ties	*V10*	BF = "success"	Hub1: "Via this framework, a lot of us knew each other, had already developed relationships, collaborations. So, we were rather familiar, we were kind of ready to set off on a new adventure"
Management of competition and tensions	*V11*	BF = "success"	Member: "There is always tensions and conflicts that may exist. But I think that the higher interest is always overhead"
Strong ties	*V12*	BF = "success"	Hub1: "What is important is to know that a group remained very strong and sound which allowed to resist to the different threats that happened"
Favourable hierarchy and governance	*V13*	BF = "success"	Member: "the founder team, they pulled out after two mandates to leave space for other [...] it was crucial, and it allowed the enrolment of other actors. Because they saw that it was working"

In ecosystems involving non-profit organizations, competition for value capture is typically lower, simplifying the management of tensions and competition. However, these organizations often rely on limited funding from a few donors, creating competition for financial resources that the hub organization must manage. In the case studies, the hub organizations themselves are non-profit, which facilitates legitimacy-building as they are not perceived as exploiting their position for personal gain. Common values among non-profit organizations facilitate collaboration but can also lead to misunderstandings and judgments of for-profit organizations.

To build social capital within the emerging ecosystem, the hub organization requires certain capabilities: visioning to develop a shared vision, partnering to select and engage members, orchestration, and leadership to manage competition and tensions, foster trust, implement effective governance, and legitimacy-building to be recognized as the legitimate actor to endorse the role of Hub organisation.

Practical Implications

These results allow to better understand how an ISSE emerges, the relative importance of some aspects of social capital and the essential role of the hub organisation in establishing this social capital between members of the ISSE. Elucidating the particularities of the context of support services ecosystems in countries of the Global South and the strong representation of non -profit organisations, allows to identify important elements to consider for practitioners.

Theoretical Implications

Contribution of our study to the research on social capital is twofold. First, we show that the importance of elements of social capital changes according to the stage of emergence. Second, we propose to refine one element and include two new elements to the dimensions of social capital.

Key elements of social capital identified by actors for effective collaboration align with those commonly associated with ecosystem or network emergence: favourable hierarchy and governance, connectivity through frequent meetings, strong ties, trust, management of competition and tensions, network stability, and leveraging past ties for new synergies (Coleman, 1988; Inkpen & Tsang, 2005; Koutsou & Vounouki, 2012; Nahapiet & Ghoshal, 1998). Some, however, need refining like shared culture and values which are important aspects of the cognitive dimension of social capital (Inkpen & Tsang, 2005), though in our context, the challenge rather lies in overcoming differences in organizational culture and values among actors. Others have long been described as important for inter-organisational collaborations but without being explicitly included in social capital like co-creation of a shared vision, which “facilitates communication, builds trust, and strengthens commitment and engagement among partners, ensuring a stable and sustainable relationship “(Shen et al., 2024). Finally, the Malagasy case study introduced a new element: shared timing and temporality.

Our preliminary results on the capabilities necessary for the hub organisation to build the social capital and make the ecosystem emerge, are opening new streams of research on the subject which can be deepened in future work thanks to the literature on dynamic capabilities.

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Key functions in a robust beekeeping knowledge and innovation system: Learning from experiences in Sweden

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Abstract:
This paper aims to investigate the key functions of a beekeeping knowledge and innovation system (B-KIS) and suggest interventions to create a robust and thriving B-KIS. In this paper, we explore what the status of functions in the B-KIS in Sweden is today, and how the functions of the B-KIS can be developed and strengthened. The method is a qualitative study of a project aimed at developing advisory services in beekeeping. The study draws on extant literature on the functions of innovation support services in agricultural knowledge and innovation systems (AKIS). The results show that the functions themselves are initially more important to discuss than who can supply them and that the functions approach is useful for providing recommendations to create a more robust beekeeping advisory service and knowledge and innovation system. The practical implications include recommendations for a national coordinator and evaluator, a network of quality-assured advisors, and finally, training and capacity-building of informal trainers. The theoretical implications include that many similarities are identified between the functions needed in the beekeeping sector and the functions of agricultural contexts in the literature, despite beekeeping not being part of the institutionalised advisory services for farmers.

Keywords: capacity building, collaboration, social learning

Purpose

The beekeeping sector is facing an increasing number of challenges, especially regarding honey bee health on a global scale (Neumann and Carreck 2010; Steinhauer et al. 2018). The knowledge needs among different groups of beekeepers are being met by a variety of bodies in different countries, and the advisory system for beekeepers is usually fragmented and poorly harmonised at both national and local levels (Ljung, 2018). This paper is based on a project aimed at developing advisory services for beekeeping in Sweden, drawing on the extant literature on functions of innovation support services (ISS) and agricultural knowledge and innovation systems (AKIS) (Proietti and Cristiano, 2022; Bachmann, 2000). The paper aims to investigate the functions of the advisory services and the beekeeping knowledge and innovation system (B-KIS) and suggest interventions to create a robust and thriving B-KIS. The research questions are the following: (1) What is the status of functions of the advisory services and the B-KIS today in Sweden? (2) How can these functions be developed and strengthened?

Design/Methodology/Approach

The project "Development of Advisory Services in Beekeeping" was set up between 2018 and 2021, with the long-term goals of increasing honey bee health and reducing winter losses by strengthening the advisory services supporting beekeeping. To do so, the functions of innovation supportive services (ISS) for beekeeping were analysed, and future interventions were developed. The project employed a multi-actor approach to make all stakeholders aware of each other and the importance of their specific roles in the overall B-KIS. The project aimed to identify a common vision and joint goals for action.

The design of the study was to initially use a rapid appraisal method on innovation systems based on findings from Schut et al. (2015) and Ljung (2018) to get a structural overview of the main actors, their roles and relationships. The method was specifically aimed to describe the general structures and functions aiming for knowledge development, innovation and learning, and to better understand how today's advisory services for beekeepers in Sweden are embedded into the national B-KIS. The steps involved in the process included three collaborative workshops with on average 15 to 20 participants representing the different identified actors. The aim of the workshops was to define the functions and components of the B-KIS today and into the future and for developing shared strategies. Finally, focus group interviews was made with five groups of the main stakeholders. The process was recorded by taking notes.

The workshops held during the project had the ambition to, through guided discussions, lead to a common understanding of today's situation and what progress in the development of advisory services for beekeeping in Sweden could look like. To suggest measures that are both desirable and feasible among stakeholders calls for a participatory approach and a systemic mindset of those involved. Through the process, a collective agency was created with shared goals among the participants (Germundsson and Ljung 2023). The project is built on close cooperation between the actors involved and the methods chosen guided by the view that development and implementation are two parallel processes, supporting each other. Such an approach aimed to reach more socially robust knowledge and gain wider acceptance.

This paper draws on the extant literature on innovation support service functions as described by for example Proietti and Cristiano (2022). It also includes older literature like Bachmann (2000) from an earlier phase of the discussions about basic functions in a knowledge system (Klerkx, Van Mierlo, and Leeuwis 2012). The concept of innovation support functions and the spiral of innovation (Fauré et al. 2019; Wielinga 2016; EU SCAR AKIS 2019) are applied as guidance to identify typologies of functions connected with the beekeeping sector. For the analysis of the status of the ISS functions of the B-KIS and to get an overview of the described function from other farm perspectives, we build on the previous work being done on typologies of functions for an ISS as compared in Table 1. The order of the papers compared is put in a timeline from the oldest research to the most recent one. There are a lot of similarities between the different studies even though they are separated in time, however, they use different language to describe the identified functions made in different contexts. The networking part, defined in Mathé et al. (2016), Fauré et al. (2019) and Proietti and Christiano (2022), is not mentioned in Bachmann (2000) as a function as such but it is discussed as a needs identification which calls for more participation of representatives of stakeholders for effective functioning of AKIS at all stages.

On the other hand, the function of Evaluation and Monitoring, Storage and Retrieval described by Bachmann (2000) is not included in the studies of Proietti and Christiano (2022), and is only partly addressed as an important function during the innovation process by Mathé (2016) and Fauré (2019). While Bachmann (2000) addresses the whole Knowledge and Innovation System and investigates its functions; Mathé et al. (2016), Fauré et al. (2019) and Proietti and Christiano (2022) bring to the discussion the Innovation Support Services as such. These different approaches provide a functional analysis comprehended from different perspectives as discussed in Knierim and Birke (2023). Despite this, they come to almost the same conclusions when identifying the functions. We use these findings to map and identify the functions found in the Swedish B-KIS context, described in the findings section.

Table 1. Comparison innovation and support functions

Bachmann, 2000	**Mathé et al., 2016, Fauré et al., 2019**	**Wielinga, 2016, Fauré et al., 2019**	**Proietti & Cristiano, 2022**
1. Need/problem identification	3. Demand articulation	Initial idea	F3) Identification and articulation of farmers' needs and innovative solutions
	4.Networking facilitation and brokerage to help organize or strengthen networks, improve the relationships between actors and align services to be able to complement each other	Inspiration Planning	F4) Identification of potential partners from different fields of knowledge and their aggregation. F5) Support to partners in the development and implementation of the project. F6) Coordination/ facilitation guidance of the dialogue and learning process.
2. Knowledge generation		Developmen t	
3. Knowledge operationalisa tion	2.Advisory consultancy and backstopping	Realization	F1) Support aimed at solving complex problems at the farm level. F7) Provision of technical advice/assistance. Co-construction of innovative solutions at farm level.
4. Knowledge dissemination	5. Capacity building 1. Awareness and exchange of knowledge	Disseminatio n	F8) Communication of the results.

			F8a) Dissemination with the purpose scaling-out the innovation F8b) Dissemination with the purpose scaling-up the innovation
5. Knowledge utilisation	6. Enhancing/supporting access to resources 7. Institutional support for niche innovation and scaling mechanisms stimulation	Embedding	F2) Provision of service to support access to resource
6. Evaluation			
7. Monitoring Storage Retrieval (access to findings)	2. Advisory consultancy and backstopping		

Findings

The Swedish B-KIS has developed based on actor possibilities, traditions, expectations and understandings of what is perceived as progressive for beekeeping in Sweden. In a way, today's status of functions available in the B-KIS has been moulded based on informal ways of beekeeper abilities to find their way towards supportive functions. In this study, we choose to use the cyclic flow pattern of functions defined in the work of Bachmann (2000). It has the best correlation with structures of functions identified within the beekeeping sector in Sweden since the monitoring, storage and retrieval function, left out in the descriptions of the other compared works as shown in Table 1, was on the agenda several times during the workshops and interviews. Based on the knowledge systems functions identified by Bachmann and on the conversations and conclusions made during the project time, deficiencies of functions and suggested development goals for each function needed were identified.

For function 1 - *Need/problem identification*: the deficiencies identified were lack of coordination when defining knowledge needs, and seldom bottom-up approach. The development goal is an increased ability to identify and transform different knowledge needs into relevant research and development projects.

Function 2 - *Knowledge generation*: the deficiencies identified were lack of coordination between research activities, which makes the operations ad-hoc in nature. The project-based funding system makes the resource access for knowledge generation short-term and insecure. The development goal is a broader research base, access to resources for innovative development projects, and participation in international networks.

Function 3 - *Knowledge operationalisation:* the deficiencies identified were the finding of a small research community and only one national advisor, meaning a lack of competencies to support beekeepers with complex problem-solving. The knowledge provision is mainly organised and led by laymen, who lack training themselves. The development goal is an increased competence among national actors to operationalize (interpret and apply) new findings and make these available through different means and channels.
Function 4 - *Knowledge dissemination*: the deficiencies identified were that competence development is mainly organised and led by laymen. The long tradition of informal, adult learning through the study circle tradition used by the beekeeping associations to reach out to beekeepers in the whole country, especially on a basic level, is predominant. The development goal is an improved advisory and educational system (breadth and depth), including increased regional presence.
Function 5 - *Knowledge utilisation*: the deficiencies identified were that research activities are seldom based on a demand from beekeepers. The heterogeneity of beekeepers highlights the demand articulation function and is identified in this stage of the innovation process as well in function 1. The development goal is an increased ability to put existing and best available knowledge into practical use.
Function 6 - *Evaluation*: the deficiencies identified were no evaluation of activities and programs. This relates to the lack of coordination of activities and coherent strategy for the apiculture program, which leads to a loss of learning opportunities. The development goal is to develop new methods for the evaluation and coordination of national initiatives.
Function 7 - *Monitoring, storage and retrieval* (access to findings): the deficiencies identified were no strategy for collecting, storing, and sharing data and experiences, which provides for a poor function of advisory backstopping and provision of technical advice. The development goal is access to an industry-wide and quality-assured database for collection, storage, monitoring (indicators), analysis and quality in all phases and aspects of beekeeping and production.
The analysis of functions provided the insight that instead of trying to change established organising principles and actor networks, the opportunity lies in the ability to build on what works already and complement missing functions in the B-KIS. The results show that the functions are initially more important to discuss in themselves than who can supply them. The results also suggest some areas as missing and others need to be reformed. There was a universal request from the stakeholders for improved collaboration and coordination between the actors to develop the advisory services and the knowledge and innovation system as a whole.

Practical Implications

Mapping functions within the beekeeping sector and comparing this specific sub-system to other identified agricultural innovation and support services in the literature opens the understanding of how a needs-based organically developed knowledge system might look. Collaboration and coordination to provide supportive functions for innovation is the key to the vision of healthy honey bees and sustainable beekeeping. In the cyclic flow pattern described by Bachmann (2000) and following the phases

identified in the "spiral of innovation" by Wielinga (2016) and Fauré et al. (2019), the following action needs were identified.
First, two identified needs are filling **the function of needs identification** and are important in the initial stage of the inspiration and planning phase: A national actor responsible for the coordination of initiatives and constituting a collaborative council. Next, two identified needs are filling **the function of knowledge generation and knowledge utilization**, important in the development and realisation stage: Establishing a regionalised advisory organisation and enabling a two-way integration of knowledge flows, bottom-up. Thirdly, these needs fill **the function of knowledge dissemination and utilisation** and are important in the dissemination and embedding stages. It is also the first step towards a repository system for **the function of storage and retrieval** of developed knowledge; Training of trainers, broadening the monitoring of actions and establishing a shared platform for quality-assured data.
The results imply that with a collaborative approach and a common understanding of the needs to support the sector, a tailor-made and robust B-KIS can be developed and strengthened. The turnover of people within the different identified stakeholder groups makes the journey towards the vision call for regular follow-up and reminders not to be forgotten. By strategic collaborative decisions, one action at a time, the Swedish B-KIS will be developed and strengthened.

Theoretical Implications

Following the discussion from Wielinga (2016) and Fauré et al. (2019) the "Spiral of innovation" with the different phases (in *italic* below) that call for different function needs (in **bold** below), links well with identified functions as presented in Table 1. Together, Table 1 and the Spiral of innovation phases identify function deficiency in the advisory services and the B-KIS. The major overall driving functions for development are the knowledge repository with storage and retrieval, funding and monitoring and formative evaluation throughout the cycle. Functions linked to networking, facilitation and brokerage call for a national actor with the responsibility of coordinating the efforts, past and present, to support the function of **Need identification** part of the phases *initial idea* (coming from sub-systems), *inspiration* and *planning*.
Functions linked to basic research and innovation development call for a knowledge input to support the functions of **Knowledge generation** and **Knowledge operationalisation** part of the phases of *development* and *realisation*. Functions linked to communication, diffusion, adoption and utilization call for a capacity-building effort of the beekeeping sector to support the functions of **Dissemination** and **Utilisation** part of the phases of *dissemination* and *embedding*. Functions linked to reinforcement and diagnosis of beekeepers' problems generate a beekeeping development if supported by the function of **Evaluation** answering the question "Did we solve the need?". If so, the new knowledge will go to **Storage** and **Retrieval**. The new knowledge feeds new ideas from the evaluation and sub-systems into a new *initial* phase and the cyclic flow starts from the beginning again. As discussed by Bachmann (2000) the process is never straightforward, information and knowledge flow freely within the cycle.

The results of this study show that the functions needed in the beekeeping sector in Sweden for a strong well-functioning advisory system and B-KIS are mostly the same as for other farming areas in different contexts described in Table 1. One major difference is that since beekeeping is not part of the institutionalised advisory services for farmers, playing a major role in the ISS as described by Prioetti and Cristiano (2022), other ways must be found. Fauré et al. (2019) conclude that there are a variety of mechanisms to operationalise an ISS and a diversity of organisations which may fulfil this role. The Swedish beekeeping sector needs a tailor-made and robust B-KIS that can be developed and strengthened. This analysis of the key functions for a robust B-KIS suggests efforts for innovation support services to be developed in the future.

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Mission oriented agricultural innovation systems to make urban and periurban agriculture thrive

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Abstract

Urban and peri-urban agriculture (UPA) can improve food security, nutrition, and livelihoods of urban dwellers, while providing access to income and employment, shortened supply chains, increased resilience, greener cities and greater social cohesion. UPA, however, comes with challenges, and its practitioners often lack the necessary knowledge and skills to succeed.

Traditional knowledge and advice providers are often oriented towards rural, large-scale, agriculture, and have lagged in responding to the growing importance of UPA and the varied needs of urban and peri-urban producers. They have generally not adapted to engage with UPA, from policy advice to service delivery.

There is a knowledge gap about who works with UPA farmers, how to address their needs and challenges, and what they can do to better support UPA. FAO commissioned an issue paper with the aim to analyse this under-researched theme, with the focus on the urban mission-oriented agricultural innovation systems (AIS) that have a key role to provide targeted and multidimensional support (from policy to knowledge and innovation support) to effectively leverage the potential of UPA to contribute to sustainable and inclusive transformation of the urban agrifood systems.

Keywords: urban and peri-urban agriculture (UPA), urban agrifood systems, agricultural innovation systems (AIS), mission-oriented agricultural innovation systems, agricultural innovation, knowledge and innovation services

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Purpose

Urban and periurban agriculture (UPA) is gaining an importance worldwide as a valid means to improve food security of urban dwellers, bring food production closer to its consumption place, boost economic activities and jobs creation, and green the cities. UPA, however, differ substantially from agriculture in rural environments, which implies the need for new type of knowledge, skills and practices. UPA practitioners continue to face very specific challenges in accessing services and innovations, and getting support they need.

The uniqueness of this paper lies in approaching key but not yet well reserached theme of new types of services, innovations and systemic approach to he UPA. The paper aims to shed some light on how knowledge and innovation support work in the urban settings, highlight some promising practices, unveil existing gaps and recommend concrete systemic actions to enable impactful innovation support to make UPA thrive.

In this sense, the paper analyses the mission-oriented[3] agricultural innovation systems (AIS), thus the AIS that has a very targeted goal of supporting the mission of the sustainable and inclusive transformation of the urban agrifood systems.

Design/Methodology/Approach

A desk study of academic literature, case studies and grey material was conducted to ascertain the literature on AIS for urban and peri-urban agriculture. This review benefitted also from an extensive and pluriennal experience in UPA, as well as large network of relevant partners of FAO and the Carrot City. Furthermore, a variety of search terms were used for searches at the Toronto Metropolitan University library portal and Google, which included: urban extension and advisory services, peri-urban agriculture and advisory services, innovations in agricultural extension, new approaches to agricultural extension and advisory services.

Findings

a. Sketch of a varied landcsape of the urban and peri-urban agriculture

Currently, 56% of people live in cities, with the number expected to grow to 70% by 2050 (FAO et al., 2023). Rapid migration to cities will continue to increase the strains on agrifood systems. Urbanization and population growth affects how urban and periurban agriculture (UPA) is practiced, and influences what innovation support and advisory services are needed.

UPA is a practice that has long occurred around the would, but is also ever-evolving, with new expressions constantly emerging (Bryant et al., 2015) differering from city to city, and in particular from the Global North to the Global South. Existing and emerging trends include controlled-environment agriculture (CEA), gardening in and around the house, community and institutional gardens, multifunctional and rooftop farms, and many others.

b. Who are practitioners of urban and peri-urban agriculture?

UPA practitioners, be it from the Global South or the Global North, most of the times differ substantially from their peers in rural areas due a very different environment in which they operate. UPA is practiced by people of all income brackets participating in various ways. These include economic reasons (more diverse livelihood, emerging niche food products), social reasons (food security, source for culturally appropriate foods), and environmental ones (greater confidence in safe growing practices, mitigation of urban heat island through productive roofs). The profiles of practitioners vary widely as well in age, gender, income level, physical ability, skill and organization level (individuals or less or may formal associations). Furthermore, many of the UPA farmers are part-time and/or new to the sector, thus lacking the generational knowledge to produce and sell.

[3] https://www.sciencedirect.com/science/article/pii/S0308521X20307629

3.3 Unique challenges of the agriculture in urban and peri-urban settings and the needed innovation response

Whatever form the UPA takes, its practitioners continue to face many challenges, including insecure land tenure, lack of enabling regulations, competition for and management of scarce resources, and climate change. Moreover, UPA has been often considered a frowned-upon practice by governments and many urban residents, with the feeling that it is incompatible with cities.

Unfortunately, relevant, accessible and impactful innovation support, including advisory services, is soarely failing to support UPA practitioners and leverage its potential for sustainable, reslient and inclusive transformation of urban agrifood systems. Reasons for that failure could be found in the fact that traditional knowledge and advisory systems, primarily designed for rural, large-scale agriculture, have struggled to adapt to the evolving landscape of UPA, leaving practitioners underserved and disconnected from crucial services and support networks. Also, practitioners may not be aware of how to acquire knowledge or to adopt innovations, or they may not have the means to do so.

As this study reveils, and considering a wide range of the UPA practices and motivations, innovation and knowledge support required for urban growers is extensive, ranging from economic to social. As land is the limiting factor, land tenure support is needed. There are innovations to gain space for UPA, such as botanical gardens, museums, roofs, or not utilized public land.

3.4 Existing and new knowledge and innovation providers in the urban settings

As mentioned above, while rare and often unstructured, some forms of advice and support exist. This study identifies four categories: governments and municipal authorities, public and semi-public institutions, and civil society and private sector entities.

Table 1. Existing and emerging knowledge and innovation providers for UPA

Type	**Name and country**	**Type of support provided**
Community gardens	Municipal program GEML (Grow it, Eat it, Move it, Live it) (the United Kingdom)	Creation of new raised-bed gardens for residents of social housing in Birmingham, UK, combined with teaching or advising residents about cultivation in these beds. https://www.torontomu.ca/carrotcity/board_pages/city/GEML.html
Public and semi-public institutions	French National Institute of Research on Agriculture and Environment	Platforms: Exp'AU (advisory office supporting local governments and private stakeholders in urban agricultural projects), Chaire Agricultures Urbaines (consortium of institutional partners from municipalities to large corporations) generating knowledge and educational tools) and SecurAgri

	(INRAE) and AgroParisTech (France)	(research and advice on soil safety to local governments and other institutions). https://www.chaire-agricultures-urbaines.org/ https://www.securagri.fr/
University	Kerala Agricultural University (India)	Educational online videos on horticulture in kitchen gardens, helplines operated by extensionists, to improve food and nutritional security of the urban dwellers during the COVID-19 pandemic. https://www.aesanetwork.org/page/2/?s=covid
Extension agencies	Yogyakarta city's Agricultural Extension Center (Indonesia)	Direction, guidance, and counseling in the field, distributed across administrative sub-districts with roles such as a motivator, facilitator, educator, and communicator. Retno Wulandari, R., Witjaksono, R., & Ineke Wati, R. (2021). The Role of Agricultural Extension Workers in Urban Agriculture Development During the Covid-19 Pandemic in Yogyakarta City, Indonesia, Advances in Economics, Business and Management Research, volume 199.
Botanical gardens	Jardins du Muséum of the natural history museum (Toulouse, France)	Open-air extension with food gardens integrated in larger thematic and regional gardening and educational displays, including spaces for training and education, lab space and a teaching greenhouse. https://www.torontomu.ca/carrotcity/board_pages/community/jardins_du_museum.html
International and development organizations	UN Food and Agriculture Organisation, FAO (global)	Individual projects in specific cities, spaces for connectivity around UPA, consolidation of numerous fragments of knowledge into synthetic documents, resource bases and platforms: the City Region Food System Toolkit, the Urban Food Actions Platform, the Urban and Peri-Urban. https://www.fao.org/in-action/food-for-cities-programme/toolkit/introduction/en/; https://www.fao.org/urban-food-actions/en/; 1https://www.fao.org/in-action/food-for-cities-programme/toolkit/introduction/en/;https://www.fao.org/urban-food-actions/en/
International, national, local, formal or informal not-for-profit	Cidades sem Fome (São Paulo, Brazil)	Access to land and infrastructure combined with educational efforts: from training in collaborative construction of greenhouses in peri-urban areas, to professional qualification courses in agriculture or commerce for unemployed and food-insecure migrants, to the construction of gardens in public

		schools and institutions combined with nutritional education https://www.torontomu.ca/carrotcity/board_pages/city/cities_without_hunger.html
UPA producers associations and self-help groups	The Gaza Urban and Peri-Urban Agriculture Platform (GUPAP) Gaza Strip	Web of governmental, educational, and civil society actors with a collaborative approach, providing technical support, establishing local networks, and facilitating capacity-building initiatives. https://gupap.org/en/ and https://sdgs.un.org/partnerships/gaza-urban-peri-urban-agriculture-platform-gupap-space-towards-agricultural-policies
Private actors	Bulgarian organic beekeeping association and Hilton Sofia hotel (Bulgaria)	Technical assistance to offer hotel guests home-harvested honey produced on the hotel roof https://bgcb.eu/listing/hilton-sofia/
Lead farmers	Jean-Martin Fortier (Quebec, Canada)	Empowering the next generation of growers to start their own successful small ecological farms worldwide https://www.en.jeanmartinfortier.com/

3.5 Innovation and advice needed by urban and peri-urban agriculture practitioners

The study unveils also a soaring gap in the more integarted and systemic support needed to make UPA and its practitioners thrive.

At times, lack of knowledge on method of production is the barrier to providing effective advice and innovations. Controlled environment agriculture (CEA) is in its infancy in many places. Same goes for agroecology and other nature-based practices. In addition to gaining production knowledge, new farmers must be skilled entrepreneurs and marketers. They need to know what their value proposition is in the market and where to legally sell the product. The literature also shows that networks are an important part of AIS systems, as a critical place where to learn new skills, approaches, and delivery methods. Other key knowledge and innovation needs include cliamte change and its impact on crops, better environmental management of agricultural by-products, in particular considering food safety issues (water and other waste management etc.), how to navigate a complex regulatory frameworks and address social justice issues in urban agriculture, including gender-related obstacles and many others.

4. Practical Implications

4.1 Agricultural innovation systems in the urban settings

UPA innovation and knowledge ecosystem in the cities is unique: knowledge may be more accessible, less infrastructural hurdles (e.g. in terms of market access), but agricultural knowledge adapted to urban practices is not abundant. Traditional advisory systems, tailored for rural agriculture, are struggling to adapt to the evolving and diversified landscapes of UPA. The entities specialized in agriculture may be distantly located. Moreover, actors engaged in rural extension and urban agricultural advice are often disconnected, with the former lacking knowledge concernig unique specificites of the UPA, and the latter not being specialised in agricultural development as it may not be their core business.

4.2 Capacities needs to enable agricultural innovation systems actors to effectively support urban and peri-urban agriculture practitioners

Many non-traditional services providers emerge with the pivotal role in urban AIS. They need, however, targeted capacity development, also to enable them to be innovation brokers and facilitate networking and entrepreneurship. The big gap is found in the systemic offer of capacity development, the governance of the UPA service system and a lack of systemic approach to it. To fill this gap, we need to innovate in the UPA-related AIS and strive to provide services in an integrated way (services addressing a wide range of diversified needs, with improved coordination among AIS actors, namely farmers, value chain actors, extensionists, researchers and urban policy makers). Targeted policies and investments can help fill this gap both by bringing technical capacities to the UPA practitioners and the experience in learning methods, including group methods and digital extension.

Another important factor is that oftentimes entities engaged in provision of agricultural advice are heavily understaffed, underfinanced and underskilled, or, in case of the NGOs, they depend on donors' funding and short project cycles, hindering thus sustainability. One way or another, there is a huge gap in skills and available technical backstopping to the urban AIS and knowledge providers, that disable them to provide relevant and impactful advice. Unfortunately, this adds up to the detachment of the research agenda from the real-life needs of the UPA practitioners. It underlines the urgent need for a profound transformation of the urban AIS, with improvements at system, organizational and individual levels, including integration of the UPA in the research and education agendas. In Paris, for instance, educational institutions like L'Ecole du Breuil4 and AgroParisTech play a crucial role in advancing knowledge and expertise in urban agriculture, contributing to the city's reputation as a leader in the field.

4.3 Policy action to enable a paradigm shift in urban agricultural innovation systems

There is a pressing need for urban AIS and advisory systems to transcend traditional models and adopt a pluralistic approach that caters specifically to the diverse requirements of UPA farmers. These services should encompass a broad spectrum of areas, from technical to socio-economic. Encouraging innovation is a crucial component, particularly in the complex urban environments where UPA operates.

By embracing a mission-oriented AIS approach (thus AIS with a specific mission, goals and systemic mutidimensional approach) and adapting policy frameworks, policymakers can empower UPA practitioners to unlock the full potential of urban agriculture as a driver for sustainable urban development, food security, and social

[4] https://www.ecoledubreuil.fr/

equity. Therefore, advocating for a paradigm shift in policy and institutional frameworks is a pivotal role of AIS actors, to bolster UPA. This role is especially important as oftentimes city planning is done by actors that have no agricultural knowledge at all, and the AIS actors should help UPA practitioners make their needs and demands heard in such processes.
Actors in the mission-oriented AIS thus have a key and transformative role in leveraging the potential of UPA, by connecting urban policy makers, traditional and non-traditional extension providers, research, education and UPA practitioners to better understand their needs and jointly innovate to find and implement relevant solutions.

2. Theoretical Implications

A better understanding of diversified needs of UPA practitioners and a pluralistic service environment in urban and peri-urban areas is urgently needed to inform enabling policies, city planning activities and contribute to the co-creation of innovative and imactful practices.
Furthermore, to be truly relevant, AIS in the urban settings need to be analysed and strengthened not only in terms of production-related support, but also as a facilitator and a key levarage of innovation to bring about relevant solutions to the UPA at production, transformation, marketing, socio-economic and political levels. In this sense, the expert and multistakeholder debate around these themes is not yet mature and not yet yielding enough results to significantly improve the design of innovative, relevant, accessible and impactful services. There is a further need to connect actors from different sectors, including urban and rural, agricultural, socio-economic, environmental and policy, to foster the dialogue, knowledge and experience exchange and coordination at global, country and local levels.
This paper hopes to add a little brick to this nascent multidisciplinary dialogue, by highlighting the need for the mission-oriented AIS, unveiling the most important gaps and needs, and connecting the dots between so far detached sectors. Further elaboration of this topic will be found in the FAO forthcoming extended paper on AIS and UPA.

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How Institutional Logics shape innovation to address nutrient pollution in the Great Barrier Reef: Implications for innovation brokering.

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Abstract:
This paper draws on the case of nutrient pollution in catchments of the Great Barrier Reef (GBR) to explore the institutional dimensions of innovation, the impact they have on desired outcomes and implications for innovation brokers. Through discourse analysis of interview data and case specific documents, we identified two competing institutional logics within the case. This manifested as an ongoing contest around the nature of the problem, its cause and possible solutions, thus contributing to poor progress towards nutrient pollution targets. Through this research we highlight how institutional dimensions of Agricultural Innovation Systems (AIS) are a key determinant of innovation in complex problem domains yet are underdeveloped conceptually. We argue for an enhanced focus on institutional analysis and appreciation of the role innovation brokering plays in identifying and negotiating institutional clashes.
Keywords: Institutional logics, Innovation, Brokering, Australia, Agriculture

Purpose

The central importance placed on innovation by governments in Australia is due to the perceived link between innovation, productivity and standards of living (Innovation and Science Australia, 2017). While in its broadest sense, innovation is concerned with new thoughts, practices, processes and things, the grounding context in Australia is almost always economic. This is indeed the case for agriculture, with investment in innovation viewed as central to achieving the objective of $100 billion in output value by 2030 (Australian Government, 2021)

However, the challenges faced by agriculture do not lend themselves to technical and economic framing alone. Agriculture produces 16 per cent of Australia's greenhouse gases, the third most behind energy and transportation (Australian Government, 2022), and is the predominant source of soil erosion and nutrient pollution in sensitive areas such as the GBR (Waterhouse et al., 2017). The impact of this contributes to the natural environment in Australia being classified as "poor and deteriorating" (Cresswell et al., 2021).

This demonstrates a disconnect within the Australia AIS between the economic and technical positioning of innovation and the problems innovation needs to address. Such a disconnect leads to the 'rendering technical' of innovation (Cook et al., 2021), a process whereby socio-political problems are interpreted technically, leading to inconsequential innovation activities. A key challenge for innovation actors is to integrate the technical, social, environmental and political to achieve innovation in contexts where such challenges exist. The institutional level is a means of achieving this, as it provides a set

of mediating concepts to position actors, organisations and society relative to problems of significance (Friedland & Alford, 1991).
There are two ways of thinking about institutions in this regard. First is the rationalist perspective, which views institutions as efficient solutions to pre-defined problems (Holm, 1995). Second is the constructivist perspective, which understands institutions as 'socially constructed, routine-reproducing, program or rule systems' (Jepperson, 1991). These two perspectives align with what Powell & DiMaggio, (1991) label 'old' and 'new' institutionalism. The Institutional logics perspective (Thornton et al., 2012; Thornton & Occasio, 2018) has emerged as a useful means of exploring institutions through a new institutionalist lense in a variety of contexts (Andersson & Liff, 2018; Coule & Patmore, 2013; Dahlmann & Grosvold, 2017; Dunn & Jones, 2010; Goodrick & Reay, 2011; Knook & Turner, 2020; Kooijman et al., 2017). We drew upon the institutional logics perspective to reveal the institutional dimensions within the case of nutrient pollution in catchments of the Great Barrier Reef (GBR) and explore how innovation performance has been shaped by these.

Design/Methodology/Approach

The world heritage listed GBR covers 348,000 square kilometres along the coast of northeastern Australia. The overall outlook for the GBR is 'poor' and deteriorating (Queensland Government, 2018) with the scientific consensus stating that a key contributor to this decline is poor water quality attributed to land-based runoff. The Australian sugarcane industry produces around 32 million tonnes of sugarcane annually from approximately 370,000 ha of land, with three-quarters of this occupying catchments that discharge into the GBR lagoon.
Over the past decade, federal and state governments have invested over $1billion AUD to address the problem. The majority of investments have been extension activities to support implementation of the industry Best Management Program - SmartCane BMP. This program is based upon a scientifically validated process called 6 Easy Steps (Skocaj et al., 2013), which describes how to balance plant and soil requirements to ensure limited nutrient loss to the environment. The water quality improvement plan has set a target of 90% of area under sugarcane to be managed through BMP by 2025, however adoption levels were only 19% in 2023 (Queensland Government, 2019). We define this limited progress as an example of 'innovation inertia' given limited progress towards targets has been made in the face of significant investment and effort.
To explore the influence of institutional logics on this inertia, we used a critical analysis of discourse (Focault, 1981; Salkind & Miles, 2010), based upon unstructured interviews with 11 innovation actors in policy, program management, intermediary and farming practices; analysis of 114 submissions to an Australian senate inquiry exploring reef management policies, and; 31 documents covering policy, technical, and strategy dimensions of the case. A dominant discourse was described, which was then critiqued to reveal an alternate discourse. Institutional logics were derived using an analytical framework developed from the micro foundations of Institutional Logics (IL) (Thornton et al., 2012). This enabled examination of the discourse to explore what it revealed with regards to processes of problem framing, theories of action and justifications for action.
After describing each logic, we applied qualitative content analysis (Elo & Kyngäs, 2008; Hsieh & Shannon, 2005) to senate enquiry data to explore how actor groups engaged

with each logic in this 'discursive hotspot' (Fuenfschilling & Truffer, 2014). Data from the hotspot was categorised based on the actor group best aligned with the submission, then coded and aligned with an institutional logic. Coding extent was then charted by logic and actor group. The aim was to explore patterns in the data and if/how different actor groups aligned with each logic.

Findings

The discourse analysis revealed a dominant and alternate discourse, with each giving expression to a competing institutional logic (Table 1). The dominant discourse was aligned with a Science logic, characterised by scientific framing of the problem and a theory of action grounded in technical rationality. This logic drew upon a range of justifications to legitimise action, dominated by technical and economic concerns. The following quote captures much of how this dominant logic was expressed by actors in the context:

Given the degree of human induced change in the catchments and the reef, it is important to ensure the values of the GBR can be maintained. The Reef Regulations are based on the science of land management practices that maintain yield while minimising off site loss of nutrients to waterways and the GBR lagoon, and the level of compliance offered by the various agricultural industries to reach or exceed guidelines developed to showcase Industry Best Practice. (Researchers>Submission 56 - Independent Science Panel.)

The alternate discourse, underpinned by an experiential logic, was characterised by a rejection of the core premises of the dominant discourse and science logic. Problem framing was based upon lived experience, the theory of action was based on experiential knowledge, and action was justified upon the existential threat posed by proposed interventions. The following quote provides an example of how this was expressed by actors in the context:

I have lived here all of my life and have failed to see any vegetation loss - fish, turtles, eels, bird life are in abundance in the river along with some very healthy crocodiles. You would expect that towards this end of the water course, chemical, fertiliser contamination of any description would be at it's most concentrated. Without any scientific background, I have trouble believing the need for such regulation when visually you cannot see damages on the water courses and in the water courses. (Land managers\Submission 79 - Mr Bryce Macdonald)

Table 1: Summary of key dimensions of institutional logics for logics identified in the case.

	Science Logic	Experiential logic
Framing	Scientific	Experiential
Theory of action	Scientific – technical rationality	Relativist – based on experience
Justifications	Universal, cultural values/Economic	Existential/political

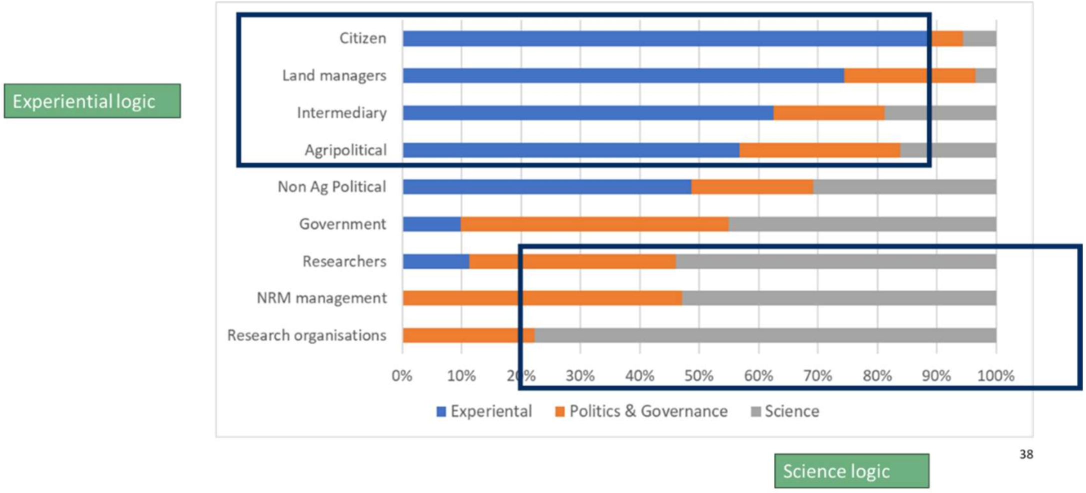
Actors drawing upon the experiential logic challenged the taken for granted nature of the dominant discourse and resisted calls for further action to make progress towards targets. Analysis of the senate enquiry data highlighted how this clash manifested as polarisation, with different actor groups drawing upon competing logics and rejecting the premises of the other (Figure 1). This provides evidence of the ongoing debate around the problem and its cause, which has reduced the capacity for collaborative action to address nutrient pollution. Innovation performance, defined as progress towards nutrient pollution targets, has suffered in part due to this clash.

Practical Implications

The history and tradition of innovation in agriculture is anchored in technical rationality (Röling, 1996, 2009). The science logic described here, is an expression of this history. As shown, different views of knowledge inform action in ways that are often counter to the dominant logic. This can lead to polarisation and innovation inertia. Practically, innovation actors need to move beyond the technical dimensions of problems, and work towards engaging with the institutional ones. Two shifts are needed to support this.

First is for actors to engage with the institutional dimensions of innovation contexts early in an intervention. To this end, institutional analysis should form part of the problem setting process which will lead to a basic awareness amongst actors of possible institutional conflicts and thus more informed intervention design. Second, innovation brokers need to be empowered to facilitate this process. Engagement, policy development and program design processes need to articulate what is happening at an institutional level or risk failure due to enabling the negative impacts of such processes. This requires advanced appreciation of innovation contexts and a capacity to 'broker' an understanding of the institutional processes shaping innovation amongst diverse actors.

Figure 1: Qualitative content analysis of senate enquiry data which shows polarisation of actor groups aligned with competing logics. Data for each actor group is shown as a proportion of total coded segments in 100% stacked bars. Black rectangles show actor groups with more than 50% of coded data aligned with one institutional logic (labelled). Politics and governance was a theme not aligned to either logic, but shared across actor groups.



Theoretical Implications

This implies two theoretical implications. First is a need to rejuvenate theoretical development of innovation brokering within AIS with a focus on institutional analysis. Innovation brokering received attention in the early 2010's (Klerkx, Schut, et al., 2012; Klerkx & Gildemacher, 2012; Klerkx & Nettle, 2013; Shaxson et al., 2012), however limited progress has been made since. An enhanced exploration and description of brokering functions within AIS should lead to a greater appreciation and resourcing of this function.

There is also a need to effectively represent the institutional dimensions of AIS within the broader description of innovation in agriculture. Multiple and varied conceptualisations of AIS work against this to a certain extent (Klerkx, Van Mierlo, et al., 2012), however there is scope for innovation systems researchers to develop a representation of AIS that accounts for the significant influence the 'institutional' has on innovation performance.

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Optimising Organic Value Chains: A Deep Dive into the Italian Advisory System

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Abstract:
The Italian action plan for organic agriculture recognised the need for improvements and investments in technical and advisory assistance, as advisors play a pivotal role in ensuring the success of the organic system. This research aims to explore, analyse, and provide evidence on advisory services within the Italian organic supply chain, mainly focusing on the capacity of the advisory system to support the European goal of achieving the 25% target for organic area by 2030. The 'Best Fit' framework was adopted, and semi-structured interviews were conducted with freelance advisors across different Italian regions. Using the software Nvivo12 for qualitative data analysis has yielded preliminary findings exploring concerns raised by advisors. Specifically, issues such as the low number of advisors, a lack of robust farm support structures, and a lack of cooperation between advisors and researchers have emerged as significant challenges. In this context, neither consultants nor farmers perceive tangible assistance. The analysis underscores the existing weaknesses in organic agriculture, emphasising the critical role of enhancing the advisory assistance sector to address and overcome these challenges. Policymakers should consider targeted interventions to strengthen advisory structures.
Keywords: organic agriculture, interviews, agricultural advisory services, AKIS, Italian agriculture

Purpose

Organic agriculture (OA) is recognised as a fundamental approach to addressing environmental concerns, including climate change, biodiversity loss, and ecological issues (Gamboni & Moscatelli, 2015). It contributes to establishing a more sustainable agri-food sector (Willer et al., 2023; Fibl, 2023) while demonstrating economic viability (Lampkin, 2023). Worldwide data show that OA land reached 76.4 million hectares in 2021, about 1.6% of the total agricultural land. In 2022, the EU's organic agriculture reached 9.6% of the total Utilised Agricultural Area (UAA), more than one-third of the 2030 target set by the Farm to Fork Strategy (25%). In this scenario, Italian organic agriculture is outperforming. Currently, the organic UAA is about 18.7%, potentially achieving the EU target three years ahead of schedule (Sinab, 2023). However, the Organic National Action Plan (NAP) (Masaf, 2023) identifies several weak points. These include 1) the absence of a field agricultural advisory system (AAS) in the territory, 2) the existence of fragmented and poorly organised production chains, and 3) an inefficient information system. This highlights the need to enrich the knowledge system further while supporting OA to attain greater sustainability and productivity (EU, 2023). A well-connected network of professionals is essential to achieve the European goals, respect the three dimensions of sustainability, and overcome the weaknesses reported in the NAP. Indeed, it could support farms and ensure a balanced growth of the organic system across the country. With these aims, EU initiatives include strengthening AAS on specific

topics (FAO, 2022) as part of Agricultural Knowledge and Innovation Systems (AKIS) and disseminating best practices and innovations in organics.
In the context of a larger research project, this article focuses on a specific research question: *Can the Italian advisory system adequately contribute to achieving the European target of a 25% organic agricultural area?* To provide an answer, we started from the theoretical framework proposed by Birner et al. (2009) and used by several researchers[5], which suggests an impact chain approach to analyse the performance and impact of AAS. This approach considers contextual factors, the characteristics of the advisory system, the performance levels, changes at the farm level, and the final impact of the services provided. The framework has been adapted to analyse organic AAS to meet the needs of different stakeholders.

Design/Methodology/Approach

The data was collected through semi-structured interviews between October 2023 and January 2024. The selection of stakeholders was informed by a thorough inventory analysis previously conducted within the i2connect project (Cristiano et al., 2020) and the list from the National Rural Network (Cristiano et al., 2023). Although the research project involves different categories of stakeholders[6], the findings presented here are the results of nine interviews with freelance advisors, who represent one of the main categories of counselling providers in the Italian system (Cristiano et al., 2020).
Coherently with the theoretical framework chosen, the interviews predominantly addressed contextual elements (political system and objectives of AAS), along with the characteristics of AAS (governance structures, capacity, management, and advisory methods) (Birner et al., 2009; Swanson & Rajalahti, 2010; Ingram et al., 2022). After the transcription of the interviews, the data analysis was developed using the thematic analysis technique with the Nvivo12 software. This technique is typically applied to identify common themes and patterns of meaning that come up repeatedly (Caulfield, 2023). The analysis involved two coding phases:
Thematic areas were identified within the interviews, with nodes assigned to each theme examined (sections of the 'Best fit' framework).
Further relevant themes were identified and aligned with information from the literature. A new node was created for each theme (e.g., advisory services structure, good cooperation, skills and knowledge needs).
Finally, the Matrix Coding Query was employed to represent the results (further explanations are provided in the findings section).

Findings

The following paragraphs summarise the findings of the interviews with the freelance advisors. The findings are organised into four sections, each addressing a different issue.
A broad spectrum of advisory objectives
A question submitted to the interviewees was about their objective as agricultural advisors. The responses allowed for the identification of the primary goals of freelancers,

[5] Hermans et al., 2015; Ingram et al., 2022; Namyenya et al., 2021; Nettle et al., 2021; Nikam et al., 2022; Österle, et al., 2016; Prager et al., 2017; Rebuffel, 2015; Landini et al., 2022; Sutherland & Labarthe, 2022; Cristiano et al., 2023.
[6] The categories involved are Universities and Research Centres, Agricultural Production Organisations, food processing companies, freelance advisors, cross-sector organisations, Certification Bodies, and suppliers of technical resources.

providing insight into the relationship they establish with the farmers. The key objectives include (1) meeting the productive needs of the client and ensuring their peace of mind by avoiding non-compliant activities that could compromise the possibility of obtaining certification and (2) improving the producer's operations in terms of formal aspects and profitability. Additionally, the production capacity should be tailored to the target market; (3) making the producer self-sufficient; (4) teaching how to increase organic matter within the soil and restore its fertility without the use of chemicals; (5) providing documented and reliable information to farmers to prevent and resolve issues; (6) guiding the farmer through the transition to organic methods, providing them with tools to find solutions in line with regulations and facilitating the sale of products.

Improving advisory system framework and fostering stakeholder connections

To verify connections between different thematic areas, we employed *Matrix Coding*, a type of NVivo query that allows us to check the interactions between items in the coded data. The relationship's intensity is calculated based on the number of interviewees (highlighted by the blue lines) who jointly addressed every single couple of items.

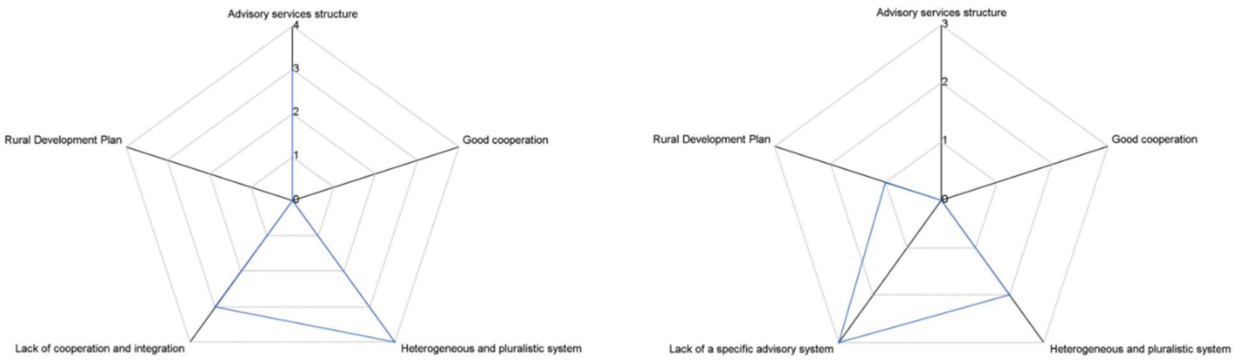
The most frequently discussed topics by freelance advisors can be traced back to the structure of AAS. In particular, six of nine freelance advisors express concern about the lack of a specific advisory system. Therefore, we verified the relationship between 'the lack of a specific advisory system' (midpoint of the graph) and five other nodes that fall under the 'governance structure' category. Chart 1A shows how the lack of a specific organic AAS is related to the system's heterogeneity and the lack of cooperation between advisors. In particular, the blue lines indicate that three advisors (coding references count) discussed the absence of a specific advisory system and the lack of cooperation between stakeholders during the interview. In comparison, four advisors discussed both the absence of a specific AAS and the heterogeneity of the AAS at the national level. On the contrary, the absence of a specific advisory system does not appear to be related to the presence of good cooperation between stakeholders.

The provision of consultancy in organic agriculture is considered pluralistic but fragmented and heterogeneous. Indeed, many professionals (private, public, associations, trade unions, etc.) are offering advisory services in Italy, but their services are fragmented due to a lack of specialisation or coordination. Moreover, they are heterogeneous in terms of the real needs of each regional context. However, the pluralism can be traced back to the duality of the leading professional roles: the technical field advisor and the advisor devoted to documentation compliance. The former is considered too low in number by the interviewees, while the latter is becoming the primary form of assistance in some regions. Furthermore, respondents point out that differences in advice provision are also related to the territorial vocation and the presence/absence of a market for specific types of farming. Despite this, one interviewee (CP_001) observes, "The advisory system is not homogeneous and proportionate to organic production in every region."

Chart 1. Matrix coding Query of the relationship between 'Governance structures' nodes (Source: authors)

A. 'Lack of a specific advisory system' node as central point

B. 'Lack of cooperation and integration' node as central point



Eight of nine freelance advisors express concern about a lack of collaboration among various advisory providers in Italy. In particular, Chart 1B highlights that some advisors discussed the 'Lack of cooperation and integration' between stakeholders and the lack of a specific advisory system (3 advisors) or the heterogeneity of the AAS at the national level (2 advisors).

The respondents emphasised the importance of focusing on the number and quality of relationships between agricultural stakeholders. Indeed, advisors suggest that the effective development of relationships requires engagement with a substantial number of stakeholders and the involvement of well-prepared individuals possessing diverse competencies. This is why advisors seek to reinforce their relationships with other advisors and researchers to develop new competencies and facilitate the exchange of ideas and experiences. In the context of research, advisors recognise their crucial role as a "bridge" between research and producers. Some prefer to establish direct contacts with researchers within research centres, believing that targeted responses to their professional needs could be more beneficial. Other advisors express concern about "clear signs of bias against organic agriculture" in scientific research entities, which hinders the development of new professional collaborations. It is also noted (CP_006) that most university research does not address business issues. Interviewees highlight that such relationships would require high and unsustainable investments. However, some respondents reported an enhancement of their relationships with the research sector, but not for some specific productions such as rice and berries.

Political support, addressing cost concerns, advisory service shortcomings, and the need for training and knowledge

According to the respondents, although politics demonstrates a particular interest in supporting the organic sector overall, concrete support for AAS appears restricted and not specifically targeted at individual professionals. The feeling of being side-lined is also fuelled by the constant increase in bureaucracy, making participation in funded initiatives, such as the PEI-Agri ones, complex due to the significant time request.

Other identified weaknesses include limited availability of advisors at the national level, high demand for knowledge and skills, and associated costs. In particular, the insufficiency of organic-focused technicians seems to be closely linked to knowledge

and skills needs and costs for advisors and organic farmers. During interviews, advisors referred to their expenses primarily related to farm visits and to the costs borne by farmers to receive the counselling. The latter may depend on several factors, including the time dedicated to each farm, the size, the productivity, the logistics, the number of visits, the type (continuous or sporadic), and the complexity of the intervention. Two situations emerged from the interviews conducted. On the one hand, farmers have been reported to express dissatisfaction due to the lack of AAS, especially for field assistance. On the other hand, low turnover earned by advisors, particularly for small farms, pushes them to reach several clients to operate under suitable conditions, sometimes lowering the quality of their activities. In addition, professionals tend to restrict their activities to a single region or province to reduce expenses.
The interviews' need for ongoing training and professional development is a consistent theme. Registration in Professional Orders[7] requires mandatory continuous training and the acquisition of training credits. However, there is a lack of specific organic training, which is not officially required by the organic system. Each advisor must search for learning opportunities independently. Identifying a training path that fully meets interviewees' needs is challenging. There is a notable willingness to learn and share knowledge in the organic sector (CP_003), particularly about topics that have not been extensively addressed, including water conservation, soil fertility and preparation, reduced consumption of non-renewable raw materials, plant pathology, and phytotoxicity.

Advisory methods and the role of group consultations

The heterogeneous agricultural system, comprising diverse business sizes, production types, and farmer generational disparities, necessitates varied consulting approaches (Prager et al., 2017). Freelance advisors mainly rely on face-to-face advice, complemented by telephone and online interactions. The chosen method and interaction frequency with clients depend on the specific nature of advice and the client's requests. For instance, some freelancers engage directly with local farmers, while others coordinate indirectly, managing distant agricultural businesses through collaboration with local technical advisors or organic farming suppliers.
Five of nine freelance advisors listed 'group consultancy' among the techniques used, albeit less frequently, due to organisational costs and time constraints. The subject matter of group consultancy varies. It is often organised to bring together producers who share similar productions. Alternatively, meetings arise from the need to disseminate information to various stakeholders about introducing technological innovations. According to one interviewee (CP_001), group consultations can lead to solid learning dynamics; however, some farmers do not enjoy discussing their failures.

4. Practical Implications

The research findings reveal weaknesses in the organic sector and advisory structure, which align with concerns highlighted in the NAP (Masaf, 2023), especially for the lack of field AAS and inefficient information and formation system.

[7] The Italian professional Orders related to agricultural activities are four and include agronomists, veterinarians, agrotechnicians, and other agricultural expert. The Orders are responsible for setting up the codes of conduct and lifelong learning training activities (Cristiano et al., 2020).

The consultants identified a series of issues about the limited and heterogeneous number of freelance advisors; the small number of professionals working in the field was a cause for concern among the interviewees. One possible explanation for this shortage is a reduction in generational turnover and an overall decline in the interest of younger individuals in agriculture. Furthermore, the absence of specific training in organic farming at the university level and for professional education results in a lack of specialisation among advisors and a reduction in client trust. At the same time, the high consultancy expenses and the challenging participation in EU or national-funded initiatives trickle down to farmers, who, given the average dimension of Italian farms, cannot always cover the costs of services. In this context, neither consultants nor farmers perceive tangible assistance.
The issues that emerged from the research appear to be extended and, in most cases, shared among the consultants. In light of this, the current consulting system is deemed unsuitable to adequately contribute to achieving the European target of a 25% organic agricultural area. Nevertheless, advisors are willing to enhance and invest in improving the national advisory system.
The agricultural policy is already moving towards valorising the advisory system at the European level. In particular, the CAP has reintroduced tools to support advisor training, invest in providing advice for agri-food companies, and exchange knowledge and innovation between different stakeholders. Nevertheless, the decision to implement these measures remains at the discretion of each professional and each region, which frequently fails to accord sufficient importance to these topics.
Identifying weaknesses faced by farm advisors could be a starting point for addressing disparities within the farming system and establishing a better and more effective support system for farmers. The final findings could provide actionable insights to enhance the resilience and effectiveness of Italian advisors through targeted interventions and collaborative initiatives between advisors and researchers to cultivate a more cohesive and efficient organic system through applied research.

Theoretical Implications

The theoretical framework of Birner et al. (2009) suggests an approach to explore and assess the AAS and its impact on farmers, income and productivity, and broader societal goals. In this research, we selected five topics from the Birner framework (four characteristic topics and one contextual topic), which enabled us to evaluate the current consulting system from the perspective of freelancers, who, as previously stated, account for a significant proportion of consultants in Italy. The Birner framework proved a relevant and valuable tool, as it facilitated the examination of agricultural consulting for the organic supply chain, a topic not yet extensively discussed. However, the complexity of Italian agriculture necessitates the participation of a diverse array of actors (e.g., farmers who manage small, medium, and large farms and other companies involved in post-production) to ensure the framework's efficacy and results comprehensiveness.
For the data collection, we opted for face-to-face interviews, aligning our methodology with other researchers for the assessments of counselling systems (e.g., Österle, et al., 2016; Prager et al., 2017). Although face-to-face interviews proved to be an effective method of gathering information, the choice of a qualitative approach resulted in a

limited number of interviews, which could lead to criticism of the representativeness of the results. However, this methodological choice allowed for a more in-depth understanding of the responses, immediate feedback from the interviewees, and greater flexibility and adaptability of the questions. Moving forward, we could enhance the comprehensiveness of our research by including perspectives from farmers and other stakeholders. Their insight could offer a broader understanding of the subject matter and enrich the depth of our analysis.

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Trust & Collaboration in Australia's Agricultural Innovation System – A Case Study into Novel Feed Inputs to Mitigate Climate Change

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Abstract:
By comparative international standards Australia's agricultural innovation output is sub optimal and faces persistent obstacles in the Agricultural Innovation System (AIS), particularly related to socio-cultural factors like trust and collaboration. This paper presents initial findings from a real-time case study focusing on the innovation process associated with the development and commercialisation of novel animal feed inputs to contribute to greenhouse gas emissions reduction in the livestock sector. Qualitative analysis of semi-structured interviews with 31 innovation system actors has found critical processes constraining and enabling the innovation process. The key themes identified were: intricate and divergent relationships between actors; goal alignment or lack thereof between actors; patterns of communication between actors; intellectual property ownership and development; government involvement in policy setting and funding allocation; and the work of intermediaries. We propose a series of practical and theoretical implications to compliment the AIS and assist actors communicate and collaborate more effectively to improve innovation outcomes.

Keywords: Innovation Systems, Trust, Collaboration, Change, Methane.

Purpose

In the Australian agricultural sector, the challenges to innovating at the firm, sectoral and national scale have been well documented, leading to a reference that there is 'an innovation problem' (Paschen et al, 2021; Lamb et al, 2021; EY, 2019; CSIRO, 2020) whereby innovation, or how value is created from new ideas (Kastelle & Steen, 2011), is not being sustained at the scale or pace expected given the investment in agricultural R&D (Lamb et al, 2021). Some of the reasons include an unwillingness or an inability to understand the other stakeholders needs (highlighted in the agriculture focused innovation studies of Lamers et al, 2017; Paschen et al, 2021)) and context (Pettigrew, 2002), a lack of a risk culture at an Australian national level (CSIRO, 2020), non-supportive Governments in policy and finance (Lamb et al, 2021), and the lack of incentives for agricultural institutions to participate in a potentially long and time-consuming innovation cycle (Lamb et al., 2021). However, the way the social dimensions of innovation performance contribute to these issues has been less considered. This paper reports on early findings from research undertaken to examine: "How do the institutional frameworks, innovation activities, and social networks of individuals and organizations enable or constrain agricultural innovation in Australia?"

Design/Methodology/Approach

Innovation performance is conceptualised differently in academic disciplines, including organizational studies, business and technology, and Innovation studies (Brandenburger & Nalebuff, 1996; Pettigrew, 2002). Drawing from concepts from AISs including actor types (stakeholders) (Lamers et al., 2017), system functions (Hekkert et al., 2007; Wierzorek & Hekkert, 2012) and innovation ecosystems (Pigford et al., 2018) the research examines trust and collaboration in the doing of innovation. This framework is chosen to enhance understanding of the socio-cultural factors impacting the AIS and to facilitate systemic improvements in the Australian agricultural innovation landscape.

A case study methodology (Mitchell, 1983) is applied to examine efforts in the development of a novel feed input, Asparagopsis[8], to reduce livestock sector methane emissions. The research involves semi-structured interviews with key innovation ecosystem actors about their activities and experiences over time. The interviewees are representative of all the Actor Types in this innovation ecosystem with a specific focus on the key decision makers and influencers. To date 31 interviews (between November 2022 and April 2024), have been completed involving key actors (Policy Makers (2); Intellectual Property (IP) Owner (1); Asparagopsis Producers (APs) (4); Investors in the IP Owner (1); Scientists (2); Investors in the APs (1); Farming industry organisations (2); Customers (1); Competitors (4) and actors spanning these categories (9); as well as system intermediaries (4) including 2 nutritionists (from potential private sector distributors); and 2 innovation brokers (government supported)).

Qualitative analysis of data in this study applies an adapted grounded theory method (Glaser & Strauss, 1967). The approach involves coding of text and the application of the conceptual framework to explore trust and collaboration dynamics among various actors. The study examines factors that enable or constrain collaboration, aiming to identify influences on delays or acceleration of plans, and the temporal dynamics of the innovation process.

Findings

a. Intricate and divergent relationships between actors

The study identified a complex innovation ecosystem of actors where nine of the 31 interviewees play multiple roles simultaneously (See table 1). This can result in conflicts of interest at an interpersonal, professional, and legal level which overtly and covertly create barriers to collaboration. Examples of these the intricate and divergent relationships are:

[8] Asparagopsis taxiformis ([Delile] Trevisan de Saint-Léon, 1845) and A. armata (Harvey, 1855)

Table 1 - Multiple Roles of Actors in the Innovation Ecosystem

Of the 31 Interviewees 22 operated in a single Actor Type and the 9 outlined below fitted into multiple Actor Types

	Actor Types											
	Policy / Government	Scientist / Researcher	Investors in IP Owner	IP Owner	Investors Asparagopsis Producers	Asparagopsis Producers	Intermediaries	Asparagopsis Producers Customers (Farmers)	Farmer Representatives / Assocations	Customers of Farmers	Investors / Supporters of Competitors	Asparagopsis Competitors
Actor A			X	Director				X			X	
Actor B					X			X		X		
Actor C			X	Director					X		X	
Actor D		X				X						
Actor E		X				X						
Actor F							X	X				
Actor G								X	X			
Actor H			X	Director				X			X	
Actor I			X	Director				X		X	X	

Note : Specific Actors are not identified to protect anonymity

A key executive in the cattle sector, representing potential customers for the product, is also concurrently serving as a board member of a foundation investor in the IP Owner of Asparagopsis (MLA, 2023). This investor is engaged in collaborative field trials with a major competitor, DSM, and their product 3NOP (Interviews 3,12&21; DSM, 2022). Simultaneously, they sit on the board of the IP Owner (Ellis, 2020; Future Feed, 2023).

Another director and major investor in the IP Owner (Future Feed, 2023) is also a shareholder in a competitor (Rumin8) and is a potential large customer for the product due to their significant beef production business. They actively compete with the APs for essential technical human resources via their extensive aquaculture businesses (Interviews 11&28).

Adding further complexity, an investor in one of the APs, is also a beef producer and major customer, and owns a restaurant chain selling premium burgers produced from cattle fed Asparagopsis. This introduces challenges regarding the level of methane reduction claims that can be made at the retail level (Interview 10), particularly as the IP Owner considers itself the custodian of these verifiable claims (Interviews 5&11).

b. Poor goal alignment between actors hinders collaboration

Instances of misalignment surfaced among investors, the IP Owner, and APs regarding vision, investment strategy (local or global markets), non-financial milestones and objectives, and financial considerations like capital raising and return on investment timelines (Interview 11). These governance shortcomings were directly tied to poor internal organizational cultures, evident in high staff turnover and undisclosed conflicts of interest, leading to missed market opportunities (Interviews 11&19). They also disrupted collaborative efforts, impacting coordination among actors. Evidence included duplicated efforts, such as a lack of information sharing, multiple parties seeking regulatory approval for Asparagopsis use in ruminant animals, studies for methane reduction claim validation, securing environmental approvals, gaining governmental support for additional research, and a lack of collaboration with supply chain partners for infrastructure establishment (Interviews 4,5,11&14). Unproductive competitive behavior, as observed in different APs undermining each other, added to the challenges (Interview 14).

These disruptions adversely affected timelines and costs related to regulatory approvals, trials, product efficacy claims, market development, and commercialization (Interviews 4,5,6&14). The key processes associated with poor goal alignment were found to be:

The different risk profiles of investors and industry actors causing frustration and a perception of inadequate collaboration or support (Interview 5).
Differing worldviews as found with foundation investors whose visions and understanding of the world differ from fellow investors (Interview 17).
The identification and prioritisation of research needs (Interview 20).
The time frame for collaboration and partnership (Interview 11).
Many parties shy away from attempting this alignment due to its inherent difficulty, with some relying on luck or expecting others to align with their objectives. Others neglect significant areas of disagreement, such as international growth and capital raising (Interview 11). All 31 interviewees in the study identified that goal alignment, devoid of conflicting objectives, fosters collaboration, significantly enhancing innovation outcomes. Strong collaboration was noted by 11 interviewees as enabling the cultivation of trust among actors, further enhancing the probability of superior innovation outcomes.
"I think we trust each other, and that enables us to get really quickly to the point of the conversation. And I would feel comfortable talking really openly and raising concerns, and also responding openly. And I'm pretty sure that it's the other way as well. To me, that really facilitates the collaboration". Interview 18
Additionally, new actors entering the ecosystem, be it an investor, AP, competitor, regulator, or customer, can disrupt the equilibrium of goal alignment, collaboration, and subsequent innovation outcomes. (Interviews 11&28).

c. Patterns of communication between actors

The diversity of actors created communication challenges, mainly associated with the terminology and expectations of science, business and policy. The diversity in terminology often results in miscommunication, which can inhibit innovation adoption at the farm gate (Interview 19).
In a communication from an academic to be converted into a policy submission, significant time was spent in writing a plain language versions of research activities:
So ...we had a full team rewriting applications for several weeks, rewriting plain English abstracts for [government/industry/farmers] to tease out what they [The researchers] were doing. So, we could put that on our website, hand-on-heart say, 'This is what's happening and this is what's going to be achieved.' It was a huge communications exercise." Interview 9
This scale of effort was replicated when communicating commercial needs to researchers in Universities (Interview 22) and efforts were noted to be hampered by the different worldviews of actors (Interview 28). Communication between commercial entities and scientists with farmers was also noted as an issue, particularly related to carbon reduction, where confusion and complexity hinder individual farmers' understanding of the implications and necessary actions (Interview 7,27).
Across the ecosystem, poor communication resulted in frequent misunderstandings and in one situation, when communication efforts were not prioritised, project abandonment resulted.
"there have been projects that have been derailed entirely because of that lack of communication." (Interview 19)

d. Intellectual property (IP) ownership and development

The Actors described a lack of clarity concerning IP ownership and the absence of well-defined entities responsible for overseeing innovation development. The way such issues effect collaboration were found to be:
Competition over IP ownership or undefined IP ownership generated conflicts with collaboration partners (Interview 3).
Control sought by one party (Interview 21).
Conflict over how research outputs can be utilized for outcomes and practice change (Interview 12).
Reduction in the rate of commercialization and meaningful industry impact (Interview 4).
Misalignment between what commercial partners want publicized and what University researchers prefer to make public (Interviews 18,20).

e. *Government's role in supporting innovation*

The Australian government's support for innovation is complicated by its three-tiered structure, leading to challenges such as duplicated regulation and legislative inconsistencies (Interview 4). This complexity hampers the ability of newer or smaller players to navigate and engage in innovation successfully. Slow policy and permit processes, further hinder timely development and market entry of innovative initiatives (Interview 14).
Governments grapple with fostering innovation, considering global impacts, local concerns, and economic effects. The recommended approach involves financial support, collaboration facilitation, and consistent policy development (Interviews 2,4,9&13). A "Carrot and Stick" approach, emphasizing government incentives, is suggested for driving innovation adoption (Interview 2). Funding, especially for discovery research, is crucial, with seven interviews stressing the importance of government guidance and incentives (Interview 2) but cautioning against favoring specific industries (Interview 10). Three interviewees highlight the need for government investment, yet issues arise with slow approvals and missed opportunities. (Interviews 2,4&29).

f. *The work of intermediaries*

All Intermediaries in this ecosystem (from both private sector and government supported) were engaged in:
Connecting researchers to most appropriate industry partners and farmers to maximise research success.
Ongoing facilitation of these actors.
Acting as translators between scientists and farmers (interviews 8,19,22,24&25).
(Those from the private sector also provided technical expertise ie Nutrition advice (interviews 22,24&25)).
When acting as translators, intermediaries comprehend complex concepts and facilitate communication between technologically proficient individuals and those less versed in the subject matter, and this can be vital in overcoming human resistance to change and fostering innovation progress (Interviews 11&19). The importance of considering not only lexicon but also modes of communication and the surge in online meeting platforms during the Covid era was cited, specifically the challenges faced by farmers, who may

not be technologically proficient or have adequate internet coverage (Interview 19). In a strategic intervention, an interviewee highlights their team's pivotal role as intermediaries in supplier-client communication. They successfully redirected communication to resolve conflicts stemming from divergent preferences between scientists and producers, ultimately bridging communication gaps and tailoring scientific discourse for effective dialogue with farmers (Interview 25).
"because not everybody speaks science. I am doing a project with industry where they are working on a very technical scientific problem and no one from the actual company has a science background." (Interview 19)

Practical Implications

1. To avoid favouring specific entities and reduce duplication Government could:
    - Focus on facilitating comprehensive industry assistance to benefit all actors.
    - Emphasize the establishment of institutions and infrastructure conducive to collective success.
    - Support innovation in areas with established infrastructure, such as fostering collaboration in opportunities like seaweed cultivation near the coast.
    - Establish an innovation platform to fund and support jointly crafted objectives.
    - Fund education to highlight the importance of aligned objectives in collaboration.
2. Technical or academic papers could include a plain language summary for comprehensible discussion, with the aim to facilitate communication with all ecosystem actors and expedite scale adoption by providing a basis for discussion and modifications.
3. To encourage actors in the Australian AIS to collaborate more and compete less (where legally permissible) to enhance innovation outcomes (Coopetition - Brandenburger & Nalebuff, 1996), they could consider:
    - Collaborating where actors have common interests which would lead to reduced costs.
    - After market acceptance, compete for customers based on quality and price.

Theoretical Implications

1. Build on the interactive learning processes in innovation systems (Lamers et al., 2017) which are best supported by process facilitation (Systemic Instrument) including intermediary roles by:
    - Developing on Klerkx & Leeuwis, 2008&2009, who find that intermediaries improve communication in ISs and Leeuwis & Aarts, 2011, who highlight the significance of these interactions, to encompass methodologies for routine communications and regular interactions amongst actors (relying solely on intermediaries is not a realistic approach for effective daily interactions among stakeholders).
    - Adding to the ISs the role that private sector actors play.
2. Build on the theory of National IS/AISs to include the impact of competition between actors in a specific innovation ecosystem (currently it focuses on competition between nations).

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AGROECOLOGY - TRANSITION

Actors’ roles in landscape labs on the agroecological transformation of agricultural landscapes

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Abstract:
Agroecological transformation requires new modes of collaboration between science and practice. This is linked to the claim in transdisciplinary research (TDR) that participants take on diverse and active roles in the co-production of knowledge process. We shed light on how scientists, practitioners, and coordinators perceive their roles in the FInAL project on agroecological transformation in three landscape labs. In 2022, we conducted a survey that was analysed using descriptive statistics (n = 37). Almost all practitioners see themselves as practice experts, supplier of data, implementation experts and more than the half as critical and self-reflective project participants, and project promotor. A few perceive themselves as innovators, co-producer of knowledge, and specialists. Regarding the role perception of scientists, more than half see themselves as specialists, data generator, co-producer of knowledge, and self-reflective participant but only a few as coordinator, promotor, coordinator, practice expert, or/and intermediaries. None stated to be an innovator. Our results show that many roles in the project are assigned as one would expect in classical collaborations between science and practice. However, in TDR, it is envisaged that roles should go beyond this "classical role model" and promote shared or bridging roles (e.g., co-producer of knowledge).

Keywords: role perception, survey, workshops, co-design, living labs, real-world labs

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Purpose

Agroecological transformation that deals with complex sustainability problems requires a new mode of collaboration between science and practice (Mupepele et al., 2021; Zscheischler et al., 2017). This new mode of knowledge integration (Mode 2 science) that is practised in transdisciplinary research (TDR) is based on science-practice collaboration on equal footing along the whole research process for co-producing social robust orientations and building up social capacities (Lang et al., 2012; Zscheischler et al., 2017). Our landscape lab approach in the FInAL project, which aims at a long-term transformation of agricultural landscapes for promoting biodiversity uses the principles of TDR and transformative research. This is linked to the claim that participants take on diverse and active roles in the co-production of knowledge process. This applies in particular to those participants who were previously often only seen as end users or feedback providers, such as farmers (Busse et al., 2023; Lacombe et al., 2018).

Roles in TDR and transformative processes are socially constructed on the basis of personal interests, abilities, resources and mutual expectations (Hilger et al., 2021; Kernecker et al., 2021; Wittmayer et al., 2017). They may also change over time during the transformation process (Wittmayer et al., 2017). In particular, the change from passive to active roles is often strived for and is considered as evidence of the successful activation of the participants' engagement and their capacity building. Being aware of the complex role constellation and dynamics can help to better reflect on one's own expectations and those of others to better collaborate, thus jointly achieving the transformation goals. In this contribution, we shed light on how scientists, practitioners, and coordinators perceive their roles in the FInAL project on agroecological transformation in three landscape labs.

Design/Methodology/Approach

In the FInAL project (2018-2025), we define landscape labs as geographical and social spaces for experimenting agroecological transformation by co-designing biodiversity-promoting measures (in-field and off-field measures), joint experimentation in real-world settings, participatory reflection of the measures, monitoring at landscape level, and the process that leads to transformational co-learning. The TDR in FInAL relies on an active collaboration between different practitioners (farmers, other land users, NGOs), researchers of different scientific disciplines, and different coordinators in the co-design process. Among the scientists are entomologists for specific insect groups, agro- and landscape ecologists, agronomists, economists, and researchers with expertise in transdisciplinary research, landscape sociology and ethnography. Coordinating actors are the three landscape coordinators of the labs as well as the scientific project leader and the project coordinator – all of them are institutional employees. The coordinators orchestrate and facilitate inter- and transdisciplinary activities but there leading role does not include making decisions alone. In the design of the landscape labs, we seek on collaboration on equal footing and on co-decision-making. Our landscape labs are located in three German regions which represent different German agricultural landscapes. Two of these landscape labs are located in Northern Germany, in the Federal states of Brandenburg and Lower Saxony. The third landscape lab has been established in Bavaria, near the Austrian border.

As framework for the analysis of actors' roles we used the typology by Hilger et al. (2021), which compiles a list of roles held by practitioners and scientists in transdisciplinary research (TDR). Hilger et al. (2021) emphasise that the categories of roles should be inclusive and comprehensive instead of focusing on specific actor groups (e.g. scientists). From this list of roles, we selected ten that are suitable for our case study and added the roles of the project promotor and innovator (see table 1). This addition was necessary because innovators and promotors play important roles in transformative research projects with an innovation approach (Hermans et al., 2013). In the questionnaire, we provided the definition or description for each role. In spring 2022, we conducted the survey with the practitioners of the FInAL landscape labs (in this case farmers) who participated in the co-design process. Here, the questionnaire was handed out as printed version in a co-design workshop. Fifteen practitioners (5 from Lower Saxony, 8 from Bavaria, 2 from Brandenburg) filled it out and returned it immediately. In the case of the FInAL project team (employed for the project), the questionnaire was provided as online version (https://www.soscisurvey.de) in autumn 2022. Twenty-three of the project employees (scientists and the three coordinators of the landscape labs) responded to the online survey. However, only 21 of them answered the questions about their roles. Thus, in total, 36 survey respondents stated about their roles in the project. The data was analysed using descriptive statistics. The results were discussed with lab practitioners in following-up co-design workshops (autumn / winter 2023) and with scientist at the joint project meeting in November 2023.

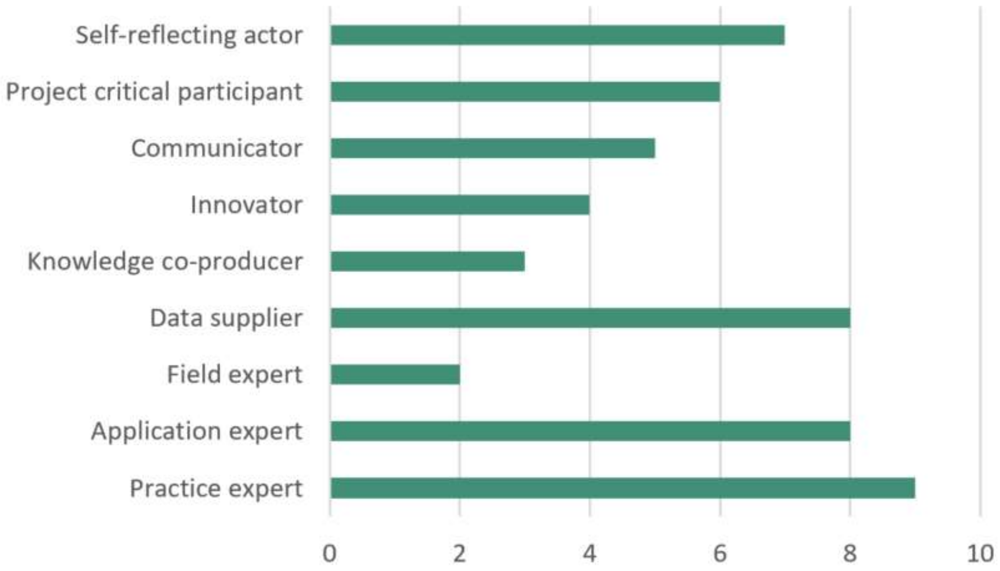
Table 1. List of roles with the description as displayed in the surveys.

Roles	**Description**
Knowledge co-producer	Discusses data, solutions, results, strategies in a team, brings ideas in
Field expert	Contributes with expertise in a specific field
Data supplier	Provides information to collectors, responds surveys,
Results disseminator	Publishes and communicates project results
Practice expert	Contributes with practical expertise, local knowledge
Application expert	Tests solutions, implementing measures
Troublemaker	Critically reflects goals, structure, and procedure of the project and discusses it with others
Self-reflexive participant	Reflects (own) goals, roles, and expectations on the project
Promotor	Promotes idea of transformation, engages others
Innovator	Comes up with own ideas and testing them
Producer of data	Collects data, conducts interviews, etc.
Intermediates	Intermediates between different perspectives and viewpoints

Findings

Figure 1 shows an overview on the perceived roles by the involved practitioners, who are farmers in this case. Almost all practitioners see themselves as “practice experts”, “suppliers of data”, and “implementation experts”. More than half perceive themselves as “project critical participants” and “self-reflective actor”. Nearly the same number of participants perceive themselves as “project promotor”. The roles of “innovators”, “co-producer of knowledge”, and “specialists in a specific field“ were indicated by less than half of the practitioners.

Figure 1: Perceived roles of practitioners (n = 15)



Looking at the role perception of the 21 scientists and coordinators, most of them see themselves as "co-producer of knowledge" (15), followed by the role being a "specialists in a specific field" (13). Additionally, about half of the respondents perceive themselves also as "producer of data" (11) and "self-reflective participant" (11). Less than half indicated the role of "analyst of data" (9), "disseminator of data" (8), and "project critical participant" (8). Few stated having the role as "coordinator", "promotor", "coordinator", "practice expert", or/and "intermediate". None of the respondents stated to be an "innovator" within the project context. When asked if the role of the respondents had changed over time, very few respondents (practitioners, scientists, and coordinators) indicated such a change during the four years of the project. We also asked how satisfied the respondents were with their current roles. Most practitioners (12/15) stated that they were (very) satisfied with their roles, while only about half of the scientists (12/21) reported this. The question about the desired roles was answered very rarely by both the practitioners and the scientists, so that a systematic evaluation of this question was not possible.

Practical Implications

Our study found that more farmers than scientists see themselves as innovators. That some farmers feel to be innovators emphasizes that the FInAL project provides indeed an active engagement of farmers and an inclusion of their own ideas. This involvement goes beyond gathering their farm data and feedback regarding tools and measures. This interpretation was confirmed by the farmers in the joint discussion. They welcome their active role and feel that their interests and ideas are taken seriously in the project. However, discussions on such rather abstract topics seldom find a place in the tight project schedule, given the many necessary and practical project activities under limited resource conditions.

As reason why scientists do not see themselves as innovators was mentioned in discussions that they perceive their activities as common scientific practice but not as innovative. A result was also that more scientists report being co-producers of knowledge than practitioners. This could be due to the fact that "co-production of knowledge” is a science-driven concept that seems to be too theoretical for practitioners. Indeed, the concept of roles is somewhat abstract for practitioners although we provided for each role a definition and anchor example in the questionnaire. They seldom think in these scientific terms or typologies. However, the discussions showed that the results of the survey are in line with their perception of how they contribute to the co-production of knowledge. In general, it seems that "learned" passive roles from previous collaborations between science and practice and through the respective professional training, are also maintained in pro-active project approaches and only change gradually. Our landscape coordinators, who have multiple roles, support to overcome such hurdles and foster practitioners’ active roles. In conclusion, comparing actors’ expectations with the resources and needs of the others and a joint reflection certainly contributed to harmonising activities, promoting transformational change in the landscapes and collaboration, and changing minds and future roles.

Theoretical Implications

Regarding methodological implications, the question remains open as to whether all survey respondents understood and interpreted the roles descriptions that were given in the survey in the same way. Nonetheless, to reduce this potential bias, we included a brief description of each role in the questionnaire.

Regarding the data collection method, we decided to integrate the questions about role perceptions in a more comprehensive questionnaire. Thus, we could address different topics with one survey without overloading people with separate requests. Additionally, we obtained with the questionnaire a better respondents rate than with face-to-face interviews. However, a standardized survey only allows to get a general overview on role perceptions but not an in-depth perspective as with semi-structured interviews. Our results show that many roles in the project are clearly assigned as one would expect in “classical collaborations between science and practice: Scientists generate and analyse (scientific) data, while practitioners implement biodiversity-friendly measures and provide data of their farms, perceptions and attitudes. However, in TDR, it is envisaged that roles should go beyond this "classical role model" and promote shared roles such as co-producer of knowledge, promoter and innovator. The survey results reported almost no perceived change in roles yet between the start of the project in 2018 and the time of the survey, although this is in theory literature mentioned as important (Nyström et al., 2014; Wittmayer et al., 2017).

Overall, our study contributed to reveal self-perceptions and interpretation of roles in a transdisciplinary project and thus to consider not only practical implications for the project, but also the theoretical discussion on capacity building of participants in transdisciplinary processes.

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Supporting the agroecological transition. The transformation of the intermediation role of technical salesmen in a large French cooperative

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Abstract:
Agricultural cooperative advisors are facing a transformation of their role as intermediaries, between the cooperative and farmers, due to the change in the production model promoted by their organization as part of the ecological transition. This article reports on how this transformation takes place. To do this, we rely on 3 years of investigation carried out within a large agricultural cooperative in the west of France as part of a thesis financed by the company between 2015 and 2021. We selected 3 areas of investigation, conducted participant observation of daily activity, and met 33 advisors and 22 farmers for several in-depth interviews. We show how, by changing its orientation in relation to the agricultural model, this cooperative modifies the role of intermediation assigned to its advisors through a different distribution of tasks and using digital technologies. This role also depends on the place and role advisors want to defend, and on the expectations of farmers regarding them. Finally, we show that the intermediation role of advisors plays out differently depending on the local context in which they operate. We open the discussion on the mechanisms to support the transformation of the work of intermediaries as part of the agroecological transition.

Keywords: intermediation, role, delegation, cooperative, agroecology, transition

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Introduction

In a general dynamic of ecological transition, the question of supporting farmers to move towards more environmentally friendly agricultural models is central. This support can be provided by a variety of organizations such as the third sector (agricultural unions, NGOs, cooperatives, etc.); public bodies (State or Regional services, etc.); private organizations (agricultural trading, firms, consultants, etc.) (Kivimaa et al., 2019 ; Yang et al., 2014).

The agents of these organizations provide advice to farmers and can be considered as intermediaries, whose function is to bridge between actors (Kivimaa et al., 2019). They can circulate information or knowledge between spaces in one direction or another, from the advisory body to the farmers and inversely. These intermediaries can be distinguished according to whether their advice is free or paid by the person who benefits from it, or whether it is ostensibly offered “free of charge”, the induced costs being integrated into the price of a product.

Agricultural cooperatives have the role of both collecting and marketing farmers' production and selling inputs to farmers. The cooperative we are referring to can be considered as large-scale, as it gathers approximately 30.000 farmers and is backed by an agrifood group. In such cooperatives, technical sales staff provide advice about the nature and use of inputs and sell them. Despite these advisors played a notable role in the modernization of agriculture, they are today facing a transformation of their role. Indeed, there is a change in the production model promoted by their organization as part of the ecological transition (Iyabano et al., 2022; Yang et al., 2014). This article aims to report on how this transformation of their role takes place.

Methodology

We investigated in a large agricultural cooperative in the western France between 2015 and 2021. After carrying out an exploratory survey, 3 survey areas where the cooperative is based were chosen, for: the variety of production, the local agricultural history and the heterogeneous relationships between advisors, farmers and the cooperative. A qualitative survey was then carried out, involving interviews with 22 farmers and 33 advisers, as well as observations of the advisers' day-to-day activities, particularly during their meetings with farmers. For the advisors, the interview guide included 4 sections: their socio-professional trajectory, the goals and equipment in their activity, the diversity of the farmers with whom they work and difficulties encountered, their integration into professional networks. For farmers, the interview guide aimed to identify their partnership strategy, the distribution of roles between these different partners, the criteria by which they evaluate them and their relationship to the cooperative.

In the analysis, types of intermediations were distinguished based on 3 criteria. The first concerns the purpose of the exchange between the cooperative and the farmers. This purpose of the exchange can be: market, when it concerns the sale of products or services; technical, when it concerns the transmission of technical knowledge; policy when it aims to manage the activities of the cooperative ; or social, when it concerns the life of the farm or the farmer. The second criterion focuses on the direction of the flow of exchange between the cooperative and the farmers, whether top-down or bottom-up direction. The third criterion is whether the intermediation is direct (direct exchange between 2 people) or mediated by an artefact (tool, plateform...).

Findings

3.1 Structuring the cooperative for agro-ecological solutions

The commitment of the cooperative in agro-ecology gradually took place from 2007, in 4 stages: 1) by receiving strong criticism from its farmer-members on its poor consideration of environmental preservation in the products and services offered; 2) by the search of “fair” greening which enables to respond to these criticisms without renouncing the logic of intensification of production or endangering the political and economic balance of the cooperative, 3) from 2011, by the commitment of the cooperative in changes in the advice and products provided, through the reorganization of the agents’ work and 4) by the structuring of a brand dedicated to agro-ecological products.

The new organization is characterized by two aspects, which correspond to two paths of development of agro-ecology: the use of digital technologies (DT) and the involvement of farmers in the search for solutions. The use of DT must meet several requirements: using an appropriate metrology to define agro-ecological solutions and the conditions in which they work; provide a better perception of crops and make appropriate decisions; structure the traceability of advice and farmers' practices ; collect technical references and improve databases (to improve advice and establish proof of greening farmers' practices). DT enable to develop new services for farmers (sensors, drones, DST or remote data analysis) alongside non-digitized agro-ecological solutions (biocontrol, companion plants, plant cover, etc.).

Furthermore, attentive to the debates on the place of farmers in knowledge production, the leaders of the cooperative intend to break with a purely top-down, diffusionist logic to include farmers in the process of knowledge production. They set up a hybrid knowledge circulation system, with a top-down approach of knowledge from the cooperative to the farmers and a bottom-up approach of knowledge from the farmers to the cooperative (Pinel, 2012).

Therefore, the cooperative redefines the intermediation role of its advisors. Two intertwined types of intermediations appear: market intermediation, where what matters is the flow of products sold and purchased from farmers and related information, and technical intermediation, where what matters is knowledge of things. In their activity, advisors must promote the use of agro-ecological solutions to farmers so that they can be informed, buy the solutions offered and deliver their products within the dedicated framework ; and pass to the cooperative the information and knowledge captured from the farmers. The impact on intermediation depend on the nature of the exchange : the use of DT is central in the daily activity of advisers, can sometimes replace direct exchange, and enable a wide range of heterogenous farmers to engage in agro-ecology without questioning their practices and networks. On the contrary, innovation processes with farmers are still conducted face to face with an advisor.

Advisors need to be trained to perform the intermediary functions expected of them. The cooperative’s managers emphasized the heterogeneity and inadequacy of the knowledge held by advisors and the inadequacy of their advisory posture. Managers thus design a system aiming to *train, equip, encourage, control* and *refocus* technical sales staff to promote agro-ecological solutions.

3.2 Defining the role of cooperative advisors by themselves: professional identities

Advisors develop “committed intermediation” – in the sense of defending the interests of farmers – to ensure a lasting attachment of farmers despite the doubts raised by this change in strategy and equipment within the cooperative. Three elements of this committed intermediation are noted: a particular mobilization of DT, a distancing from the discourse of the cooperative and the affirmation of proximity with farmers.

The defence of farmers' interests takes place on two levels of intermediation: top-down market and technical intermediation and bottom-up market intermediation. As the cooperative develops alternatives to direct exchange between advisors and farmers, advisors reaffirm the importance of face-to-face exchange, central to their activity. They are also reinvesting DT to defend the reciprocal interest of farmers and the cooperative to cooperate, presenting them as guarantees of responsiveness, reliability, and precision or as the impartial arbiter of divergent assessment from the situation of farmers. These tools allow them to assert their professionalism (ex : presenting themselves as experts with increased capabilities).

The work of distancing the cooperative is not only played out in speeches but also in actions. Advisors materialize their commitment to farmers by making arrangements, adapting to their requests beyond the formal operating rules established by the cooperative (in the products to be prescribed, the advice to be given). They use the degrees of freedom they are given to develop offers that they feel are more in line with farmers’ expectations and more consistent with the professionalism they wish to embody. In this sense the solutions proposed are not necessarily agro-ecological. Advisors are no longer in a pure role of intermediation between the cooperative and the farmers since they do not completely follow the prescriptions of their managers: they speak on their own behalf or possibly on behalf of their professional group, where they stabilize their conception of things. The cooperative must grant this autonomy relative to advisors, as they guarantee its relationship with members.

Finally, to affirm their proximity to farmers, advisors strive to emphasise their belonging and their attachment to the agricultural world by sharing standards and values with Farmers. For advisors, farmers are looking for signs of their attachment and dedication to the agricultural world, as well as technical skills. These signs involve highlighting their affiliation with a farmer or the staging of a common destiny. They also involve common occupation of the same living space, as they share leisure activities with certain farmers (hunting, football, etc.). Many of them also cite time they have supported a farmer through personal hardship (divorce, drug dependency…).

They thus develop a political intermediation and a social intermediation, distinct from the market and technical intermediation designed for them by the cooperative.

3.3 Farmers' perspective

To understand how this repositioning of the role of advisors is perceived by farmers, we met cereal growers and breeders in 3 territories distinguished by their history, production, and relationship to the cooperative. They differ on the intermediation roles they assign to advisors and on the degree of power to be entrusted to them (degree of delegation).

Cereal growers value top-down market and technical intermediation, operated through the advisors or a DT artifact. They are interested in all tools developed by the cooperative, which they consider well suited to their expectations of anticipation, implementation, and security of practices. However, beyond these general elements, the intermediation role they attribute to advisors can correspond to that designed by the cooperative or be either below or beyond. The roles assigned to advisors in crop production cover more varied modalities than in livestock farming. Three different roles appear in the remarks of farmers, which vary according to the level of delegation and dependence that they wish to grant to an external prescriber : input supplier (lowest delegation), technical support (partial or major delegation), administrative and work coordination (highest delegation).

The breeders grant advisors a reduced top-down market and technical intermediation role compared to that desired by the cooperative, while the top-down and bottom-up political role is expanded. There is both a reduction in the role set up by the cooperative and an overflow. In a top-down direction, breeders value the direct intermediation of advisors as opposed to that which operates through DT artefacts. The relationship with advisors gives them more weight to control the content of the intervention. They attribute them a role of technical intermediation between the professional group of advisors carrying this knowledge and the farmers. In the top-down and bottom-up political domain, the intermediation role of advisor is expanded by breeders compared to that desired by the cooperative. Breeders expect, in a form of "extreme committed intermediation" from the advisor, that they can transmit information but also represent their interest and weigh in the strategic choices of the cooperative in accordance with their remarks. They are also more demanding of social intermediation and support.

Farmers thus share the same perception of intermediation as the cooperative, in technical and commercial areas. On the other hand, the perception of intermediation by breeders diverges from that of the cooperative, when they demand political and social intermediation which goes beyond the role that the cooperative entrusts to advisors.

Considering the territorial dimension, however, refine this analysis and reveal different positions of the cooperative and the advisor depending on the local structure of advisory services and history of its activity.

3.4 Territorial variability of intermediation roles

Considering the territorial dimension will however refine this analysis and reveal different positions of the cooperative and the advisor depending on the local structure of advisory services and history of its activity in the territory. Table 1 describe the 3 territories studied, which are differentiated by the position of the cooperative (monopolistic or not), the local cooperative history (anteriority of a relationship of trust or a cooperative tradition for example), and the main agricultural production (Breeding or crop production).

Table 1. Description of the 3 territories studied

	Monopolistic position of the cooperative	Historical cooperative dynamics	Main production
Territory 1	No	Strong	Breeding
Territory 2	Yes	Strong	Breeding/ Crops
Territory 3	No	Weak	Crops

Our observations reveal the adjustment of the role of advisors according to these contexts.

In situation 1) the breeders experience a situation of misalignment with the orientations of the cooperative. The strategy of advisors of distancing themselves from the cooperative and developing proximity with the breeders is even more affirmed. They are involved in a form of “extreme engaged intermediation”. They claim a lack of attention to the situation of breeders and a lack of recognition of their work as advisors working in the interest of breeders.

The situation 2) is characterized by an equal presence of cereal growers and breeders and by a monopoly situation of the cooperative in the area. The practices of advisors are less contested due to the absence of competitors in this territory. Breeders face the same structural and cyclical constraints as in situation 1), but they associate the difficulties of the dairy sector more with these structural and cyclical problems than with a lack of advice or opportunistic behaviour on the part of the cooperative.

In situation 3), farmers are essentially cereal growers. They inherit a cooperative history that is poorer than other areas and more degraded, marked by embezzlement and other abuses of trust. Farmers thus have the feeling that, thanks to the cooperative, they have access to a healthier functioning structure, to an operational technical service and to a greater variety of crops than before. Unlike situation 1), in which the image of the cooperative has gradually deteriorated, in situation 3) the cooperative has slowly gained the trust of its members who remain vigilant about developments. Due to the competition in this territory, farmers can compare the offers, prices, and quality of services of different structures. The cooperative appears to be “a supplier like any other”, particularly attractive through its contracts, its commitment to agro-ecological solutions and the use of DT.

3.5 Conclusion

Our investigation aimed to understand how an agricultural cooperative format the profession of its advisors to engage in the agro-ecological transition. Here the cooperative mobilizes significant resources to restructure its back-office activities to produce agro-ecological solutions backed by DT tools. The cooperative trains, equips, encourages, controls, and refocuses advisors in the sense of technical and market intermediation. This result in these advisors developing variable forms of engagement in their activity, sometimes going beyond the intermediation roles designed for them by the cooperative. Likewise, farmers sometimes lock them into roles below the role desired by the cooperative, and sometimes expect more from advisors, demanding significant political and social intermediation. Finally, advisors adjust their intermediation role according to the social spaces of farmers. The components of this intermediation are mobilized in different ways to maintain a stable and lasting relationship with farmers.

4. Practical and theoretical implications

Agricultural cooperatives have a strong capacity development to support transitions. Their DT tools enable a fast and considering change of references in farmers' practices, and their advisors provide support, as intermediaries, to farmers. They develop different levels of relationship with farmers, depending on the type and degree of intermediation they need. Advisors thus play a key role in specifying the agro-ecological transition framework for each farmer's single case. They also play an investigative role in adjusting the positioning of the cooperative. They are key in specifying the general frameworks of advisory systems to ensure that they mobilize the greatest number of farmers. The framework built to transform the advisor's profession beyond technical and market intermediation fail in supporting advisors in other forms of intermediation. It would be appropriate to design resources to help them carry out the political and social intermediation expected by farmers.

Earlier work has shown that technical and economic functions of cooperatives, and its horizontal and vertical intermediations, are complementary (Iyabano et al., 2021; Yang et al, 2014). Our study enriches these finding, firstly inviting to rethink the different forms of intermediation through the prism of four components : market, technical, political, and social intermediation. It also invites to think about the degree of commitment expected from the advisor on each of these components and to situate them in relation to the intermediation role envisaged by each stakeholder (below, beyond). This should be considered regarding the expectations of farmers and the place they intend to give them. We also invite to think about these intermediation roles regarding the professional identities of advisors themselves, which shed light on their variable commitment to what employers and farmers expect of them.

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Combining constraint programming and a participatory approach to design agroecological cropping systems

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Abstract:
Designing diversified agroecosystems is particularly complex due to the multitude of factors involved, which vary according to the local context, and the many possible combinations of crops in time and space. This paper proposes an agroecological design approach to explore and optimise the spatio-temporal arrangement of crops in diversified systems using constraint programming in real design situations with farmers. Our four-step framework includes 1) diagnosis of the initial situation and identification of problem data and spatio-temporal constraints with farmers; 2) use of a constraint programming model, progressively removing constraints aligned with farmers' objectives until a solution is found; 3) evaluation of the solution through model assessment; 4) presentation of the solution to farmers. We applied this approach to the case study of a mixed orchard market garden in southern France. This methodology encouraged farmers to formulate their constraints for the spatio-temporal arrangement of their crops. By integrating constraint programming into our approach, we effectively managed the complex combinatorial nature of designing highly diversified systems and took account of farm-specific constraints. This process introduced a disruptive solution for farmers, providing a basis for discussion on evolving their practices to strike a balance between integrating agroecological principles and maintaining acceptable operational management.
Keywords: Agroecological design, Spatio-temporal arrangement, Constraint programming, Participatory approach, Mixed horticultural systems

Purpose

To address agricultural challenges, engaging agroecological transition is crucial, necessitating a redesign strategy for productive, self-sufficient, and resilient biodiversity-based farming systems (Duru et al., 2015). Various levers, such as diversification (Beillouin et al., 2021) and spatio-temporal crop arrangements (Ratnadass et al., 2012), have been identified to enhance ecological functions, reduce reliance on synthetic inputs, and maintain productivity. However, implementing spatio-temporal design of diversified systems is complex due to the diverse factors that need to be considered (varying with the local context), the large number of possible crops combinations in time and space, and uncertainties about biological and ecological processes (Duru et al., 2015b). Current methods and tools often fail to consider spatial aspects comprehensively, particularly for diversified farms. To our knowledge only one tool (Juventia, 2022) has been identified that integrates agroecological principles at the spatial and temporal scale, but it is limited to a small number of crops.

To support agroecological transition and diversification of cropping systems, it is necessary to develop tools and approaches to optimize the spatial and temporal arrangement of crops based on agroecological principles and that are flexible enough to take into account the specificities of each farm.Artificial intelligences such as constraint programming can contribute to the development of these tools by providing formalisms with a high level of expressivity, (Rossi et al., 2006). Constraint Programming (CP) is a declarative paradigm used for modelling and solving constraint satisfaction and constrained optimization problems (CSPs and COPs). To our knowledge constraint programming has never been considered for designing crop management decision support tools, with the exception of (Akplogan et al., 2013), which used a weighted CSP approach to solve the crop rotation problem. Yet, due to its expressiveness and flexibility (Rossi et al., 2006), it is well-suited for designing generic and adaptable support tools for diversified agroecosystems.

In this article, we propose an agroecological design approach to explore and optimise the spatio-temporal arrangement of crops in diversified systems by using constraint programming applied in real situation of designing with farmers. We developed and implemented this method for designing mixed orchard market gardens, which are among the most complex systems because of the number of species cultivated (often more than 40 market garden species and more than 10 tree species and varieties), and the diversity of crop cycle lengths (from a few weeks for a radish to several decades for a fruit tree).

Methodology

We propose a four-step framework for spatio-temporal arrangement of crops in a diversified system (Figure 1). This framework combines a participatory approach with the use of a constraint programming model. The model used in this study is AGROECOPLAN, which generates a spatio-temporal crop allocation solution (Challand et al., 2023). The four constraints that compose this model allow, a priori, to take into account all the pedoclimatic, operational and agroecological constraints for the spatio-temporal arrangement of crops in a diversified agroecosystem. The four constraints and the two optimisation objectives of the model are:

- C1. Return time: two crops must not be consecutively planted in the same cropping area unless the recommended return time for each crop is observed
- C2. Impossible neighbourhood: Each pair of crops whose interaction is negative must not be assigned to adjacent cropping areas.
- C3. Impossible precedent: Successive planting in the same cropping area is not allowed if the first crop has a negative precedent effect on the second crop
- C4. Impossible locations: Forbid a set of cropping areas to certain crops, because they do not satisfy cultivation or operational requirements.
- O1. Maximise beneficial neighbourhoods: Maximize the number of adjacencies between crops that have beneficial interactions.
- O2. Maximise beneficial precedents: Maximize the number of positive precedences.

The first step in the framework involves diagnosing the situation and identifying and formalising the problem through a semi-directive interview with the farmer. After diagnosing the initial cropping system and the farm context, the objectives are to collect two types of data: (i) general data related to the problem, such as cropping areas and the cropping calendar (including sowing/planting dates, harvest dates, and quantities), and (ii) operational, pedoclimatic, and agroecological constraints for the spatio-temporal arrangement of crops from the farmer's perspective. The model integrates the data through four constraints and two optimization objectives. In the second step, the AGROECOPLAN model is used to allocate the crops from the list of crops to the cropping areas respecting the set of spatio-temporal constraints defined with the farmers. If the model does not find a solution that satisfies all constraints, it is considered over-constrained. This is a common occurrence in market gardening due to the numerous, and sometimes conflicting, constraints that farmers must consider. Agronomists prioritize constraints based on the farmer's objectives established during the initial diagnosis. The least important constraints are then removed, and the model is used to find a solution. This process is repeated until a solution is found. The third step involves evaluating the model's output by calculating the performance scores (level of satisfaction of each constraint) of the cropping plan and mapping the performances on the cropping plan. The fourth step is to present the solution and its performance to the farmers. During an interview, farmers evaluate the cropping plan and compare it with the initial situation. If the farmer is convinced of the added value of the new design, they can adopt the cropping plan.

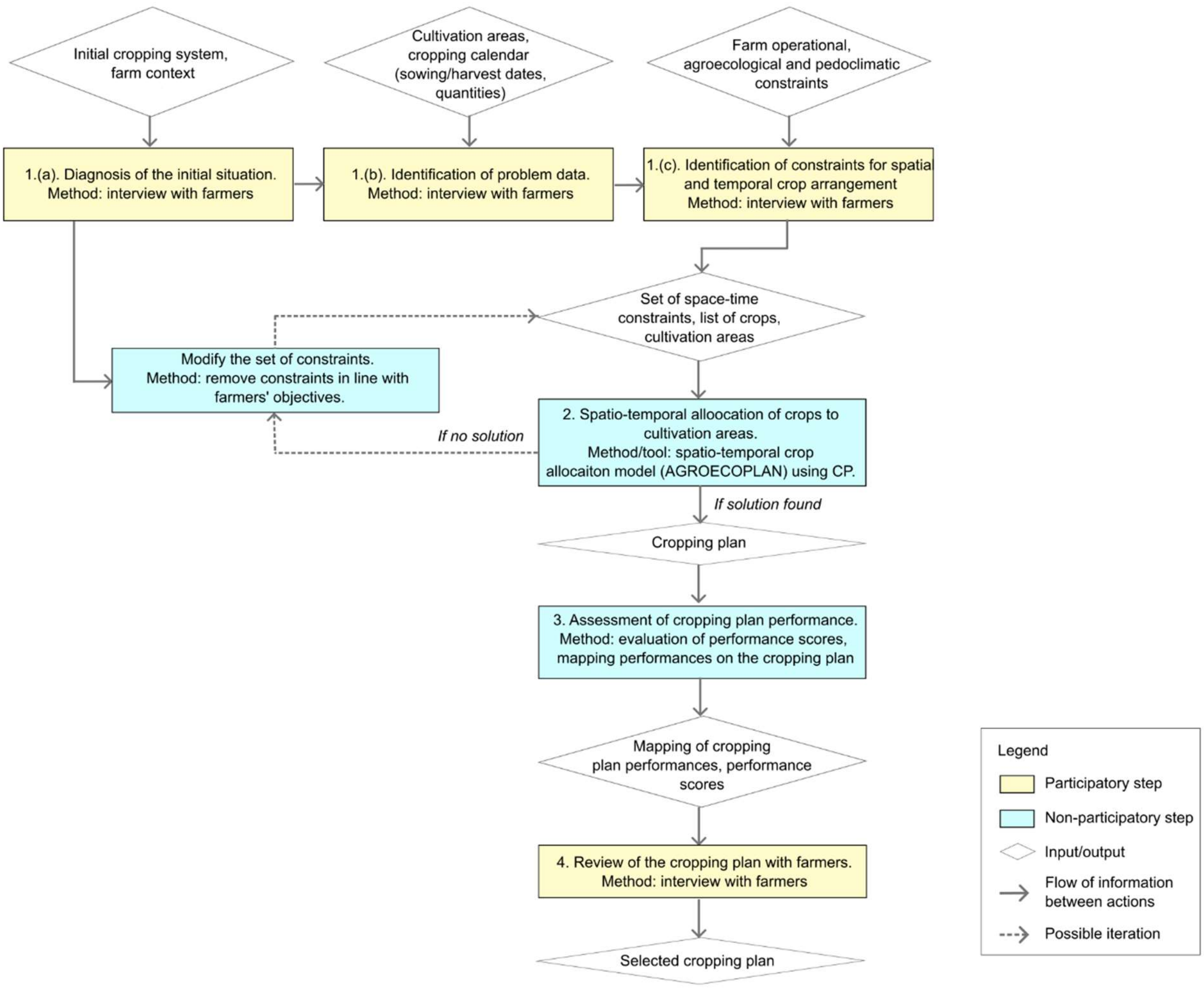


Figure 1. Flow diagram of the four-step framework for spatio-temporal arrangement of crops in a diversified system.

We applied the framework to a case study farm located in the south of France. The objective was to create a cropping plan for their one-hectare mixed orchard market garden, which involved assigning market garden crops to cropping beds for a defined period. The interviews were conducted with an agronomist and the two market gardeners who manage the microfarm. The farm's mixed orchard market garden consists of eight gardens, each comprising ten vegetable beds, separated from each other by double rows of fruit trees.

Findings

The diagnosis of the initial situation led farmers to formulate and prioritise their objectives for the spatio-temporal arrangement of crops. In order of priority, the four objectives identified were: productivity, acceptable working time, limiting the spread of pests and diseases, and maintaining soil fertility.

Implementing the approach required seven iterations to reduce the constraints in order to find a solution. At each iteration, constraints were selected for removal based on their theoretical impact on farmers' objectives. Priority was given to eliminating constraints that only affected the least important objectives of farmers. For example, the precedent effects constraint (C3 and O2), which hindered the resolution of the model, was singled out for reduction. Three of the four sub-constraints encompassed in the precedent effect constraint were theoretically linked to labor time (i.e., weed-suppressive crop before non-occluded direct sowing, and Fabaceae before an undemanding fertiliser crop), while one had a theoretical impact on pests and soil fertility (i.e., avoiding two consecutive crops from the same botanical family). Considering that the objective of achieving an acceptable working time was more crucial for farmers than restricting the spread of pests and preserving soil fertility, the reduction efforts focused on the constraint of avoiding two consecutive crops from the same botanical family. The reduction of this constraint consisted in applying it only to botanical families sensitive to pests in their context, such as Solanaceae and Cucurbits.

The cropping plan presented to the farmers (see A in Figure 2) was designed based on the constraints defined by the farmers in Step 1. It was found to be more satisfactory overall regarding the constraints than the initial cropping plan designed by the market gardeners (see B in Figure 2). Indeed, the cropping plan of the market gardeners included 24 return times that were not respected (C1), 2 neighbourhoods that were not feasible for operational reasons (C2), 2 neighbourhoods that were not feasible for agroecological reasons (C2), 19 negative precedent effects (C3), 8 crops allocated to prohibited beds for operational reasons (C4), and 13 crops allocated to prohibited beds due to unsuitable pedoclimatic conditions (C4) (see A in Figure 3). Conversely, the cropping plan presented to the farmers included only 9 return times that were not respected (C1) and 3 negative precedent effects (C3) (see B in Figure 3). It also incuded 40 positive precedents (O2), while the market gardeners' cropping plan had only 27, and 1 positive neighbourhood for agroecological reasons (O1). The only suboptimal aspect of the cropping plan presented to the market gardener is the maximisation of beneficial neighbourhood that need to be considered for operational reasons (O1). Indeed, it contained 67 positive neighbourhood, compared to 79 in the market gardeners cropping plan.

Figure 2. Comparison of the first three cropping plans' gardens: market gardeners cropping plan (A) and selected cropping plan of the workshops (B)

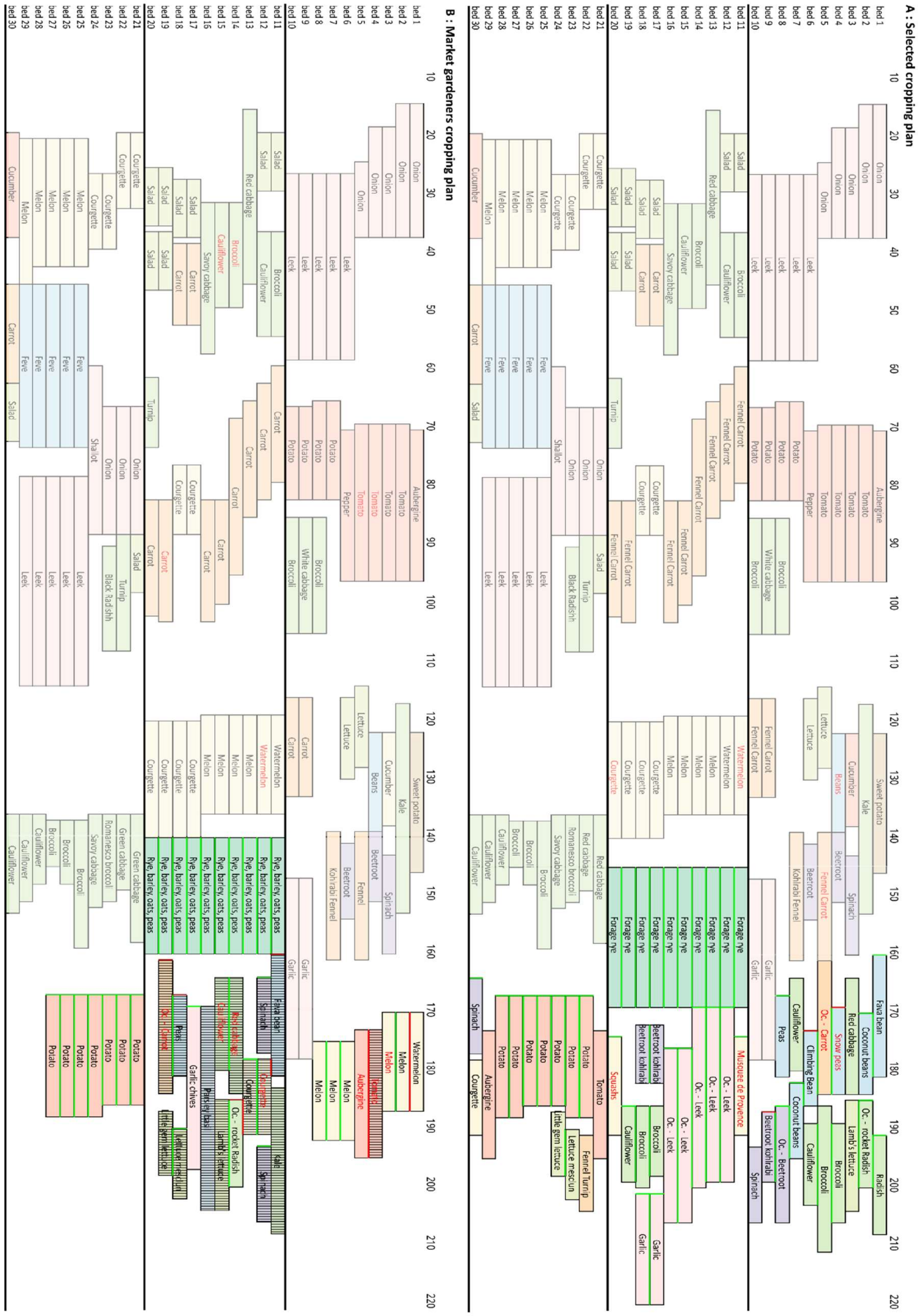
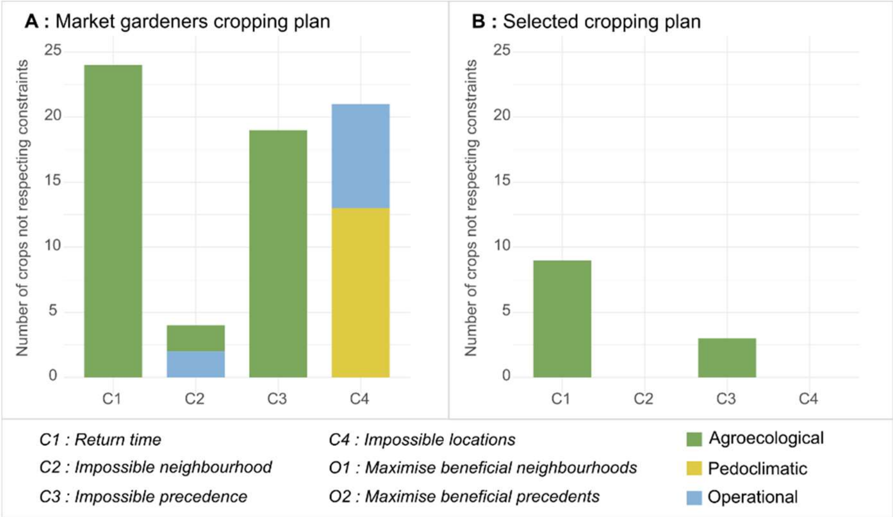


Figure 3. Performance assessment of the selected cropping plan of the workshops (A) and the cropping plan of the market gardeners (B)



Practical Implications

The farmers appreciated the approach, which allowed them to formulate their constraints for the spatio-temporal arrangement of their crops. This was a new opportunity for them, as they usually use an empirical method to simplify the process of designing their cropping plan. The approach enabled farmers to realise that there is no single solution that satisfies all their theoretical constraints. Therefore, they must make compromises, especially between their strong operational constraints, and the agroecological constraints they aim to incorporate into their system. They became aware that they spontaneously favour their operational constraints, in particular the grouping of similar crops, and that this led to less satisfaction of their other constraints. The proposed solution offers an alternative that takes better consideration of their pedoclimatic and agroecological constraints. However, it may complicate the operational management of crops by not grouping all similar cultures together. The approach enabled the creation of a cropping plan that differed from their usual practices, providing a basis for discussing their methods and how they might evolve in order to mobilize new agroecological practices. This method is designed for use by farmers accompanied by agronomists, in order to integrate empirical knowledge with scientific and expert knowledge. However, the model could be used by farmers on their own once it has been tested against various case studies, which will have built up sufficient knowledge to be made available to farmers.

Theoretical Implications

The incorporation of constraint programming (CP) into our methodology made possible to manage the combinatorial nature and complexity of the design of highly diversified agricultural systems. Participants were faced with a multitude of constraints of different types, as well as a variety of crops to integrate. CP provided a systematic approach to solving these complex problems by generating crop arrangements that accounted for all the constraints identified. The flexibility inherent in constraint programming (Frühwirth and Abdennadher, 2003) was also crucial. It made possible to model all the constraints specific to farmers and adjust them easily as new information emerged. This adaptability was particularly beneficial given the lack of quantitative data on agro-ecological and operational constraints. By enabling the adaptation of a qualitative approach, CP made it possible to take account of tacit knowledge and qualitative elements, thereby filling in the gaps. Compared with model-assisted design approaches (Bergez et al., 2010), our approach makes possible to account for different types of constraints and to integrate empirical knowledge. It is also less burdensome, particularly in terms of parametrisation time, as it requires less quantitative data. The use of CP has therefore helped to make the design process more transparent, iterative and adaptable to the diversity of agroecological design issues. Participants appreciated the ability to visualise and understand the implications of different combinations of constraints, thus facilitating informed decision-making.

The agronomist, involved in the participatory process, facilitated the elicitation of farmers' reasoning from implicit knowledge, subsequently translating it into constraints that could be modelled. This process enabled the agronomist to learn how to integrate empirical knowledge into the design process.

Finally, while we tested the approach on a mixed orchard market garden, it possesses the versatility to be applied to various cropping systems without necessarily requiring adjustments to the methodology. Indeed, the cultivation areas can take any shapes and sizes (e.g. plots, crop strips, crop rows), the cultivation calendar can contain any type of crop (e.g. cereals, legumes, fruit trees, meadows), and any agroecological, pedoclimatic and operation constraints for spatio-temporal arrangement of crops can be modelled by the four constraints of the AGROECOPLAN model.

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Insights of a nested social-ecological-technical systems framework for agriculture transitions.

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Purpose

This work introduces a nested framework of social-ecological-technical systems (SETS) for agriculture transitions by merging two existent structures: the social-ecological systems framework (SESF) (Ostrom & McGinnis, 2014) and the multi-level perspective of socio-technical systems transitions (MLP)(Geels, 2019). This convergence attempts to centre agricultural change in terms of interacting social and technological elements, preceded, in experience and context, by the lessons learnt with the Green Revolution. Namely, the *techno-utopias* made possible today where digital, physical, and biological traits are fused to create units of smart technologies but, simultaneously, the *techno-dystopias*, where challenges are restructured and take different territorial shapes but crystalise the same fundamental imbalances causing ecological and social suffering (Fresco, 2015; Gupta, 1998; Pielke & Linnér, 2019).

Design/Methodology/Approach

A scoping literature review was conducted to achieve the SETS framework, stemming from the research question (RQ): How can social-ecological and technical systems be nested for understanding farming transformations? This unfolded into scoping the SESF and MLP individually, but also what has been done to structure SETS so far (table 1). The scoping had the ambition to insight on limitations that can be overcome by a theoretical and conceptual convergence of the frameworks. To do so, Guiding Answers (GA) were distilled and interrelated using the imagery of *Retying the Gordian knot*, introduced by Latour (1991, p. 3). Thus, from the GA, four *threads* were conceptualised and *tied* to, in the end, achieve a *nested* structure of SETS for agriculture.

Table 1. List of research topics, Web of Science's search strings inputs, and number of results included and discarted.

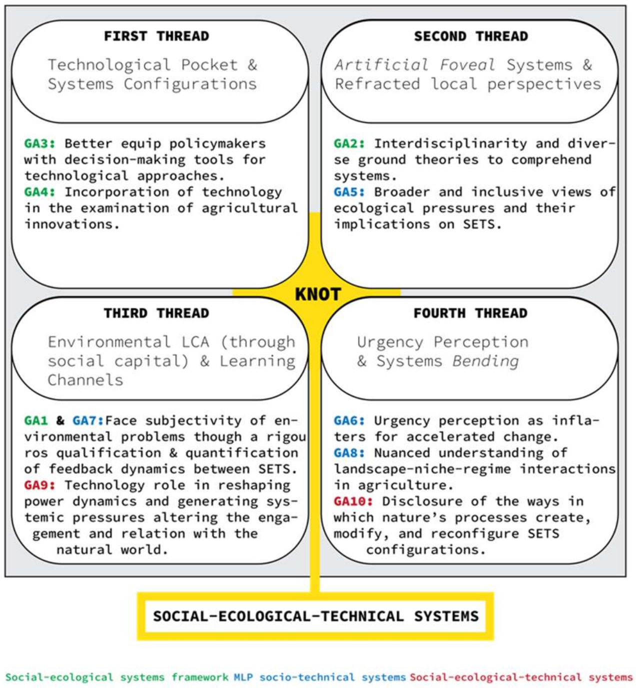
Topic	Search strings	Articles included	Articles discarded
SES Framework	("Social ecological system* framework") OR ("Social* ecological system* SES framework") ALL in-title.	57	2
MLP socio-technical systems	("Multi-Level Perspective") AND (sustainab* or transition*) and tech* ALL in-title; and 2) Multi-Level ALL in-title AND Geels Author.	18	9
Social-ecological-	("soci* ecologic* tech* " or "soci* ecologic* and tech*" or "soci* tech* ecologic*" or "soci* tech* and ecologic*") or ("tech* soci* ecologic*" or "tech*	28	3

technical systems	soci* and ecologic*" or "tech* ecologic* soci*" or "tech* ecologic* and soci*") or ("ecologi* soci* tech*" or "ecologi* soci* and tech*" or "ecologic* tech* soci*" or "ecologic* tech* and soci*") ALL in-ttile		

5. Findings

The findings of the scoping review are presented in figure 1 and discussed in the subsequent sections.

Figure1. Introduction of four threads to conect (knot) a social-ecological-technical systems framework given the remarks (Guiding Answers (GA)) identified in the three scoping review topics: GA 1-4 are related to the social-ecological-systems framework, GA 5-8 are related to the multi-level-perspective of socio technical systems, and GA 9-10 are related to social-ecological-technical systems.



Theoretical Implications

1st thread: Technological Pocket & Systems Configurations in the value-chain: The separation or distinction of technological aspects from social ones can be achieved through creating a set of first-tier variables, akin to the approach taken by Marshall (2015) in the context of transformation systems. Given the state dynamics of transitions, which involve a *system A* to transform into a *system A'*, the pair should account for: "Technical Systems" (TS) and "Technological Innovations" (TI). The first assesses the technical model of the system, and the latter links it to the characteristics of potential technological innovations**.** The interaction between these two aspects and the other pre-defined SESF variables - *governance system, actors, resource system, resource units* – would portray the spectrum of readiness of a specific system to take on a transformation. The blueprint of it also indicates where the system needs to be leveraged to take on that transformation. On another end, the dissociation of technological aspects from social ones does not intend to overlook the *homopoietic* traits intrinsic to technology and technical transitions, i.e, the human-made essence of the technologies as social constructed tools. However, enlarging the analysis unpacks dynamics and interactions that tended to be black-boxed, or that neglected the leveled mutual influence of forms of constitutive power, i.e, the influence and power that is not exercised in a direct, top-down manner but is, in turn, embedded in the structures of innovation systems (Ahlborg et al., 2019). Consequently, the "Technological pocket" must consider the dialogic relationship of these external and internal configurations. This entails examining how local transformations in physical and mental capacities can integrate, transform, and adapt - through a process of making explicit value-chain relations - some of the implicit pressures occurring at higher-level social motions.

2nd thread: artificial foveae systems & refracted local perspectives of production systems: The introduction of the concept of artificial foveae system within systems puts perspective as a mediator of transitions, such as the ones in agriculture. In anatomical terms, the fovea, situated within the retina, facilitates acute vision in the central field, enabling selectively focus on certain stimuli while side-lining others. Analogously, the metaphorical placement of the fovea defines what is seen with clarity and detail, and what is oversighted and marginalised. This concept illuminates how priorities are established, and how attentions vary within co-existent individuals and groups (Midgley, 1994). Introducing artificial foveae that include diverse humans' perspectives, but also ones of non-human skin is an exercise of recognition and sympoiesis – a term Haraway defines as intrinsic to complex, responsive, historical systems (2016, p. 58) – and allows for an elucidated, amplified representation, that fosters a comprehensive integration of environmental justice within design frameworks (Hernandez-Santin et al., 2023).

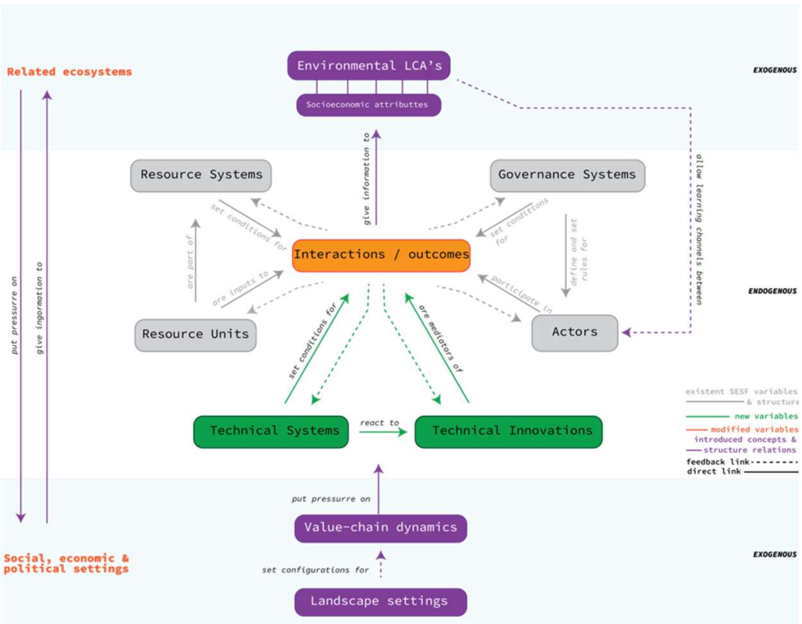
3rd thread: environmental life cycle assessment via social capital & learning channels: Technocratic transitions have historically advised us to account for the "sacrifice zones" that transitions might inadvertently create. Given the intricate, global, and decentralised nature of supply-chains, it becomes imperative to acknowledge the trade-offs and burden shifts inherent to each actor's attempt to change and adapt (Zanghelini et al., 2018). The SESF structure already integrates an exogenous first-tier variable of Related Ecosystems, which encompasses the flows in and out of the focal system and that can be interpreted, if defined, as the extended impacts of the system. In this way, the consequential life cycle assessment (CLCA) emerges as a pivotal methodology to be coupled since it is designed to quantify the repercussions of a decision (Weidema et al., 2018). Simultaneously, an assessment of environmental impacts according to different socioeconomic attributes of system's actors allows the identification of social groups with better environmental performance. If channelled, this information can effectively define learning channels between different groups (Houshyar et al., 2019).

4th thread: urgency perception & systems bending: When addressing transitions, the concept of urgency, and how regimes can adapt to avoid or delay urgency, appeared foundational for systems resilience and, therefore, for systems to take on transitions. This aspect also expresses the plasticity and morphing abilities of regimes, in which urgency is a matter of perception subjected to the realm of distortions fields of power. These distortions can be positive, if they reinforce the current model of production (the TS, or *regime* in MLP terms), or negative, if they pressure systems to take on major transformations (the TI, or *niches* in MLP terms). The ability or inability of a given system to navigate these pressures defines the organisation power to do systems *bending*. The urgency for transformation is higher once this *bending* cannot proceed, i.e., where the options of slight changes are exhausted. Taking the work of Roberts & Geels (2019) regarding the transition from traditional mixed agriculture to specialised wheat agriculture (1920–1970), it becomes evident that alterations in the sense of urgency can accelerate change. Back then, the diversion of government funds from international to national agriculture happened only due to the need of self-sufficiency pressured by the war. The narrated pre-existent needs of national farmers struggling on the consequences of the free global market had been dismissed for decades and were thus insufficient to advance change. In this way, one can think of *urgency* and *urgency perception* as inflaters for accelerated regime change. Also, several of the scoped articles have reflected on the pressures of changing ecological conditions causing niche-innovation and/or regime change. These pressures are portrayed as increase of awareness about environmental disasters and climate change; and as a vector-valued function alongside market, war, and political apparatus (Geels et al., 2016; Genus & Coles, 2008; Wu et al., 2021). However, incumbent actors fail to perceive ecological pressures alone as powerful enough to radically alter their trajectories (Flynn, 2016; Geels, 2012).

Practical Implications

The capacity to maintain a system of production represents the resilience, or ability to *bend* to pressures. Major transformations occur when the system finishes its capacity to *bend*, steering a radical change. A transformative human-made change takes a technical (or technological) innovation into the system, to mediate such alterations. Which innovation is pursued is a matter of relation between the technical configurations and the social and ecological attributes endogenous to the system, as well as exogenous macro configurations shaping it. Thus, a SETS framework is presented, to characterise such nested relations. Taking the structure of the SESF, a new pair of variables is introduced: TS and TI, schematised in figure 2 and elaborated further in table 1 and figure 3. These new variables take the *regime* and *niche level* concepts of the MLP to interlink an existent model of production (TS) and a constant pressure for change (TI).

Figure 2. Proposed nested SETS framework



At the same time, the exogenous variables of the SESF are also restructured to accommodate (1) the environmental life cycle assessment with relation to the socioeconomic attributes of system actors, and (2) the value-chain analysis of the focal system to understand higher level threats and pressures of change. In the proposed SETS (fig. 2), the new concepts of *artificial foveae*, system bending, and urgency perception are also introduced as an interaction of, respectively, the ecological, technical, and social elements. Particularly, the *artificial foveae* are highlighted as representing the natural resources, that can embody the perspective of a river to a whole landscape. However, as described in section 4, to this matter also diverse human perspective (social), should be accounted.

Table 1. Identification, description, and indicators of suggested second-tier variables (var.) associated to the Technical System and Technological Innovations.

First-tier var.	**Technical Systems** *(Assessment of the technical model of the system)*	
Second-tier var.	**Variable Description**	**Indicator description**
TS1 – Complexity of technical devices in use	Complexity level of the technical elements or tools in use to produce the resource unit.	*Low* the tool has no electronic/digital components nor has any mechanical fueled engine *High* smart or 4.0 technology with internet access
TS2 – Duration of the TS	The time between the implementation of the technical system and its occurrence with minor changes / slight adaptations.	*Low* duration is < 5 years of *High* duration is > 15 years
TS3 – Function of social alignment dependency in the TS	The level of alignment dependency between the systems elements to guarantee efficiency of production or marketing power.	*Low* system's actors don't depend on other actors to take transformations in the system / bairgain power in market *High* system's actors depend on other actors to take transformations in the system
TS4 – Economic attachment to technological model	The infrastructures, equipment and machinery putting the production forward and in which the system actors are attached through sunk investments.	*Low* return of investments (ROI) < 1 year *High* return of investments (ROI) > 10 years
TS5 – Level of threats (urgency) to the technical system	The aspects of production impacting efficiency or resource unit productivity and that threat the sustainability of the model of production as it is, both socio-economic and ecological. This level defines the limits of the system to *bend* and the urgency for a given system to change	*Low* actors have available changes to the TS model of production that allow to bypass threats *High* actors cannot sustain the TS model of production without transforming the system

TS6 – TS model blindness	The degree in which actors are limited to recognise developments beyond their model of production specific focus.	*Low* actors are willing and actively seeking for transformations in the system *High* actors insist on the TS principles
TS7 – Level of high-level influence in model of production	The regulations, standards, and policies mandatory to the system of production and/or the pressures demanded through the value-chain.	*Low* actors don't have to seek change because of policy frameworks *High* actors are forced to transform the system because of a policy framework
TS8 - Environmental impacts for different socioeonomic groups	The calculation of environmental impacts (LCA) of the system according to different socioeconomic groups of the system.	*Low* heterogeneous performance between socioeconomic groups; *High* homogeneous performance bewteen socioeconomic groups.
TS*n* - ...	...	*Low... High ...*
Second-tier var.	**Variable Description**	**Indicator description**
TI1 – Fitness for solving system threats (including artificial foveae)	The fitness of the innovation to tackle specific challenges of the current model of production / regulatory requirements both socio-economic and ecological and that meet the urgency of systems transformation including the artificial foveae (foreign and voiceless) of human and non-human nature	*Low* the innovation tackles threats in a) only one of the three sustainability pillars; b) within a time horizon of < 5 years *High* the innovation tackles threats in a) all of the three pillars; within a time horizon of > 10 years
TI2 – Disruption degree of the technology	The level in which principles of the current system are abandoned and replaced.	*Low* the great majority of production principles are abandoned but the technological devices and knowledge are used for a new TS model *High* the great majority of production principles and technological devices and knowledge are abandoned
TI3 - Function of social alignment for the TI	The level of alignment/dependency between the systems elements to guarantee efficiency in the use of the innovation.	*Low* the system actors don't depend on other actors to take a technological innovation *High* the system actors depend on other actors to to take a technological innovation
TI4 – Readiness / time for learning the innovation	The readiness of the actors as the time and means needed for actors to learn	*Low* the system actors can learn the TI knowledge and/or see complete results in one productive cycle

	and carry on with an innovation.	*High* the system actors need > 5 productive cycles to learn TI knowledge and/or see coomplete results
TI5 – Reliability of innovation	The level in which the innovation was tested / experimented, and in which actors can rely on the supply of possible equipment and consumables	*Low* innovation is still prototyping / niche *High* the innovation is completely test proof
TI6 – Economic demand of the innovation	The investment needed / the adaptation impacts on the production of the system of the innovation	*Low* ROI of investment is < 5 years *High* ROI of investment is > 15 years
TI7 – Power of influence of the innovation	The level of familiarity to the system of the means/channels introducing the innovation to the system	*Low* the means (channels of introduction) of the innovation are completely foreigner to the system *High* the means (channels of introduction) of the innovation already exist and are trusted in the system
TI8 – Environmental impacts of the innovation for different socioeonomic groups	The calculation of environmental impacts (LCA, preferably consequential LCA) associated to the innovation and with different socioeconomic groups of the system.	*Low* the innovation has an environmental performance very heterogenoeous among the the diffferent socioeconomic groups; and a lower environemntal performance of indirect impacts (outside the border of the system). *High* the innovation has an environmental performance homogeneous among the diffferent socioeconomic groups; higher environemntal performance of indirect impacts (outside the border of the system).
TI*n* - ...	...	*Low... High ...*

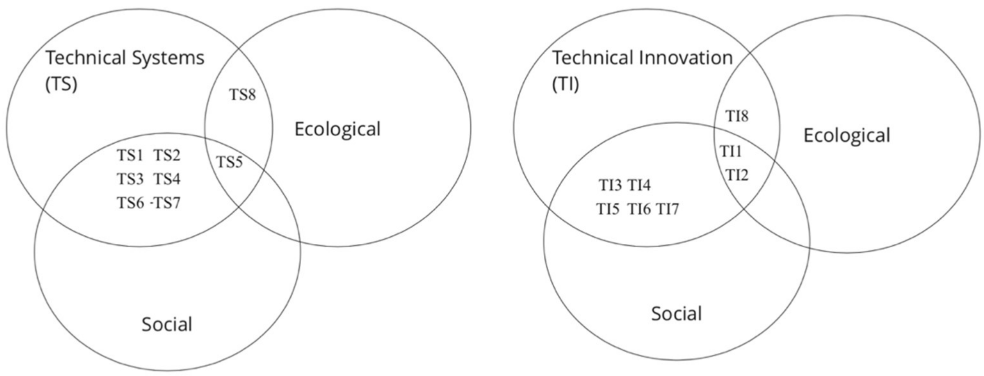


Figure 3. Nested hierarchy of technological variables in relation to social and ecological systems (of endogenous or exogenous nature).

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Place-based modes of knowledge sharing in agriculture: social learning and transformative capacities for the agroecological transition. Empirical results from three case studies in France

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Abstract:
New forms of cooperation are emerging between farmers and other stakeholders to exchange and co-produce knowledge for the agroecological transition. What transformations do they enable at the level of individuals, groups and local agri-food systems, and how can we accompany and support these forms of co-production? We mobilize the conceptual frameworks of social learning to better understand what is learned, by whom and how, and of the transformative potential of social innovations to explore the effects of knowledge co-production processes at different scales. We compare 3 cases of agroecological knowledge co-production in Drôme (France). The results highlight four learning mechanisms: through vertical or horizontal transmission of knowledge; through pragmatic inquiry; through deliberative processes; and through reflexive and critical processes. We also identify four types of tools to support these groups, which can be symbolized by a toolbox, a compass, a mirror and a hub. Finally, we discuss some of the processual and contextual conditions that foster the transformative capacities of these initiatives.
Keywords: agroecological transition, knowledge co-production processes, social learning, Drôme (France)

Agroecology at the scale of agri-food systems attempts to respond to the crises of agricultural overproduction, erosion of biodiversity and climate change. The agroecological transition of agri-food systems (Altieri, 1995; Lamine, 2012; Duru et al., 2014) implies a paradigm shift both in terms of production and transmission of knowledge and in the professions supporting farmers (Norgaard & Sikor, 1995; Meynard, 2017). Thus, new forms of cooperation between farmers and other actors are emerging, in order to exchange and co-produce knowledge in agroecology. Co-production can be defined as an "iterative and collaborative processes involving diverse types of expertise, knowledge and actors to produce context-specific knowledge and pathways towards a sustainable future" (Norström et al., 2020). These forms are characterized by: (1) the diversity of partners beyond farmers: researchers, rural development players, experts, prescribers, constituting different types of "accompaniers" to farmers; (2) the lability of the forms of commitment of participants, without necessarily formal collectives; (3) new conceptions of what knowledge is (systems approaches, non-linear thinking, knowledge produced in and by practices); (4) the importance of reflexive and learning processes, notably on the objectives and methods of knowledge management themselves; (5) and finally, their territorial dimension. This involves taking into account the specific features of farming systems and the local context, as well as legitimizing the knowledge co-produced as a guarantee of its subsequent use. These groups develop multiple activities such as peer-to-peer meetings, practical exercises, on-farm experiments and so on. What transformations do these new forms of knowledge co-production enable at the level of individuals, groups and local agri-food systems? How can we accompany and support these forms of knowledge co-production? The aim of this empirical study is enrich the emerging existing literature on the role of these collective modes of knowledge co-production in the agro-ecological transition at different scales, and to highlight practical lessons for the support processes.

Design, Methodology, Approach

We mobilize the conceptual frameworks of (1) social learning to better understand what is learned, by whom and how (Reed et al., 2010; Scholz et al., 2014) and (2) of the transformative potential of social innovations to explore the effects of knowledge co-production processes (Koop et al., 2016; Anderson et al., 2019). We compare 3 empirical cases of co-production of agroecological knowledge in the Drôme (France) : (1) on goat and sheep phyto-aromatherapy, (2) on animal health in free-range pig farming, (3) on simplified tillage and plant cover techniques. They bring together breeders and farmers, rural development agents, researchers in biotechnology and social sciences, veterinarians and pharmacists. The phyto-aromatherapy breeders' group was created in 2011 by goat breeders, then extended to sheep breeders in 2017. It brings together 60 breeders, coordinated by a breeders' union in collaboration with a local veterinarian, a plant pharmacist and two research institutes (animal sciences -FiBl and social geography-Inrae). The group has the dual aim of (1) finding alternative solutions to synthetic plant-based treatments and (2) enabling farmers to improve their knowledge and practices in the field of animal health. The group on animal health in free-range pig farming was created in 2018, on the initiative of an NGO that promotes organic farming (Agribiodrôme). By cooperating with an agronomy research institute (FiBL), farmers identified and defined common animal health issues, which led them to structure and further federate the nascent sector. This NGO also initiated a group of farmers working on simplified tillage and plant cover techniques, in collaboration with researchers and rural development agents (Itab). Their meetings revealed the diversity and specificity of individual problems. It did not lead to a collective dynamic, but it did help to better target the forms of support needed (for example, for seed supply). These three groups carried out various knowledge co-production activities: peer exchanges during meetings or farm visits, training courses or exchanges with experts, practical work such as coprological analysis, on-farm experiments such as testing plant extracts (oak) on a herd or cover plants. We worked with these groups for three years, as part of an action-research project, and monitored the work through participant observation, semi-structured interviews, activity monitoring and participatory meetings.

Findings & discussion

On the knowledge co-production process

We constructed the activity trajectories of each group. On this basis, we were able to model knowledge co-production as a series of multiple tasks. They form a cycle, with no linear order, which can be carried out by farmers or other workers who support them. It includes (1) the design of a common framework of activities (who, what, how), (2) the implementation of activities: experimentation, training, ..., (3) capitalization and transmission of learning ; (4) putting lessons learned into practice and (5) identifying a problematic situation and formulating common work objectives. We identify also two other parallel and transversal tasks: monitoring and evaluation, animation and logistical organization of activities. Farmers were mainly involved in tasks 2 and 5, sometimes in tasks 1 and 3, but never in transversal tasks, which were handle by others.

On social learning processes, differently activated

These knowledge co-production groups are places of social learning. All participants - breeders and other workers, such as veterinarians or researchers - develop learning: they acquire knowledge, develop new understandings of the world or new skills, and so on. They foster the adoption of new agricultural practices, but also new ways of collaborating with others, defending a point of view, etc. This individual learning is social, in the sense that it also involves people who are not directly involved in the group's activities (relatives, neighbors, colleagues, etc.). Social learning can thus foster transformations on a larger scale, whose scope concerns practices, but can also be political or even epistemic. We have identified 4 learning mechanisms, which are activated differently within the 3 groups observed, and which we cite in order of importance of activation in our case study. (1) The transmission of knowledge is the most common learning mechanism: it can be vertical, between an expert and farmers as part of a training course for example, or horizontal, through exchanges between farmers. (2) Pragmatic investigation is the iterative process of making observations or tests based on a problematic situation, and drawing lessons from them to act or reconsider the situation. This can be seen in the form of agronomic experiments on the farm, but also in the social experience of collective work between a plurality of actors, with different (scientific/empirical) knowledge. (3) Deliberative processes are those moments when group participants explain, debate and negotiate the visions and objectives of collective work, where they learn to share values and/or a common horizon. (4) Reflexive and critical processes enable us to take a step back from the knowledge produced by the group, its scope and the conditions under which it is used. For example, the goat-sheep group discusses the relative value of empirical knowledge versus scientific knowledge and decides to get involved in the fight against veterinary regulations on aroma-phytotherapy, which limit the empirical use of plants by breeders

On postures & tools to support agroecological knowledge coproduction

Supporting the agro-ecological transition has led to a recent evolution in the support profession : it's no longer a matter of advising, but of accompanying the change of farmers who design and manage their systems, as well as accompanying each individual, but in collective dynamics. We have analyzed the ways in which 'accompaniers' conceive and practice their work. We have highlighted a shared ambition to strike a balance between helping participants imagine the unthinkable, on the one hand, and confronting the real world and anchoring themselves in the territory, on the other. To achieve this, we have also pointed out that they use four support tools. Drawing on Cristofari et al. (2018) and other authors, we can symbolize these tools as follows: (1) a toolbox to provide means and resources ; (2) a compass to guarantee meaning; (3) a mirror to stimulate reflexivity and (4) a hub to connect people together.

The toolbox consists in making available a range of resources from which everyone can draw according to their needs (Chantre, 2001), such as knowledge supports (training courses, guides, etc.), technical equipment (seeds, plant extracts, etc.), logistical support (organization of meetings, techniques to encourage learning), technical support (moderation of debates, method for evaluating cover crops, etc.), or even funding and working time. The accompaniers define this part of their work as "helping to solve technical, economic and working time problems" or "providing a resource for farmers to reflect on each other". The compass makes it possible to create and guarantee the "construction of meaning" (Hazard et al., 2018): sustaining the desire for change (and drawing on the toolbox), articulating individual transformation projects and the common framework of actions, guaranteeing coherence at different scales (individual, collective, project) and between objectives, means and results; converging theory and practice, scientific legitimacy and social relevance. One accompanier explains his role as follows: "Finding the right time and the right form for a fruitful and constructive exchange, while leaving everyone free to make their own choices. The mirror symbolizes support for reflexivity (Popa et al., 2014): facilitating and stimulating reflective work on individual and collective activities; ensuring that the group keeps track of different experiences and experiments (failures and successes) both on agronomic activities and collaborative work and even on coaching. Examples of the use of the "mirror" are evaluation sheets or end-of-session debriefings, questionnaires or semi-directed follow-up interviews, and the reconstruction of group activity trajectories. The aim is to enable the group to take a step back, monitor and learn lessons. As an accompanier put it: "We do things intuitively, without formalizing them: we ask ourselves questions about our modes of action, but we don't have a miracle solution (...) my role is to facilitate exchanges and capitalize on what this produces". The hub aims to maintain contact between people (Nostrom et al., 2020): facilitating interrelations between participants by working on collective identity and dynamics (multiplying meetings, conviviality, celebrating progress, etc.); strengthening territorial anchorage, i.e. drawing on the resources and potential of the territory (lived experience, specific resources, situated knowledge, etc.); freeing up room for manoeuvre and extending influence by networking alternatives, cooperating with institutional and political stakeholders to access support and/or influence local decisions. As an accompanier explains: "In 2016, farmers were tinkering, today farmers can really help and advise each other".

Theoretical and practical implications

Our work has highlighted two conditions for fostering the transformative capacities of these initiatives (on a personal, collective and territorial scale): (1) understanding and cooperating with a diversity of actors (researchers and farmers) is a learning process in itself, requiring time, methods and resources dedicated to collective work; (2) collective work enables, at the very least, the sharing of resources and skills, facilitating change in individual practices; but to last over time and reach more farmers, participants must also share a common framework of activities, i.e. find coherence between the needs of each and what collective work can bring. But on this second point, must the group also share normative orientations, the same reasons and the same objectives? Our results show that this is necessary when the group is aiming not only for individual technical change, but also for political or social change. Indeed, sharing the same values and objectives is a factor in group cohesion and collective mobilization, and makes it possible to display a structured, legible discourse in order to find allies and influence institutions. This is the case, for example, of the goat breeders' union, which, by working on the issue of the use of phyto-aromatherapy in livestock farming, is mobilizing politically to bring about changes in national regulations on the use of plants. Finally, we also noted the importance of internal reflexive monitoring and evaluation as a factor of transformation: if we conceive of the agroecological transition as a bottom-up process, the fruit of multiple initiatives, it is particularly important to take care of the spaces and times for taking a step back from what we are doing, and to follow what is being done and said. This is a source of motivation, individual commitment and individual and social learning. We can draw some operational lessons for local authorities. They can facilitate the emergence of knowledge co-production initiatives, but also foster their capacity for transformation, notably by: (1) by granting them material, financial and technical support over the long term to enable experiments to be deepened; also by accepting the principle of experimentation without guaranteed results to unleash creativity; (2) by providing them with political support; in particular by recognizing and enhancing the forms of multi-stakeholder cooperation and hybrid knowledge that are produced; (3) by linking up the various initiatives; to facilitate coupled innovations (agriculture and food, for example) and the spin-off of innovations. Local authorities can also facilitate the work of supporting the agro-ecological transition by supporting the learning of collective work between the various actors and supporting "accompaniers" in perfecting their new profession (providing a toolbox, facilitating the exchange of practices, creating spaces for reflection and stepping back, etc.).

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Analysis of advisory services for agroecological transformation in Central Africa

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Abstract:
To achieve a transformation of the food system, it is essential to understand the factors and circumstances that shape the adoption of optimal combinations of agroecological practices. In this contribution, we aim to describe the nature of the advisory services and their function in promoting the shift towards agroecology through the operation of eight Living Labs established in the Democratic Republic of Congo, Burundi, Cameroon, and Rwanda. We aim to answer the following questions: i) Who are the actors participating in the national and local agricultural knowledge and innovation systems (AKIS) of the Living Labs? ii) What is the nature of their interrelationships and interactions? iii) To what extent are agroecological principles integrated into the AKIS? To answer those questions, we used a mixed methods approach combining: i) participatory mapping of the AKIS at local and national level with the members of the eight Living Labs and, ii) an online survey answered by 46 advisory service providers. As a result of the study, we described the key actors and their interactions (extension, value chain, authorities, development cooperation, research) in the adoption and scaling of relevant

agroecological practices, which are primarily influenced by the specific farming practices and the institutional context of the country.
Keywords: agroecology, AKIS, living labs

Purpose

Innovation networks are currently recognized as a basis for innovation generation, promotion, and scaling (Ndah et al., 2017; World Bank, 2006). These new arrangements are designed based on the concept of Agricultural Knowledge and Innovation Systems (AKIS) (World-Bank, 2006). For enhancing agroecological innovation systems and processes, and especially increasing end-user adoption, there is a need for mobilizing and strengthening the broad range of new and emerging advisory and innovation support services presently provided by a pluralistic field of service providers (Mathé et al. 2016; Faure et al., 2019; Ndah et al., 2018). The AKIS plays a role in developing the capacity to adopt agroecological practices and viable business models. We aim to characterize AKIS in DRC, Burundi, Cameroon and Rwanda. With this characterization, we aim to answer the questions, *Who are the support service actors engaged at national (country) and local (Living Labs) levels in enhancing the transition of the agricultural knowledge and innovation systems for agroecology*? *How do those actors relate and interact together?* and *How are the specific agroecological principles currently addressed within the AKIS, and what support needs to exist and are yet to be covered*?

Methodology

To address the mentioned gaps, we applied a mixed methods approach to systematically map and characterize AKIS, addressing three main units of analysis: national AKIS, Living Lab, and advisory service organizations. Through a process designed and executed together with project partners, three activities were conducted: *i) Mapping of AKIS actors at the national or provincial level; ii) characterization of advisory and innovation support service actors across Living Labs, and iii) characterization of advisory service institutions.*

Those activities were made in three phases. Firstly, an exploratory phase of desk review was conducted through online research. The main tools utilized were the Google Search Engine and Google Scholar. Sources taken into consideration ranged from scientific literature to project and program reports. For the inventory of advisory and extension providers, we used the database of the Global Forum for Rural Advisory Services (GFRAS) and the connected database of the African Forum for Agricultural Advisory Services (AFAAS). As a result of the literature review, an initial mapping of actors was drafted.

As a second step, the draft of the map based on the literature review was reviewed, validated, or reconstructed with country teams during different workshops. In those workshops, Living Lab members reviewed, discussed, enriched and validated the presented AKIS diagram. Additionally, each Living Lab mapped the actors at the local level that are influencing the adoption of relevant agroecological practices in their region.

Thirdly, an online survey of advisory service organisations in the countries was conducted. The surveyed organisations were identified by project partners and the African Forum for Agricultural Advisory Services (AFAAS). The survey covered six key areas: organizational profile, advisory topics and methods, staff characteristics, capacity building needs, funding, and relationships with other organizations. The project partners identified a list of organizations, to which an English and French version of the survey was sent by email. A total of 47 advisory service organizations responded to the questionnaire.

Findings

3.1 AKIS system at the macro (national) level

The AKIS systems show variations in the number of actors and the number of connections. In particular, the national AKIS for Rwanda has a large number of actors with fewer connections, while Burundi has the smallest number of actors but with more connections between them. Cameroon has the highest number of connections despite a relatively low number of actors, and the Democratic Republic of Congo (DRC) shows regional differences between northern Kivu and southern Kivu (Figure 1). Understanding the dynamics of actors and connectivity within AKIS systems is crucial for promoting cooperation, knowledge exchange, and the transformation of agricultural practices towards more sustainable and agroecological approaches.

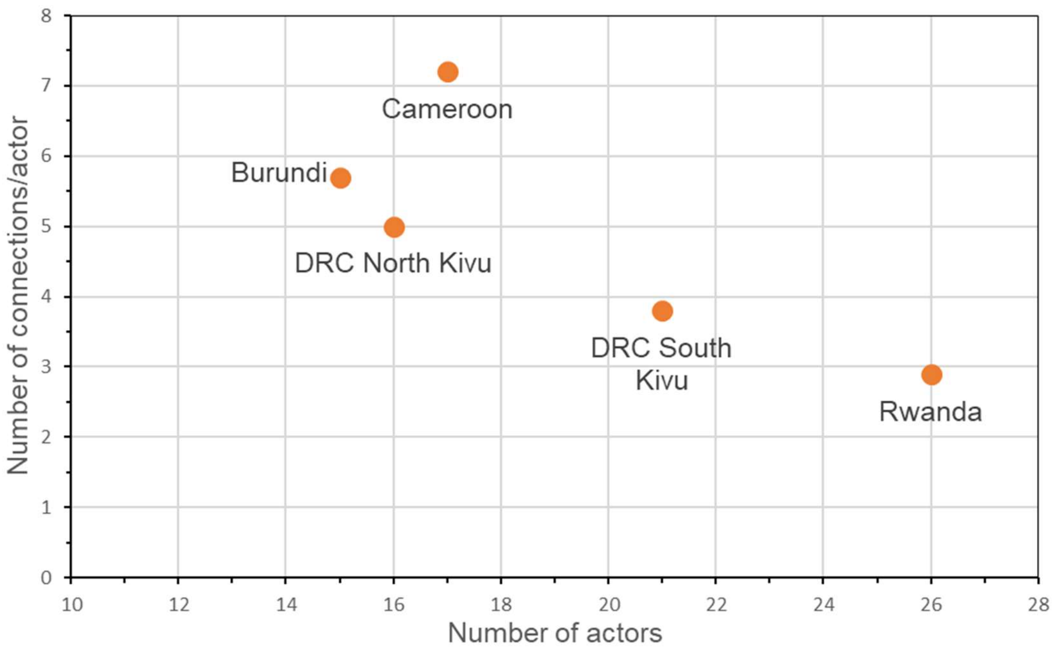

Figure 3: Countries distribution according to the number of AKIS actors and degree of connectivity.

3.2 Actors of innovation support systems at Living Lab level

At the Living Lab level, we found that there are important differences in the presence of organizations providing innovation support services for targeted agroecological practices. These differences may also indicate the possibility of sharing best practices in the adoption of agroecological innovations within regions or between countries. The findings suggest that different interventions are needed to address the unique conditions of each Living Lab (Figure 2)

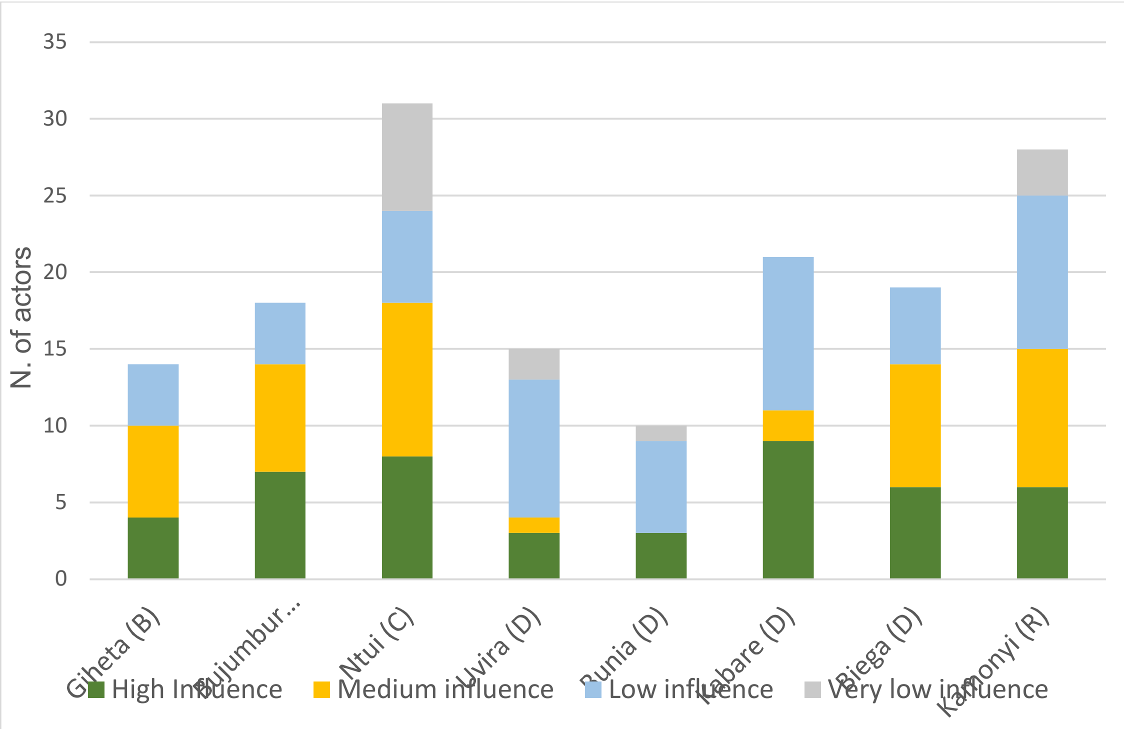

Figure 2: Number of actors by Living Lab according to the level of influence on the adoption of relevant agroecological practices relevant

3.3 Advisory service organizations

The organisations surveyed identified themselves as providers of services related mostly to training and capacity building, as well as the facilitation of knowledge exchange. In relation to the less present services, demand articulation and access to resources were mentioned (Table 1).

Table 2. Type of services provided (N=47)

Type of service	**TOTAL**	**Burundi**	**Cameroon**	**DRC**	**Rwanda**
Facilitate exchange of knowledge	**36**	11	13	11	5
Consultancy and backstopping	**22**	6	8	7	3
Networking/facilitation/ brokerage	**17**	4	10	5	2
Demand articulation (access to markets)	**12**	4	5	5	2
Enhancing access to resources (supporting access to funding)	**14**	5	6	2	2
Training and capacity building	**42**	10	15	13	6
Providing support for the design and enforcement of laws and regulations for agricultural innovation	**19**	5	8	5	2

Regarding the characterization of innovation support actors and their extension activities, we found that most extension organizations mention that they promote agroecological principles in their work. Agroecological principles related to the promotion of agroforestry, input reduction, and economic diversification have been widely mentioned. The extent to which this service provision is effective in promoting the adoption of agroecology needs to be investigated.

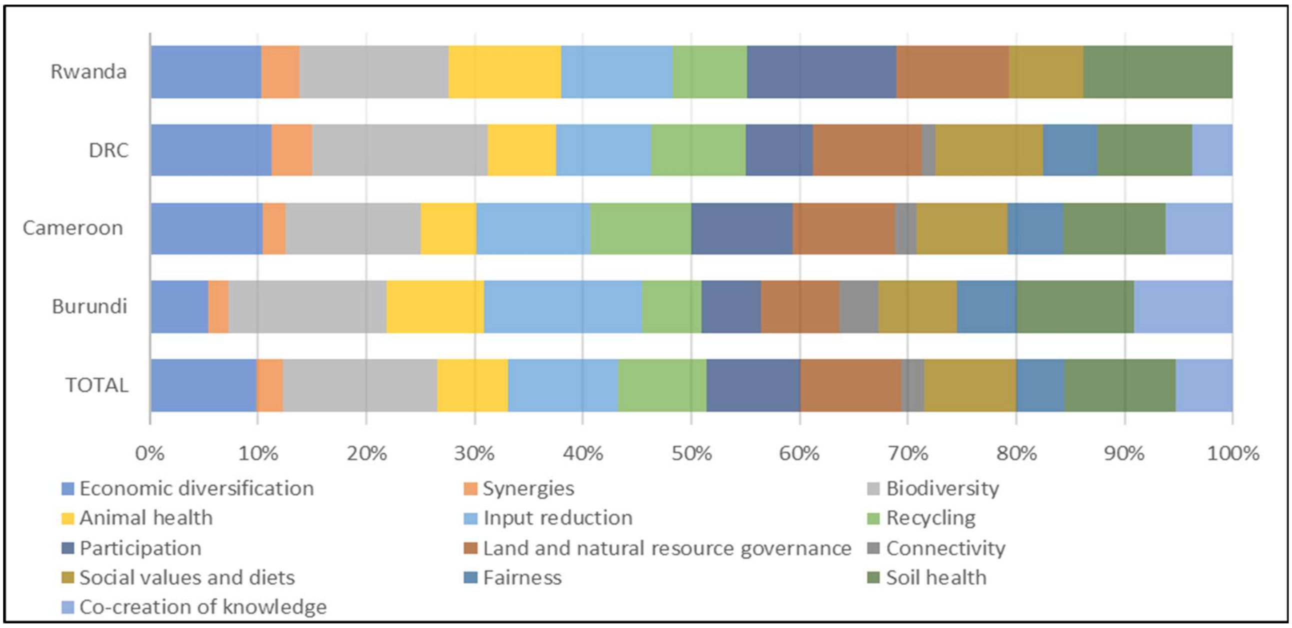

Figure 4: Agroecological principles (13) for which the organizations consider they have a relatively larger impact

Implications

4.1 Practical implications

From a practical perspective, the differences identified imply the potential for knowledge sharing across national borders, including collaborative initiatives between different countries and between different Living Labs. This approach recognises the value of using insights and experiences from different contexts to foster a more globally informed and interconnected agricultural knowledge landscape. A further area for improvement is the promotion of connections between extension programs, applied research, and universities. Such an approach could facilitate mutual learning and the capitalisation of collective efforts.

4.1 Theoretical implications

The findings highlight the necessity for further research on agroecological practices, with a particular focus on the specifics of these practices and how farmers and advisors perceive them. It is recommended that case-by-case investigations be conducted, with a focus on agroecological practices tailored for specific crops, in order to capture the localized difficulties of agroecological adoption and identify context-specific factors influencing its acceptance among farmers. Finally, it is proposed that research be initiated directly with advisors and extension agents in order to gain a deeper understanding of their roles and practices. Research conducted in collaboration with AKIS actors can capture individual perspectives, exploring the details of their activities and their impact on the promotion and adoption of agroecological practices. By studying these specific areas, the research can inform targeted strategies and interventions for advancing sustainable and innovative agricultural practices. Findings highlight the need for further research on agroecological practices, with a particular focus on the specifics of these practices and how farmers and advisors perceived them.

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The forgotten farmer: The social dimension when giving advisory support to farmers implementing regenerative practices in agriculture

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Abstract

Purpose: The purpose of this paper is to explore how a stronger emphasis on the social dimensions of farming in advisory services can support agricultural transformation towards more sustainable soil practices, using regenerative farmers' perspectives.

Research approach: The paper is based on a multi-methodological approach, using both qualitative and quantitative data from two different on-going research projects about soil health and sustainable soil management.

Findings: Swedish regenerative farmers are left alone to find relevant information concerning soil management, since advisory services are conventional oriented, lacking a more holistic and long-term perspective. In addition farmers tell about social stress and questioning from both colleagues and advisors in relation soil management practices.

Implications: As today's AKIS is not adapted to support transformative change at farm level, there is a risk that transformation will go slower than needed and that front running farmers miss support and even feel opposed leading to their psycho-social health being affected negatively.

Originality/Value: The paper highlight a dilemma called the *agricultural transformation paradox*: society demands transformative change in agriculture, but is unable to support the process.

Keywords: transformative change, regenerative practices, advisory services, social sustainability

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Background

In 2015, the world community adopted the UN 2030 Agenda for Sustainable Development, also known as *Transforming our World*. Ever since, the need for transformative change has been part of the worldwide sustainability discourse – in agriculture as well as in other sectors. According to Chan (2019) transformative change includes '*individual decisions to help build new social norms*'. The societal interest of agriculture, soil health and sustainable soil management (SSM) has increased internationally as well as in Sweden the last years, and agricultural soils has increasingly come to be seen as a resource in the climate debate through its potential to sequester carbon. At policy level, the importance of healthy soil conditions is at the heart of the *Green Deal for Europe* and one of the five EU missions, *Soil Health and Food,* is dedicated soil health issues. The mission's approach is based on the recognition that: 1) it is people and their action that need to change; 2) soils are dynamic living systems that deliver essential ecosystem services; and 3) soils can only be tackled within a systems' approach.

In recent years big actors in the Swedish AKIS has come up with strategy reports in order to develop a direction for future farming (Lantmännen, 2019; LRF, 2023). In these, improved soil health from a broad ecosystem perspective and the need for a transformation of agriculture, is not obviously considered. The Federation of Swedish Farmers' report 'Costs of Agriculture Green Transition' (LRF, 2023) quote Eriksson (2021) who state that '*the condition of the soil in terms of content of organic matter, pH and plant nutrition is generally good* [in Swedish soils]' (LRF, 2023). However, the report also refer to an own survey of Swedish farmers who claim that the biggest threats to soil health on their farms are insufficient drainage followed by low pH and low humus content (LRF, 2023). In 'Focus on Nutrients', the large Swedish governmental funded environmental advisory program, soil health and soil as a provider of a broad range of ecosystem services is hardly not mentioned (In English - Greppa). This despite that several investigations regarding the future of Swedish agri-food system emphasise that advisors are key actors in bridging between actors and supporting farmers to find new transformative paths (Hansson et al, 2021; SOU 2015:15).
Ingram and Mills (2018) have put the question whether advisory service is 'fit for purpose' to support SSM, concluding that there is a great need for building capacity regarding these questions. They list several aspects in the whole knowledge chain that need to be improved (ibid). Ingram et al (2022) further highlight the need for changing the professional culture and mindset at both organisational and individual level within advisory organisations to support the development of SSM practices on farm level. Obviously, there are several gaps between policy, research, advisory service and farming practice and the view about what kind of transformation is needed and how to work with soil health issues. Hence, the preconditions for Swedish farmers to get adequate advice related to soil health issues are not very good.

Purpose

The purpose of this paper is to explore how a stronger emphasis on the social dimensions of farming in advisory services can support agricultural transition towards more sustainable soil practices. We use the case of regenerative agriculture to discuss these aspects.

Research approach

This paper is based on a multi-methodological approach, using both qualitative and quantitative data from two different on-going research projects about soil health and SSM in Sweden. In this paper, we use the expression regenerative farmers to describe the farmers engaged in these agricultural practices. The projects are interdisciplinary, having both a natural science and a social science part.
The first project is studying fields and farmers along a west-east transect in Sweden, in order to capture a variation of growing conditions due to differences in precipitation (ranging from 1000-1200 mm on the west coast to 500-600 mm on the east coast). The social science part of the project is studying farmer experiences of extreme weather, their view of soil health and yield stability and what they perceive as problematic/challenging in their crop production. Data has been gathered by qualitative semi-structured in-depth interviews and a quantitative online Netigate survey to farmers in the study regions. The survey was distributed through two different channels:

1) through the customer register of the two advisory organisations participating in the research project (one for each region) and 2) through regional newsletters from the Swedish national environmental advisory programme 'Focus on Nutrients'. In total, the survey was responded by 118 farmers. The answers were analysed in SPSS.
The second project follows three groups of farmers, who are interested in SSM practices to increase soil health, albeit through different measures. The data from these farmers are both as semi-structured in-depth interviews as well as field notes taken during soil sampling and digital meetings. In this project we also have field notes from meetings and discussions with advisors about soil health and SSM practices.

Findings

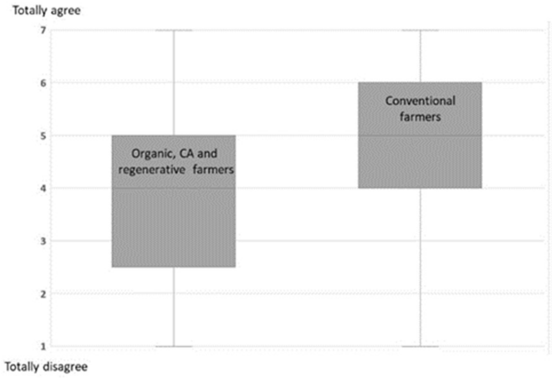
A group of farmers that are learning on their own

A recurring comment when discussing learning and advisory services with Swedish farmers engaged in SSM and regenerative agriculture, is that they feel that they to a large extent is left to their own learning journey. They claim that there are very few advisors who are knowledgeable about soil health improving measures who can help them adequately. There are also very few relevant field trials that support them in their decision making. This means that they need to find relevant information themselves (from Internet and farmer colleagues around the world) and to make the regenerative methods work in practice. Sometimes they turn to advisory services abroad, to for instance Denmark, Norway and England, to find relevant support (see Box 1).

An advisory service based on a conventional norm

In the online Netigate survey, the farmers where presented to two different kind of questions: *i)* questions to describe themselves and their production (i.e. age, number of hectares, kind of farming system, number of crops in the crop rotation, soil management strategies, etc.) and *ii)* statements related to extreme weather and soil health related issues. The second part used a 7-grade Likert scale, where the farmers should judge to what extent they agreed on certain statements, ranging from 'totally disagree' (1) to 'totally agree' (7).
In one of the questions the farmers were presented by the following statement*: 'I have the support I need from advisory service regarding soil and soil health issues'*. The mean value of all answers was 4,67 – hence slightly above a neutral response. Since the farmers were reached through different advisory channels (both private and public), thus being farmers that both use and pay for advisory services (albeit to different extent), one could have expected that the mean value would have been higher among these respondents. When analysing the answers based on farming system, it become obvious that the satisfaction of advisory services varies between farmer groups (Figure 1). While the conventional farmers had a mean value of 4,99, all other farmers except the conventional ones (organic, regenerative, conservation agriculture) had a mean value of 3,93. It is also worth noting that both groups had answers ranging from 1-7. Obviously, farmers who are breaking the conventional norm have problems finding adequate advisory support.

Figure 1. Two different farmer groups' answers to the question: *I have the support I need from advisory service regarding soil and soil health issues*.



The Likert question was followed by a free answer-question: *'If you are not satisfied with the advisory service, please tell us what you would like to have'*. The comments indicate that today's advisory service is based on a conventional norm, and that regenerative farmers are missing advisors taking a more holistic and long-term perspective of the processes on the farm. This is in line with earlier studies of Swedish advisory system, showing that advisors tend to focus on discussing here-and-now-question of rather limited problem-solving character (Höckert, 2017; Lindblom and Lundström, 2014).

Box 1. Quotes from Netigate survey in relation to the question 'If you are not satisfied with the advisory service, please tell us what you would like to have'.

« Advice from whom? The advisors who may be available are trained in chemistry/large-scale agriculture. There is a lack of biological knowledge and a holistic view of nature. »

« Today's advice is still based on traditional cultivation methods, so the experiences and innovations in crop cultivation that are carried out without ploughing and with reduced soil tillage are our own. »

« It is difficult to find advisors with experience in soil health. I don't want to train advisors without getting something in return. The advisors you get abroad are expensive and you only get an introduction. Sometimes I wish someone would come and show me what improvements I have made and if it has even gotten better. It is easy to interpret signs and just as easy to doubt. »

« More focus on long-term advice. »

« You seldom hear about advisory services like that. »

Norm breaking practices that leads to irritation and questioning

Regenerative farmers are, to varying extents, norm-breakers who are challenging established knowledge and conventional soil management practices in order to find more sustainable ways of managing their soils. One recurring theme in our interviews and conversations with these regenerative farmers are what they think restricts farmers in general from applying more soil health friendly management practices on their farms. When they talk about their own soil health learning journey, it often includes stories of feeling questioned – both by farmer colleagues and other actors within the agricultural sector (see Box 2). Some of them have even quit talking about what they do on their farm in public, because they are so tired of being questioned. A common comment among regenerative farmers is that the biggest change that takes place when changing soil management strategy, is the one that takes place in your head. These comments are supported by Wramsler et al (2021) who discusses the role of internal change in order to achieve external sustainability. Farmers also testify that they feel that advisors react with irritation when they hear about soil management practices that goes against established norms and knowledge. There are even advisors who claim that 'soil health has become religion' (Box 3), which illustrates the scepticism that exists within the group of agricultural advisors.

Box 2. Quotes from farmers applying regenerative farming practices.

*« How do you have the strength to be creative and believe in yourself when people look at you with askance because you are breaking the norm? » (*A question put by a farmer during a conversation about what he thought restricts farmers from working with farm management improvements in order to increase soil health.)

*« I don't talk loudly about what I do anymore. » (*Quote from a regenerative farmer who is working on increasing the soil health on his farm and who is tired of being questioned.)

*« When some of the advisors heard NN [a pioneer advisor in soil health] talk about his experiences, several of the advisors reacted with irritation - not curiosity. » (*Quote from a farmer after having visited one of the agricultural fairs in Sweden where NN gave a speech.)

« The biggest change that takes place in the development towards new management practices is the one that takes place in the head. » (The quote appears in repeated interviews in slightly different forms, but the meaning is shared by several farmers

Self-critical advisors exists

It is, however, not only farmers who express criticism regarding the lack of advisory services related to soil health issues. Even among the advisors there are self-critical voices about the lack of advisory services offered. One key actor admits that the development of soil health knowledge is driven by the farmers themselves, and that it would be good if advisory services would be able to support them better (Box 3). And during the planning meeting of a Soil Health Day, a senior advisor stated that he believed having had the wrong focus in his work so far. Also from earlier conversations with advisors there has been self-criticism expressed regarding the focus in advisory services in general. One senior advisor even said *Advisors are busier filling their working hours with different work tasks, than putting themselves in the farmer's shoes thinking about what he/she would really need.'*

Box 3. Quotes from advisors active in the soil health discourse.

« Today, the development [of knowledge in relation to soil health] is driven by the farmers themselves. It would be good if advisory service could support them. » (Quote from a key actor in the Swedish advisory system.)

« I feel that I have been working with the wrong focus all these years. I have focused on plant nutrition. After all, it is soil and water that are important. » (Quote from a senior advisor said during a meeting when we planned a soil health event to farmers.)

« Soil health has become religion. » (Quote from an influential key actor in the Swedish advisory system.)

Practical implications

Farmers are, as other people, faced by several stressors (Mynak, 2022). It is in the light of these stressors, that the transformative change expected from society – at least on UN and EU level – should be understood. Even if some of the stressors (like climate-related and economic) can work as drivers for the requested change, they could also work inhibitory. A newly released report stated that almost 40% of the Swedish farmers are worried about their economy, followed by politics, governmental decisions and lack of understanding from politicians and the general public (Landshypotek, 2024).

As today's AKIS is not adapted to support transformative change at farm level, there is an obvious risk that the transformation will go slower than needed and that farmers who dare to be frontrunners feel opposed leading to their psycho-social health being affected negatively. When the public sphere demands change, but is unable to support it, farmers are in a catch 22. We call this the *agricultural transformation paradox*.
Advisory encounters are to a large extent a social activity. But issues regarding farmers' well-being and socio-psychological situation are seldom topics for serious conversations, more than at accidental basis. We argue that it is due time to take social dilemmas of sustainability seriously and to better equip advisors for dialogues beyond their specialisation. Moreover, we argue that there is reason for the entire AKIS to think about how we view and meet those who break norms and try to develop agriculture in a more sustainable direction. The urge for a resilient agriculture must also include resilient farmers.

Theoretical implications

The case of regenerative farmers in Sweden, as an example of sustainability frontrunners who are questioning established norms and knowledge to transform their farms in a more sustainable direction, highlights at least four things for future research to explore further:
The gaps between policies on UN/EU level and the different strategies and priorities among national AKIS actors pinpoint the need for leading national actors to jointly discuss and agree on *if* a transformation of the agricultural sector is needed and, if so, *what* that would mean for their operations. We claim that if, for example, soil health and SSM practices would get higher priorities, the needed capacity building mentioned by Ingram and Mills (2018) would probably be accelerated.
The regenerative farmers' testimonies of feeling questioned for breaking norms – even though that is the only way of reaching transformative change – adds yet another stressor to the list of potential stressors that use to be included in studies about farmers' psycho-social health (e.g. Mynak, 2022). How widespread is this feeling among farmers and how does it affect them in their profession?
Building on the point above and including the experiences of advisors reacting with irritation when confronted by experiences and practices that are norm-breaking, raises the need for further cultural changes among advisors than those earlier mentioned by Höckert (2017) and Ingram et al (2022). How could we better equip advisors (as well as other key AKIS actors) to dialogues beyond technical/biological/economical aspects of farming, where also the social dimensions of farming is included?
Lastly, a question for self-reflection. Despite over 40 years of farming systems research, there are still gaps between our view of farming as a socio-biological-technical system with the *farmer* at the centre and the advisory practice focusing on biological and/or technical issues. How could it still be so divergent? How can we get better at emphasizing the role of *people* in agricultural sustainability work – when fundamentally, transformative change is about people who act in a different way?

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GOING DIGITAL

Short food supply chains go digital: Development of a competency framework for farmers

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Abstract:
The wealth of research on agricultural digitalization has not yet arrived at a framework describing essential competencies that allow farmers to cope with the digital transition. In the present study, we attempted to offer such a competency framework by focusing on farmers who distribute their products through short food supply chains and following a mixed research design. In parallel, we investigated how conceptions of digitalization affect the prioritization of such competencies. A first qualitative strand involving a workshop with experts led to the theoretical identification of 26 digitalization-related competencies. Drawing on data from Greek farmers and advisors, in a second strand, we uncovered that these competencies can be divided into seven sets. Notably, the importance ascribed to different competencies is affected by participants' perceptions of the transformative potential that digital technologies incorporate. As the analysis revealed, conceptions of digitalization as a driver of radical change are associated with attributing higher importance to future-centered competencies, whereas understanding digital technologies as enablers of incremental change is related only to the development of technological literacy.
Keywords: short food supply chains, agricultural digitalization, social change, competencies, alternative food networks, digital transition

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Purpose

Digital agricultural technologies have the potential to change farming, farmers' lives, and rural societies (Forney and Epiney, 2022; Rose et al., 2021; Shepherd et al., 2020). From a theoretical standpoint, the term "change" refers to transformations of the society as a whole or specific areas of socio-economic life. In this work, building upon De la Sablonniere's (2017) typology of social change, we distinguished four types of change: stability, which represents the situation in which the emergence of digital technologies affects only a limited number of people without significant societal consequences; inertia, in which social structures and systems activate mechanisms allowing them to maintain stable despite the emergence of digitalization; incremental change that leads to gradual – and slow in pace – digitally-guided transformations; and radical change – termed "dramatic" by De la Sablonniere (2017) – which describes fundamental transformations with intense impacts for social groups and/or the society.
To cope with the last two types of change, actors should develop new and sharpen or adapt existing competencies. Scholarly work describes a variety of relevant competencies, ranging from utilizing technologies to developing skills in digitally-enabled farm management to change value creation practices (Michailidis et al., 2024; Heitkämper et al., 2023; Ingram and Maye, 2023). Nevertheless, little is known about the competencies required to help farmers who follow alternative food production and/or distribution paradigms deal with the change that digitalization initiates. In the present study, which reports on data surveyed in the project "Digitalizing Short Food Supply

Chains," we turned our attention to farmers directly selling their products through short food supply chains (SFSCs), pursuing a twofold aim. First, to develop a farmers' competency framework for effectively dealing with digital transitions. Second, to examine how the perceived nature of digital transition (i.e., inertia, incremental change, or radical change) affects the importance of these competencies. In so doing, we sought to include forward thinking to the development of our competency framework, thus understanding how the pace, breadth, and significance of changes associated with digitalization affect the competency priorities.

Design/Methodology/Approach

To answer our research questions, we followed a mixed research design. As a first step, we conducted a workshop to identify initial competency areas. The workshop participants were eight persons with expertise in agricultural digitalization and experience in designing agricultural training programs. Experts were asked to reflect on the opportunities and challenges of agricultural digitalization, and, considering the potential specificities of SFSCs, propose critical competency areas for farmers who will adopt digital technologies in the near future. A collective elaboration of these areas followed the process to allow for a better description of them. After the workshop, we scanned the agricultural digitalization and competence development literature to refine these competency areas further. Such a procedure allowed us to divide some areas. For instance, we split the general area labeled "understanding digital technologies" into the more basic competence to understand the potential uses of technologies (Ozdogan et al., 2017) and the ability to capture their value (Charatsari et al., 2023). This way, we arrived at a list of 26 candidate competencies. In a follow-up stage, we performed a quantitative study involving 140 farmers (36.1% women; mean age=37.3 years, S.D.=10.2) distributing their products through SFSCs and 42 advisors (61.9% men; mean age=47.5 years, S.D.=6.1) who collaborate with them.

To evaluate competencies, we created a scale including the candidate competencies, rated on a five-point response range from "not at all important" to "very important." A principal axis factor analysis revealed seven factors cumulatively explaining 75.7% of the total variance. We named the factors based on the items they comprised. The seven competency sets identified were aptitude development, creation of new business models, digi-visioning, digitally-enabled decision-making, digital intuition, transition navigation, and technological literacy. An item was excluded from our analysis due to low loading. In all cases, Cronbach's alphas were satisfactory, receiving values greater than 0.87. Table 1 presents the results of factor analysis and the summary statistics for each category of competencies.

We also constructed three measures to assess participants' perceptions of the transformative potential of digital agricultural technologies. Combining items referring to the pace, breadth, and significance of the change that can follow digitalization, we created scales for inertia (example item: The digitalization of agriculture will only affect a small group of people), incremental change (example item: The digitalization of agriculture will moderately change farmers' lives), and radical change (example item: The digitalization of agriculture will have significant social impacts). In all cases, factor analyses confirmed that scales have a unidimensional structure. Cronbach's alphas had satisfactory values (>0.80 in all cases).

To perform comparisons between and within groups we used independent and paired samples t-tests, respectively. We also built seven simultaneous regression models to examine if and how the perceived type of social change affects the importance attributed to the seven competency clusters, using as response variables the emerging sets of competencies and as independent variables the three types of change.

Findings

3.1 Qualitative strand

The first stage of the study uncovered 26 potential competencies associated with the digitalization of farms. During the workshop, experts emphasized the need to see beyond pure technological competencies, stressing that digital technologies can transform farming and farm work, therefore generating the need for adopters to reorganize work routines and operational paradigms to adapt to digital transition. Notably, the competencies described included the capacity to learn through experimenting with technologies and the ability to re-think how technological evolution will affect farming practice.

Table 1. Categories of competencies and summary statistics for the samples of farmers and advisors

Scale/*example item*	**Number of items**	**Mean score (S.D.)**	
		Farmers	**Advisors**
Aptitude development *Building new skills through the use of digital technologies*	4	3.09 (0.85)	3.24 (0.45)
Creation of new business models *Integrating technologies into existing operational models*	4	3.05 (1.03)	3.46 (0.49)
Digi-visioning *Understanding how digital agriculture will evolve*	4	3.15 (0.71)	3.60 (0.45)
Digitally-enabled decision making *Use the information offered through digital technologies to make farm management decisions*	4	3.51 (0.53)	3.21 (0.60)
Digital intuition *Recognizing the opportunities that digital technologies create*	3	3.77 (0.45)	3.10 (0.62)
Transition navigation *Reorganize the farm after adopting digital technologies*	3	2.81 (0.89)	3.26 (0.57)
Technological literacy *Use digital technologies in everyday farm tasks*	3	3.47 (0.70)	3.17 (0.66)

3.2 Quantitative strand

For farmers, paired samples t-tests showed that digital intuition competencies received a significantly higher mean score than all other categories of competencies ($t>4.16$, $p<0.001$ in all cases). Competencies referring to making decisions through the use of digital artifacts and technological literacy skills also had significantly higher mean scores than the remaining sets of competencies ($t>3.80$, $p<0.001$ in all cases), while, between these two categories, the difference was not statistically significant ($t=0.65$, $p=0.514$). For the sample of advisors, digi-visioning and the capacity to create new business models received significantly higher mean scores than the remaining sets of competencies ($t>2.1$, $p<0.05$ in all cases), with the exception of the competencies related to transition navigation that had a non-significant difference from business models creation.

Independent sample t-tests showed that advisors attribute higher importance than farmers to the competencies needed to effectively navigate the digital transition (t=105.18, p<0.001), build new business models (t=147.05, p<0.001), and envision the digitalized future (t=110.00, p<0.001). On the other hand, farmers emphasize the need to acquire digital intuition and decision-making competencies more than advisors (t=7.65, p<0.001, and t=3.17, p=0.002, respectively).
Concerning the transformative potential of digital technologies, the conception of digitalization as radical change had the highest mean score (M=3.47, S.D.=0.88), followed by the scale referring to incremental change (M=2.91, S.D.=1.05). The difference between the two scores was significant at the 0.001 level (t=6.62). The conception of digitalization as inertia had a significantly lower mean score than the above-mentioned variables (t>7.38, p<0.001 in both cases).
Our regression models uncovered that the different conceptions of digitalization-guided social change are associated with the importance attributed to some of the identified sets of competencies. The perception that digitalization can radically transform agriculture is significantly related to future-centered competencies like aptitude, development of digitally-enabled business models, digi-visioning, and transition navigation, also showing a positive association with technological literacy. On the other hand, the analysis demonstrated that conceiving digitalization-guided social change as inertia affects the importance attributed to technological literacy.

Practical Implications

In this work, we provided a competency framework outlining pivotal competencies required to help SFSC farmers undergo digital transitions. Our results underscore the importance of enhancing farmers' competency levels in a broad array of areas, including competencies that receive limited attention by policy-making, such as digi-visioning, the ability to create new business models, and transition navigation. Training programs targeted at farmers who distribute their products through short supply conduits should equip trainees with intuition competencies and skills that permit them to shift from experience-based to digitally-enabled decision-making. To move in this direction, training providers have to understand digitalization as a process that can alter agriculture and the very nature of being a farmer, which requires more than just technical competencies on the part of farmers.

Theoretical Implications

From a theoretical viewpoint, the present study adds to the relevant literature the concept of change-related and future-centered competencies, revealing that prioritizing competencies should thoroughly consider the transformative potential of digital technologies, and be based on forward-thinking. Notably, although such thinking represents a central component of agricultural digitalization literature and lies at the center of many studies (e.g., Eastwood et al., 2021; Fleming et al., 2021), it has not yet penetrated the field of research dedicated to uncovering farmers' digitalization-related competencies. Future researchers can also exploit our conceptualization of social change to understand farmers' adaptation strategies to digitalization and the tactics actors operating in agrifood systems follow to manage rapid and high-impact change.

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A European perspective on skills needed for digital transitions in agriculture

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Abstract:

Several scholars have underlined the role of agricultural digital technologies (AgTech) as one of the main drivers to reach successful agricultural transitions. Indeed, AgTech is expected to contribute to resource savings while increasing on-farm productivity. However, AgTech diffusion in farms is not as fast as expected, moreover the lack of use of new technology represents a new form of digital divide. Our aim is to understand the mismatch between the new skills needed for using digital technologies and the current educational programmes. To better understand perceptions on the skills needed, in this work we present the results of a survey administered with AgTech stakeholders in five European countries. The survey was organized in three parts: respondent sociodemographic, AgTech use and barriers to its diffusion, and perception of the skills required for its use. Findings showed different perceptions among respondents. Nevertheless, all pinpointed similar barriers to the spread of digital technology, confirming a general need for renewed educational and training programmes for better understanding and mastering digital technologies.

Purpose

In the last decades, there has been a fast development of digital agricultural technologies (Agtech), expected to contribute to save resources and increase on-farm productivity. Many researchers have analysed the adoption and the different barriers that prevent the spread of precision agriculture (Pathak et al., 2019; Novak, 2021). Several of them have focused their attention on the skills needed to manage the agricultural technologies (Kitchen et al., 2002; Michailidis et al., 2019; Bournaris et al., 2022). The future agricultural workforce will be influenced by technologies and digital solutions that will likely change the way people work (Ayerdi Gotor et al., 2020). However, an accelerating lack of proficiency in operating these digital technologies and devices can be observed**.** One aspect of this issue may be the mismatch between farmers and training providers due to a lack of communication and mutual understanding of requirements, opportunities and challenges (Lang & Bleasing, 2022). This research was carried out within the context of the Erasmus+ LATEST project, aimed to understand the mismatch between the digital skills needed and the current educational university programmes. In this framework, we present here the results of a survey made among different stakeholders of the AgTech in five European countries to understand perceptions and barriers on the skills needed for the spreading of AgTech.

Design/Methodology/Approach

Table 1 shows data from an online survey targeting 68 actors of precision agricultural technology supply chain, namely farmers and contractors (Group A), dealers and manufacturers (Group B), technology and data providers (Group C) according to the precision agriculture technology supply chain provided by Rizzo et al. (2021).

Table 3 : Survey distribution per stakeholder and country

	France	United Kingdom	Austria & Germany	Italy	Total
Farmers and contractors	2	9	3	8	22
Dealers and manufacturers	6	6	15	2	29
Technology and data providers	1	6	7	3	17
Total per country	9	22	25	13	68

The survey was administered between May 2023 and September 2023 in Italy, France, UK, Austria, and Germany. Stakeholders were selected according to partners' contacts in each country and enlarged until reaching a satisfying numerosity through a snowball approach. The survey included three sections: a sociodemographic part (age, gender, level of education…), a section concerning professional practices, and a third section accounting correspondent experience in precision agriculture with details about the required skills. The definition of the different skills required was implemented through a literature search on the articles and reviews dealing with educational needs for AgTech, having a focus on agronomic and data analysis skills and other skills. This review allowed us to identify six papers indicating several types of skills and knowledge areas (Table 2).

Table 4 : Skills needed for AgTech in a literature survey.

Autors	Agronomical skills	Data Analysis skills	Other skills
Kitchen et al., (2002)	Agronomical	Data analysis, GIS, Spatial data analysis	
Bullok et al. (2007)	Agronomical	Data Interpretation	Engineering, Economics
Michailidis et al., (2019)	Agronomical		Environmental, Technical, Management
Baptita, et al., 2021	Agronomical	ICT	Environmental, Management
Bournaris T., et all., 2022			Technological, Legislation, Local community leadership, Business & management, Marketing, Sustainability

Puntel L.A., et all, 2023	Agronomical	Data processing & analysis & interpretation	

For the data analysis of the survey, we performed both a quantitative analysis (descriptive statistics and differences among groups) using the Real Statistics Using Excel software and qualitative analysis on textual responses using TagCrowd to identify the most important items. Last, ChatGPT was used to find the most common discourses per each question of the survey.

Findings

As expected, the sample showed a heterogeneous age distribution, with female representation low but homogeneous (10-20%). In the group A, 50% of the activity was in the cereal sector and livestock breeding was less represented. Most of the farms where larger than 100 ha. In the group B, most of the surveyed people are the managers and their clients are mainly farmers or contractors. In the group C, most of the surveyed people were the managers and the 60% were in the precision agriculture sector since less than 10 years; 86% of them provide agronomic recommendations to their clients, which are for a half farmers or manufacturers. Regarding the use of technology in farming, the 60% of respondents declared to use a digital tool for their job. The most commonly used software were Field View and My John Deer. Concerning machine equipment, guidance was the most common (46%) as also underlined by Ayerdi Gotor et al. (2020). Data used by farmers were provided by agricultural machinery 39% and satellite data 30%, and are used especially for sowing, fertilization, and harvest. Only the 35% of sampled farmers had received a specific technological training, in most cases (71%) directly from the technology provider. However, the 43% of them declared that the training was not helpful.
About the skills needed in precision agriculture, there is an agreement among the three groups on the mechanics and the engineering skills, whereas a different importance devoted to economics/business or agronomics according to the group was found. Particularly, for Group A, agronomy & ITC emerge as the most important skills, whereas for Group B and C they are IT and economy/business. Surprisingly, there is no distinction between groups in the ease of use of technology. The skills lacking in the job market of precision agriculture concern mostly ICT, followed by business and economics for the group B, agronomic for groups C-D and engineering for group A. Table 3 summarizes the stakeholders' point of view about the barriers limiting the AgTech spread using the most frequent words appeared in the surveys. There are some differences between the stakeholders, the survey A respondents highlighted the cost as the main barrier, followed by the economic uncertainty about the returns and the lack of knowledge. The focus points of the respondents to the group B are the problems about the use of new technologies: fear of the unknown, limited accessibility and affordability of technologies, Interoperability challenges between machines and databases, followed by lack of knowledge, lack of direct economic visibility, lack of competence among support staff. For the respondents from the group C the main barriers are the costs for farmers and lack of competences.

Table 3: barriers limiting the spread of AgTech according to the surveyed sample.

Category	Type of barrier
Technology and data	**Lack of Knowledge and Technical Skills**
	Poor Information Technology Skills
	Compatibility Issues

	Complexity and Lack of Interoperability
	Data Privacy Concerns
Affordability	**High Initial Costs**
	Uncertain Return on Investment
	Commercial Pressures
Knowledge	**Lack of Knowledge and Technical Skills**
	Poor Information -Technology Skills
	Insufficient Training
Other	Fear of the Unknown
	Advanced age of Farmers
	Resistance to Change
	Limited Government Subsidies

Table 4 summarises the answers to the question about what should be done to foster the adoption of AgTech. Even in this case there are some differences between stakeholders. Concerning group A, key actions identified include prioritizing training and skills development, expanding training opportunities, and emphasizing practical applications of AgTech. These measures aim to ensure training relevance and applicability to real-world farming contexts, thereby fostering effective AgTech utilization. Similarly, technology simplification and IT training were found to be relevant also for group B. Stakeholders in the group C highlighted the importance of ease of the technology use and its standardization followed by economical and technical support to farmers and the training for all categories.

In summary, of the action that could be contribute to the wider adoption of Agtech, according to the respondents, are comprehensive approach involving education, financial support, technological advancements and awareness campaigns. Factors such as high initial costs, knowledge gaps, and interoperability issues are identified as key barriers. Overcoming these obstacles is imperative for the successful dissemination of AgTech solutions and their effective integration into agricultural practices.

Implications

The goal of this research was to identify the main skills needed for the implementation of AgTech by several stakeholders' groups relevant for its use (farmers, contractors, dealers and manufacturers, technology and data providers). In fact, several authors underline the lack of updating of university curricula on specific skills and competences related to technology and technology use (Charatsari et al., 2023). These university curricula can also be open to professionals through the implementation of micro-credentials (Council of the European Union, 2022) but there are still some institutional constraints for their development. After a first literature search, we were able to identify relevant domains related to skills rather than specific skills. These domains were used within the survey to identify the main skills needed in the implementation of AgTech. We believe that more qualitative research will support a clearer identification and characterisation of specific skills, starting from group discussion. Some interesting insights from the respondents on the main actions to be implemented to increase the adoption of Agtech were identified, such as “field demo” or “demo on the practical use of data captured” identified mainly by practitioners (farmers, contractors and dealers), or «improve the IT part of agronomic education», «train the farmers» or «more on farm training for staff» underlined that still education and training on AgTech are quite sectoral and lack of interdisciplinarity. This research involved mainly actors close to AgTech, either because they have adopted them in their farm or because they are working in the AgTech field. However, we have to consider that there are still some issues about adaptation of digital innovations to users, privacy and data ownership that should be considered in future trainings and academic programmes. In particular, a transdisciplinary approach linking the different players can support integrative solutions that look at a combination of technological, ethical, social, economic and business challenges (Klerkx et al., 2019).

Table 4: actions to be done to increase the use of AgTech according to the surveyed sample.

Category	Type of action
Technologies	Simplification and Usability
	Data Processing and Integration
	Global Standardization
	Demonstration of Practical Uses
Support Economy / Costs	Financial Support
	Economic Incentives
	Government Policies
	Technical Support and Research
	Individualized Approaches
Training education	Improvement of Skills
	Promotion of added Values
Other actions	Awareness and Promotion
	Collaboration and Communication

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Evaluating Swedish dairy farmers' experiences of the digital work environment of automatic milking system over a long-term horizon

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Abstract:
Adopting automated milking systems (AMSs) aligns well with the technology-oriented development of farming. It has been revealed that implementing AMS significantly alters the work practice of milking and the relationship with the cows, which now is re-configurated around the AMS and related digital tools. From a care perspective, this study aims to understand dairy farmers' positive and negative experiences of the digital work environment when using AMS over time. Data were collected from four Swedish dairy farmers using contextual inquiry and the user experience (UX) curve method. The findings reveal that although the farmers experienced the AMS very positively, there were more negative experiences related to various apps and farm management systems. The most negative experience appeared to be the distance between the AMS display and the robot arm when there was a need to support the cow or heifer in the milking robot manually. The implications are that more interdisciplinary research should be conducted where UX researchers focus more on farming, placing the farmer at the centre and the need for a shift from the dominant technocratic paradigm to the farmer's care of cows, people, and technology, which are necessary to foster sustainable farming practices.
Keywords: Automated milking systems, Dairy farmers, User Experience, Digital work environment, Care, Social sustainability

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Purpose

The ongoing and global technology-oriented agricultural trends, often denoted as smart farming, digital agriculture, and agriculture 4.0, represent agricultural production in the dominant technocratic paradigm (Klerkx et al., 2019; Lioutas et al., 2019; Liu et al., 2020; Rizzo et al., 2024), and have made Swedish farms more technology-dependent. The rise and adoption of automated milking systems (AMSs) align well with this technology-oriented development since they entail additional possibilities for data collection of the cows to increase milk production and monitor cow health (Martin et al., 2022). Beyond these aspects of milk and cow conditions, implementing AMS mainly results in a positive physical work environment since the heavy physical tasks related to milking are reduced or eliminated (Lundström and Lindblom, 2021; Lunner-Kolstrup., Hörndahl and Karttunen 2018). However, new cognitive tasks, such as various mental strains due to night alarms, lack of sufficiently skilled labour and milking 24/7, have been added on dairy farmers and their staff (Lundström and Lindblom, 2021; Lunner-Kolstrup et al., 2018; Martin et al., 2022). In Sweden, the adoption of AMS has been steady, and there are indications that AMSs at a general level meet the expectations. However, it has been revealed that implementing AMS significantly alters the work practice of milking and the relationship with the cows, which now is re-configurated around the AMS and related digital tools (Finstad, Aune and Egsweth, 2021; Lundström and Lindblom, 2021; Rose, Barkemeyer and de Boon, 2023). It is therefore necessary to study how the AMS impacts the digital work environment embedded in farmers' work practices from a care perspective (Krzywoszynska, 2015), which includes people, technology, and cows over time (Lundström, 2022; Lundström and Lindblom, 2021). The care perspective inspired us in the present paper due to its criticisms of the techno-centric and productivist trends in agriculture (Lundström, 2022).

Researchers in human-computer interaction (HCI) and user experience (UX) have studied the digital work environment within various socio-technical systems such as healthcare, information technology development, transportation, and public authorities (Sandblad et al., 2018; Simsek Caglar et al., 2022). UX is about the positive or negative emotional impact that users experience through using technology in a particular context based on their needs, preferences, expectations, and goals before, during, and after interacting with technology (Roto et al., 2011). This means that the real value of AMS is revealed in the work practices that are supported, replaced, or transformed in sustainable ways for both people and cows. However, AMS use in dairy farming is an understudied domain from this perspective.

This study continues our prior research on care in AMS (Lundström and Lindblom, 2021), with the aim of deepening our understanding of dairy farmers' positive and negative experiences of the digital work environment when using AMS and other digital tools in their work practices over time from a care perspective.

Design Approach

We used the UX curve method (Kujala et al., 2011) and contextual inquiry (Beyer and Holtzblatt, 1999). The UX curve method supports users in reporting in retrospect how and why their experiences with a system, in this case, the AMS, have changed over time. The strength of the UX curve is that it enables users to express the quality of long-term user experience and the influences that improve or reduce the user experience over time (Kujala et al., 2011). Briefly stated, the UX curve is a basic two-dimensional graph space. Following Kujala et al. (2011), the horisontal axis characterised the time dimension from adopting AMS to the present time. The vertical axis represented the intensity of the users' experience, which had a horizontal neutral line dividing the space into a positive upper area and a negative lower one that was graded from + 10 to -10 with 0 as the neutral. We developed five different UX curves of which the first one focused on general UX, the second one on ease of use, the third on the workload of cow management via AMS, the fourth on the integration of AMS with other IT tools/systems, and finally how AMS contributes to work engagement, meaningfulness of work and being a good farmer. Contextual inquiry is a type of ethnographic field study that combines observation and interviews of a small sample of users to gain a robust understanding of current work practices and technology used (Beyer and Holtzblatt, 1999).

In previous research, we did a combination of field visits and interviews with nine Swedish farmers and a web-based questionnaire (Lundström and Lindblom, 2021), so we acquired some understanding and insights into farmers' care practices with AMSs. In this study, four dairy farms in Sweden were visited. Three of them were located in the southwest of Sweden, which is the most cow-dense area, and one was located in the middle of Sweden. The inclusion criteria were that they had adopted AMS, that the AMSs were from different brands, and that the farmers had used AMS for more than three years. The farm visits started with a discussion of the UX curves, and the farmers freely expressed and reported their experiences concerning the different themes. In order to complement their revealed user experiences from the UX curve discussions, we then conducted the contextual inquiry to exemplify how the AMS was used in practice at the farm. The UX curve discussions were audio recorded and the contextual inquiry was complemented with photos and video clips. The data collection lasted between 2.5 and 3.5 hours on each farm.

Findings

Generally, the findings revealed that farmers experience the adoption of AMS positively. It should be mentioned that due to space limitations, only a brief summary of the main findings is presented here. The most expressed positive experiences were work flexibility, a better work-life balance, and the reduced physical strain of not being forced to perform conventional milking twice daily. Some farmers said that they should not have continued to be farmers if they had not implemented the AMS. The reasons for this statement were the abovementioned factors and the challenge of finding and keeping competent staff for conventional milking. Adopting AMS reduced the labour demand for milking the cows on the dairy farm. Additional positive experiences were the ability to monitor milk quality and quantity and keep track of milk production on a general level. Several farmers also mentioned aspects related to cow health such as being milked more often, that the automated milking procedure was experienced beneficial for the cows since the AMS acted similarly during the milking procedure compared to human staff who varied their work practices in conventional milking. An often-mentioned positive experience was the integration of activity-measuring IT tools with the AMS that supported farmers in identifying cows in heat. With this way of working, the likelihood of cows being inseminated on the correct occasion also increased. The task of manually examining cows to check whether they were in heat was mitigated, which was also considered beneficial for the cows.

It appeared that the learnability of the AMS was experienced positively, both for farmers and most cows, in the shift from conventional milking to AMS. The shift was mostly experienced smooth and a prominent success factor was the swift support from local service personnel and technicians provided by the sales manager. One farmer expressed that the shift had not been realisable without that close support. Most farmers were surprised at how fast most cows learned to be milked by the AMS. The shift usually took less than a week to implement fully at the farm.

Although the farmers experienced the AMS very positively, there were more negative experiences related to various IT tools connected to the AMS, like apps and farm management systems. It was revealed that the apps had several drawbacks. One such negative aspect was revealed during summertime when the cows were out grazing. This particular farmer mentioned that the connectivity was lost in the fields, and therefore, he needed to write down the identifications of cows he had to catch to get milked. He said that this was frustrating because he could not trust the app's connectivity, and it was stressful to go to the barn where the AMS was located before going out in the fields, which often resulted in workarounds in his work practice. Other negative experiences with the apps were that they sometimes lacked functionality and did not provide up-to-date information. It should be mentioned that receiving alarms from the AMS 24/7 was a major negative experience depending on the frequency and when the sleep was negatively affected. Farmers said that most night alarms could be handled from the bed, and they seldom had to go to the barn. However, there were different strategies at different farms for handling these alarms. Quite often the farm owners were responsible for handling night alarms, but one wife said that she took over the role from her husband when he was away. The husband had minor problems falling asleep once the alarm was handled, but she said that she did not fall asleep that quickly, and sometimes she could not sleep any more that particular night.

Another negatively experienced aspect was poor integration with other farm management systems. One farmer who ran a big dairy farm had cows distributed on several smaller farms that were situated outside the main farm. He experienced several negative aspects, like problems of smoothly changing locations of certain cows and calves in the farm management systems since it lacked proper functionality for these changes of cow herds that a certain cow should belong to. The farmer had developed several workarounds to make these changes, but these workarounds were rather tricky and complicated to perform. Additional mentioned negative experiences were that different versions of AMS and the farm management systems were problematic to integrate fully, and the sales manager's solution was to invest in later versions of the AMS or farm management systems, independent of the actual brand. However, this was not perceived as feasible due to the associated investment costs. Another farmer said she had received a heavy fine for not reporting a cow carcass correctly to the Swedish Agency for Agriculture. However, she received feedback from the Agency's IT management systems that the procedure was completed, but she still missed finalising it without noticing it was incorrectly performed. Additional negative experiences were the huge amount of data available and the challenges of correctly interpreting and using the data.

The most negative experience appeared to be the distance between the AMS display and the robot arm when there was a need to support cows or heifers in the milking robot manually. Although these situations were rare, they were experienced very negatively by the farmers due to the stress caused to the animals. The situations that they needed to support the animal were often caused by some individual cows or heifers who did not like being milked by the AMS, that they should learn how to get milked, or that they had issues with the udder that made milking more complicated. It was explained that they first had to place the robot arm manually close to the udder, and when that was done, they had to let go of the cow's udder, stand up, and go to the AMS display to press a button, and then start over with the cow. Some expressed that in earlier versions of the AMS, the display was located much closer to the robot arm so that they could still sit down, manually position the udder to the robot arm, and then press the button by the head or elbow, although somewhat tricky to perform, it was still doable. It all boils down to causing less harm and stress to the animals.

Practical Implications

The increased use of AMS and other digital tools changes the distribution of tasks between humans and technology, the work-life balance, and the relationship between humans and cows, which have many positive outcomes but also result in various socio-ethical dilemmas. The need for a stockperson’s eye' is still necessary after the implementation of AMS, but it is hard to find staff that excels in caring for both cows and technology. Several farmers expressed their main motivations for being a farmer and what contributed to meaningfulness at work, and what they considered to be a good farmer, were not to mainly monitor and handle cow data but rather to take care of their land and animals and the cultural heritage of earlier generations of family members on that particular farmland. However, it was mentioned that they still needed to increase milk production to earn money to continue running their dairy farms.

Another raised practical implication in the wake of smart farming is the risk of de-skilling certain skills and competencies because certain manual work tasks will change or disappear. When more smart technology is implemented, more time will be spent on managing and monitoring the technology, at the expense of traditionally occurring tasks such as looking after the animals and managing forests and land. The practical implications at a longer time horizon may be an altered portrayal of what it means to run a farm, being a good farmer, the attractiveness of agricultural professions, and the concern that practical skills risk being lost, for example, a good stockperson’s eye (Lundström, 2022; Lundström and Lindblom, 2021). It might feel surreal that the future farmer might be sitting in the office in front of a computer screen and controlling his farm via drones and robots (Liu et al., 2020; Martin et al., 2022; Rose et al., 2023).

Theoretical Implications

The digital work environment on AMS farms is experienced rather positively. Substantial improvements are still needed to mitigate the negative experiences of the digital workscape on the AMS farms, make them more sustainable, and cultivate a positive digital work engagement. Recent research shows that farmers experience high work engagement but still lack a well-aligned work-life balance and, therefore, have increased risks for burnout (Kallioniemi et al., 2022). Current UX research shows that all technology use results in positive or negative experiences which are strongly linked to perceived meaningfulness and usefulness (Simsek Caglar et al., 2022). Thus, technology use must contribute to the farmer's experience of competence, control, relatedness, and goal achievement. Therefore, we suggest that more interdisciplinary research should be conducted where UX researchers focus more on farming, placing the farmer at the centre.

Future work consists of continuing the analysis of all the collected data, aligning the themes of the five UX curves with the contextual inquiry to gain a deepened understanding of dairy farmers' positive and negative experiences of the digital work environment when using AMS and other digital tools in their work practices over time from a care perspective. This means that we intend to zoom in on aspects such as the learnability of AMS for both people and cows as well as the the integration of AMS with other IT systems to identify any shortcomings, bottlenecks, and challenges. Finally, we hope to provide answers about to what extent AMS contributes to farmers' work engagement, meaningfulness at work, and, ultimately, being a good farmer.

We want to emphasize that the care perspective provides a shift from the dominant technocratic paradigm to the farmer's care of cows, people, and technology is necessary to foster sustainable farming practices. Today, it is acknowledged that good care is viewed as essential for any kind of good farming (e.g., Puig de la Bellacasa, 2017; Krzywoszynska, 2015; Lundström, 2022; Lundström and Lindblom, 2021; Svensson et al., 2023). Although the interest in the care perspective is increasing in the farming community, it offers alternative perspectives since it focuses on situatedness and developing local solutions to specific problems. Moreover, care encompasses a relational approach that is built on mutual dependencies between the living and the technological (Lundström, 2022). Aligned with the care perspective, there is also a need to ask more critical questions and reflect on how future technology should resolve goal conflicts, such as large-scale farming versus biodiversity (Lundström, 2022). These aspects must be incorporated into the UX field with the increased importance of sustainable care for our planet. In other words, the issue must be broadened. We need to eventually go beyond the human-centred perspective (Wakkary, 2021), instead putting animal welfare aspects at the centre of future digitalization and designing for both meaningful human-robot interaction as well as cow-robot interaction in future AMS.

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Digital decision-support tools for designing agroecological farms? Reflections inspired by the multi-actor development of an online software for vegetable growers in France.

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Abstract:
Our objective was to explore the characteristics of a digital decision-support tool (DDST) that could match the specific expectations of agroecology networks. We relied on a case-study in France where we have been implementing a participatory approach to develop an online software (La Pépinière-Mesclun) since 2020 to support vegetable growers to (re)design and assess their cropping plan while integrating agroecological practices relying on diversification. The analysis of qualitative content gathered throughout the project showed that to be judged salient, relevant and legitimate by agroecology actors, the DDST had to match specific expectations characterized as 73 design choices, grouped into 14 design principles, underlied by 4 main design values: (i) respecting the diversity and complexity of farming systems; (ii) being accessible to a diversity of farming profiles; (iii) valuing peoples' expertise and fostering decisional autonomy; (iv) being designed and managed as a digital common. Fostering digital commons for agroecology raises many theoretical and practical challenges, among other related to relevant modalities collective of governance and contribution and to fair business models. This work corroborates and enriches the very few studies based on concrete field work investigating the conditions for digital tools to be compatible with expectations of radical agroecology networks.
Keywords: farming system design; participatory research; horticulture; innovation; sustainability

Purpose

Although increasingly presented by mainstream actors as key pillars of a transition toward sustainable agriculture, digital decision-support tools (DDST) can face criticism or create controversies in agricultural networks defending a radical view of agroecology (Ajena et al., 2022; Bellon-Maurel et al., 2022; Leveau et al., 2019; Schnebelin, 2022). By radical agroecology, hereafter called simply "agroecology", we mean a global approach to transition of farms and food systems toward more sustainability based on systemic redesign rather than seeking for optimization of existing systems (Duru et al., 2015). For example, DDST can be perceived as supporting dynamics of agricultural industrialization or threatening farmers' decisional autonomy. This perception is strengthened by the fact that farmers are rarely involved in the initial design of digital tools for agriculture (Di Bianco and Ghali, 2022). Nevertheless, DDST can also be considered as promising options to support the design and management of agroecological systems which are knowledge-intensive and complex. Our objective was to explore the characteristics of a DDST that could match the specific expectations of agroecology networks. Our main assumption was that involving farmers and farmers' networks in all steps of the DDST design and development would be necessary to reach our objective.

Design/Methodology/Approach

Our analysis relies on a case-study in France where we have been developing an online DDST (La Pépinière-Mesclun[9]) for vegetable growers since 2020. For vegetable growers, agroecological practices relying on diversification (longer rotations, cover crops, green manures) can increase drastically the complexity of spatial and temporal crop planning. Moreover, farmers need to assess the impacts of such practices on the farm sustainability and ensure the possibility to match marketing objectives, which is specifically challenging as it requires to combine throughout the year a large range of short cropping cycle vegetables to provide every week a diversified and sufficient offer for different marketing outlets.

The DDST we developed aimed at supporting vegetable growers in addressing such challenges in the (re)design of their farm. The 2 main use situations for which our DDST was developed relates to (i) vegetable farm creation where crop planning design is a key strategic element of the farm business plan, (ii) redesign of crop planning for existing vegetable farms which are involved in strategic change (e.g. diversifying production). The DDST was designed in the perspective of facilitating interactions between current or future (students) vegetable farmers, agricultural advisors and trainers. We assumed that to be really used by these end users, our DDST had to be perceived as credible (data and models judged adequate by end users), salient (relevant to their needs) and legitimate (respecting their diversity of values and situations) as suggested by Cash et al. (2003). To reach such objectives, we carried out a participatory design approach involving researchers from 4 units of our research institution (INRAE) and 8 organizations of the agricultural sector inspired by agroecology (RandD, Farmers' organizations and agricultural support, Education), 1 IT startup and 1 freelance designer. Inspired by Cerf et al. (2012), our methodology relied on two main stages: (i) a diagnosis of uses (based on initial interviews and collective workshops with end users) aiming at identifying the diversity of situations related to crop planning, exploring how stakeholders take their decisions, the role of existing tools and how the future DDST could make this decision process more effective and (ii) an iterative co-design methodology relying on frequent interactions based on a prototype (37 design and test workshops all across France) with 256 end users. Users' feedbacks were integrated to inform the design of mockups, software development and structuration of a database based on an agile development methodology (Anand and Dinakaran, 2016).

Based on a large database of vegetable temporal availability (from field and sheltered production), yields and prices of 75 vegetables, the user can design different marketing scenarios (number of outlets, quantity and diversity of vegetables sold every week, level

[9] Available at https://pepiniere.outils-mesclun.fr

of sales). The user can then explore different combinations of cropping cycles to match marketing objectives and allocate these cropping cycles (and cover crops) on different field and sheltered plots leading to a cropping plan (main output of the DDST). From this cropping plan and complementary inputs on farming practices and context, the DDST allows a multicriteria assessment of the sustainability of the cropping plan.

We systematically tracked the content of the different workshops and the agile development meetings in a word document (372 pages at the end) extensively describing needs expressed by end users', discussions between participants, possible options considered, choices made and their justification. This content was processed through inductive qualitative analysis using thematic coding without any preexisting conceptual categories (Miles and Huberman, 1984). We characterized first "design choices", as basic analytical categories. Design choices were concrete design options considered in the DDST development based on end users' requirements and feedbacks, e.g. "not presenting mean vegetable yields but rather a range of yields to account for the fact that production is variable and uncertain". Design choices were then grouped into a second-level more generic category of "design principles", e.g "accouting for uncertainties and variability". Then we observed that design principles could be grouped in a last third-level more conceptual category of "design values" describing the ideological foundation underlying design principles, e.g. "respecting the diversity and complexity of farming systems".The concept of "digital commons" was used to characterize one of the design value. This concept was brought by researchers inspired by literature (Calvet-Mir et al., 2018; Dulong De Rosnay and Stalder, 2020) only at the end of the analysis because it deeply echoed what participants expressed.

Findings

During the workshops, end users expressed that they saw no contraction in using a DDST to promote agroecological approaches (trainers and advisers) or design agroecological systems (students and farmers) if and only if the DDST was designed in line with a set of principles and values echoing their specific experience and worldview (**Table 1**). Four distinct values were highlighted. The DDST had to (i) respect the diversity and complexity of farming systems, (ii) being accessible to a diversity of farming profiles, (iii) value peoples' expertise and foster decisional autonomy while not providing prescriptive solutions, (iv) be designed and managed as a digital common. Under these conditions, a DDST was perceived as having a great potential to support agroecological approaches while allowing users to explore and reflect on contrasting scenarios of crop planning. At the conference, design principles and choices will be illustrated with many concrete examples.

As illustration, we will focus here on the design principle of "Keeping it as simple as possible while valuing users' expertise rather than modelling to account for complex biophysical processes of agroecological systems". To this purpose, we can consider the necessity to account for the variability of tomato yields every week during the production season. This is a very complex problem as tomato production dynamic will rely on many interacting factors such as plant cultivar, farming practices, climate conditions. On a typical agroecological vegetable farm growing for example 50 vegetable species with 300 cultivars, including undocumented landraces and/or genetically evolving populations, this challenging problem becomes a nightmare of complexity. Based on participatory workshops, we decided to keep it simple. For each vegetable specie, the DDST provides a range of yield (low-medium-high) and this yield is considered to be the same every week of the harvest period (which is unrealistic). These data allow a first approximation of the potential production every week per unit area for a first broad approach of crop planning based on marketing requirements. However, the software is designed to enable farmers to distinguish varieties if they think it is relevant and to manually adapt yields every week based on expertise. If they do not have this expertise, they are encouraged to discuss with other farmers, their neighbors, agricultural advisors which leads to exchange of ideas, experience, learning. The results of this learning process, carried out in "real life" outside of the DDST, can then be set as input in the tool.

Practical Implications

Our work shows that there is space for the development of DDST adapted to the needs and values of end users promoting agroecological approaches. However, we think that involving end users throughout the whole iterative process was key to identify their specific needs and integrate their feedbacks to ensure that the DDST development was in line with their expectations. This makes the development process very time demanding. In this regard, this makes it challenging for private companies to develop digital tools for agroecology as they often need to ensure short term profitability. Although the project involved a private IT startup and a freelance designer, is was led by researchers from public institutions hand in hand with partners from organic agriculture RandD, agricultural education and farmers' organizations whose participation was funded by public money (French Ecophyto program).

Table 1. Design values, designs principles and related number of design choices for the participatory development of "La Pépinière-Mesclun"

Design values	**Design principles**	**Design choices (nb)**
Respecting the diversity and complexity of farming systems	Allowing a systemic multi-objective approach with functionalities, dimensions and indicators relevant to farmers	19
	Allowing flexibility regarding a diversity farming practices and socio-technical contexts	7
	Accounting for uncertainties and variability	3
	Providing dynamic interfaces which allow different approaches of crop planning	1
	Sub-total for this design value	**30**
Being accessible to a diversity of farming profiles	Limiting the amount of initial input data required	7
	Allowing different levels of precision according to users' needs, step and type of the design process (exploring phase or deepening phase, training purpose or real farm design)	4
	Presenting user-friendly interfaces	4

	Sub-total for this design value	**15**
Valuing peoples' expertise and fostering decisional autonomy	Keeping it as simple as possible while valuing users' expertise rather than modelling to account for complex biophysical processes of agroecological systems	6
	Developing functionalities to foster sharing of knowledge and training	5
	Enabling simulation and assessment of contrasting strategic options rather than providing an optimal prescriptive solution	3
	Sub-total for this design value	**14**
Being designed and managed as a digital common	Allowing open-access of non-personal data, models and codes	5
	Developing a governance model allowing the end users to discuss and orient strategic decisions related to the tool	4
	Creating a community of users who could contribute to improve the tool and supports its use in different networks	3
	Developing a business model considered as fair by end users and collectively discussed	2
	Sub-total for this design value	**14**
Total number of design choices		**73**

Without the participation of agricultural actors and institutions, the private IT company would never have had such an "easy access" to agricultural networks and the required legitimacy to work with them. This implies that a private-public partnership may be necessary for such projects. In our experience, this partnership was very fruitful but required time and attention to build a common language between researchers, private actors and farmers' organizations and to account for the specific constraints and objectives of everyone.

In our project, participants expressed that they were willing the DDST to be designed and managed in line with the 4 principles of "digital commons" defined by Dulong De Rosnay and Stalder (2020): (i) data, models and tools available online with an open access license allowing, (ii) a collective participation to the development and strategic orientation of the tool, (iii) based on alternative economic models beyond market and state, (iv) guided by a collective and horizontal governance. The first principle was followed while making the DDST, the related database, mockups and software codes available online with an open-access license. However, partners of the project highlighted many challenges to match the 3 other principles: how to make RandD and agricultural support organizations collaborate on the long term to contribute to the development of a common tool and share data as some of these organizations have competing interests and tend currently to develop their own tools and datasets only available to their members? How to develop a fair business model allowing end users to freely access the DDST while funding software future development and maintenance?

(indeed while open software codes theoretically allow anyone to develop the software, this requires IT skills that interested actors may not have or not have the time or wish to employ for free) How to foster a long-term collective emulation and participation to the DDST development once the public funding (obtained only for the first development phase) has ran out? Which practical and legal forms could support a collective governance of the DDST? As very limited example of digital commons applied to agroecology are documented (Calvet-Mir et al., 2018), there is a strong research need to better investigate how to overcome those challenges.

Theoretical Implications

Some scientific papers or reports have made suggestions on the conditions for digital tools to support a radical transition, most of the time formulated a generic and prospective way as a research agenda conceptually articulating literature on digital innovation and literature on agroecology (Ajena et al., 2022; Bellon-Maurel et al., 2022; Leveau et al., 2019). Very few studies based on concrete field work investigate the conditions for digital tools to be compatible with expectations of radical agroecology networks. Our work is a contribution to fill this gap and highlight design values and principles which are globally in line with the more generic papers above-mentioned and with the few studies based on field work (Hilbeck et al., 2023; Wittman et al., 2020).

However, our field work brings interesting new insights. For example, conceptual papers highlight on one hand the need to empower farmers' decisional autonomy rather than providing optimal solutions and to value farmers' knowledge. On the other hand, they raise the dilemma of accounting for the high complexity of agroecological systems while promoting digital frugality. Our work shows that a way to overcome this dilemma is to articulate these two dimensions. It suggests that valuing farmers' expertise in complementarity of simple models not aiming to account for complex biophysical processes allows to keep the tool simple, to approach complexity and to empower farmers (see illustration provided in section 3).

Studies analyzing the use of digital tools by farmers often emphasize and discuss two types of tools: digital technology for production (tools designed to support farmers in operational decision making, e.g to optimize use of inputs) and technology for information and communication (to access and exchange knowledge, e.g. through social media) (Rose, 2016; Schnebelin, 2022). Schnebelin (2022) showed on organic farms that the use of digital technology for production tends to facilitates industrialization trajectory whereas technology for information and communication can support ecologization of farming practices. The DDST we developed belong to another category: digital decision-support tool for the design of agroecological systems (rather than for supporting operational decision). Our work shows that this type of DDST can be specifically relevant to agroecological farmers as radical agroecology relies on a systemic (re)design of farming systems (Duru et al., 2015; Martin et al., 2013) rather than optimizing existing practices (which is the goal of digital technology for production). We thus think that the role, potentialities, limits and characteristics of digital tools to support the (re)design of agroecological farming systems need more attention from research.

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How can digitally supported extension workers enhance smallholder farmers' decision-making in climate adaptation?: Insights from the experience of the Digital Participatory Integrated Climate Services for Agriculture (e-PICSA) in Malawi and Zambia

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Abstract:
The urgent global agenda to support smallholder farmers' climate adaptation faces limitations due to a lack of evidence-based approaches and methods that assist farmers' adaptation decisions in a non-linear way. Drawing on ongoing intervention evaluation data, this paper examines how digitally-supported extension intermediaries can enhance farmers' knowledge of climate change and variability, promote the use of weather and climate information, and effectively stimulate adaptation changes suitable for farmers' complex farming and livelihood systems. The findings reveal that the digital empowerment of extension workers, including training on digital skills and the use of an e-PICSA app, brings additional benefits. The intervention has a dual impact, resulting in behavioural changes among both extension workers and farmers. Extension workers gained access to up-to-date location-specific weather and climate information, along with manuals and tools, to guide facilitation, on their mobile devices. They transformed their use of digital devices beyond personal use to support farmers, forming WhatsApp groups with farmers which created social platforms with two-way communication flows. Through the trained extension workers, farmers acquired knowledge on how to interpret and use climate information, developed trust, and activated climate information-seeking behaviour. Most farmers made adaptation changes after one season. This experience offers valuable lessons learned for other climate adaptation interventions.

Keywords: extension, climate services, smallholder farmers, decision-making, digital PICSA

Purpose

Farmers in the Global South face complex challenges, notably climate variability and change. However, their innovation and uptake of Climate Smart Agricultural (CSA) practices is still limited, partly due to the continued use of linear 'transfer of technology (ToT)' extension approaches (Klerkx, van Mierlo et al. 2012, Lemos, Kirchhoff et al. 2012), which often hinders farmers' learning processes, and a lack of research in the social and economic dimensions and coordination and decision-making aspects of CSA (Chandra, McNamara et al. 2018). In addition, most farmers lack access to relevant climate and agricultural information and decision-making support tailored to their individual farm contexts (Fisher, Abate et al. 2015).

Despite recent developments with digitalisation, the widespread availability of digital devices, network coverage, and digital products in the Global South, the challenges and potentials of e-extension in climate adaptation and the use of digital applications for weather and climate information are under-researched. For mobile applications providing weather and climate information to be relevant and useful for smallholder farmers, the role of trusted intermediaries is crucial (Caine, Dorward et al. 2015). However, empirical studies and evidence on how intermediaries can enhance farmers' adaptation using digital tools are still scarce.

Participatory Integrated Climate Services for Agriculture (PICSA) is an approach developed to support and empower farmers in their adaptation decision-making processes. The approach has been introduced to over 30 countries in the Global South, with nearly one million farmers trained. In the PICSA process, , each farmerconsiders their existing resources and activities using a set of participatory tools which include a Resource Allocation Map and Seasonal Calendar before collaborating with peers to explore and analyse historical climate information. They then use an Options Matrix to identify potential crop, livestock, or other livelihood options to address the challenges they face. Farmers then evaluate and plan these options in detail for their individual farms and households using a Participatory Budget, creating sustainable coping and adaptation strategies. The approach also integrates seasonal and short-term forecasting just before and during the season. Farmers utilise seasonal and short-term forecasts to adjust plans and make shorter-term decisions. The evidence shows that 87% of 4,299 studied farmers have made beneficial changes in their livelihoods (Clarkson, Dorward et al. 2022).

To support scaling up this approach, the digitally supported version of the PICSA approach (e-PICSA) has been piloted in Malawi and Zambia since 2022. The initiative is supported by the Fund for the Promotion of Innovation in Agriculture (i4Ag), GIZ[10], in partnership with Ministries of Agriculture and National Meteorological Services in both countries. To date, this pilot research project has developed an e-PICSA app and supported access to tablets for 130 government extension workers. They received a 2-day digital skills training and a 5-day Training of Trainers on the PICSA approach, participatory tools, and e-PICSA app use, in collaboration with National Meteorological Services and Ministry of Agriculture in each country. In digital skills training, they were trained in how to use and manage their digital devices effectively and in a secure way, as well as how to find, evaluate, share, create and connect information. This was followed by PICSA training which introduced the e-PICSA app and use of different participatory tools along the PICSA flow. These digitally empowered extension workers subsequently trained over 10,000 farmers in two years.

The purpose of this study is to understand how digitally empowered and climate-informed extension workers can support smallholders' learning, decision-making, and adaptation processes while analysing the challenges and opportunities of the phased

[10] https://www.giz.de/en/downloads/giz-2023-en-digital-climate-services-for-smallholder-farmers-in-zambia-and-malawi-e-picsa.pdf

digitalisation of climate services for agriculture. This study focuses on three research questions outlined below.
(1) How have extension workers changed with the use of e-PICSA, in terms of access to up-to-date local climate information and their extension capacity to support farmers?
(2) How have farmers changed, as a result of extension support in terms of access to climate information, decision-making, and adaptation?
(3) To what extent can the digital empowerment of extension workers contribute to farmers' adaptation?

Design/Methodology/Approach

The study draws on the evaluation data from the 2022-23 agricultural season. The evaluation study was conducted in Malawi and Zambia in May-June 2023 using a mixed-method approach, including a quantitative survey of 480 randomly sampled women and men farmers trained in 2022, in-depth interviews and participatory storytelling case studies involving 104 farmers, and 8 Focus Group Discussions (FGDs) with extension workers. Quantitative data were analysed using SPSS to provide descriptive statistics, mainly comparing disaggregated data based on socioeconomic attributes such as gender and wealth. For qualitative data, thematic analysis was conducted using NVivo to obtain in-depth understanding of respondents' intentions and behaviours.

Findings

The evaluation of this research discovered that e-PICSA greatly stimulated smallholder farmers' adaptations in their diverse farming systems and individual contexts. This was achieved through extension workers who were trained to integrate climate information into their advisory services and equipped with digital skills and tools. The intervention had a dual impact, resulting in behavioural changes among both extension workers and farmers.

Learning and Behavioural Changes of Extension Workers

Firstly, the trained extension workers who participated in FGDs highlighted that e-PICSA facilitated timely access to site-specific climate information, a resource previously unavailable to them. They learned to integrate this information into their advisory services, a skill that was entirely new. While some extension workers had prior training in climate smart agriculture, including crops to plant and timing of planting, e-PICSA training enhanced their ability to interpret climate and weather information, promoting a more interactive and informed approach to advising farmers. Thus, e-PICSA built the capacity of extension workers in facilitating farmers' decision-making processes with climate data, rather than pushing top-down transfer of technology (ToT) of prescriptive climate smart agriculture technologies. Importantly, the introduction of the e-PICSA app, compared to a paper-based approach, provided extension workers with better access to up-to-date local climate information and digitalised knowledge on various household decision-making support tools, such as resource allocation maps, seasonal calendars, option matrices, and participatory budgeting.

Secondly, the extension workers revealed that e-PICSA transformed their use of digital devices. Previously, they had rarely used smartphones or tablets for the purpose of supporting farmers. Interestingly, some extension workers had received training on how to use digital devices earlier, but this had been limited to registering farmers, for example, for the government's fertiliser distribution programme, or mainly collecting and uploading project-specific data from farmers. Contrarily, through e-PICSA, the extension workers mentioned that they were now searching for and sharing useful information for farmers, which represents the opposite flow of information i.e. promoting farmers' access to knowledge and information.
Thirdly, the digital skills training enhanced extension workers' confidence in operating digital devices and advising farmers using digitally available information. They learned how to search for, evaluate, and share relevant information for farmers, as well as download and operate agriculture-related apps like Plant Wise and Zaulimi, which was a novel experience. This approach encouraged complementarity and bundling with existing digital resources or apps available online, avoiding duplication of information for farmers. Moreover, with less than 5% of female-headed households and 16% of male-headed households in both countries having access to smartphones, and some of farmers in the target area unable to read or write, extension workers played a crucial role in bridging knowledge gaps.
Lastly, the digital empowerment of extension workers with the e-PICSA app and digital skills facilitated easy information sharing among their peers and with farmers. Many extension workers reported assisting other extension workers and farmers in installing the app in their smartphones. While extension workers initially used WhatsApp solely for personal purposes, they learned to use it for extension services. Subsequently, they established WhatsApp groups with farmers and lead farmers who had phones, creating a platform where farmers could freely pose questions, and extension workers could share relevant information. Consequently, the encouragement of using digital devices for advisory services led to the formation of social platforms for knowledge sharing.

Learning and Behavioural Changes of Farmers

Following training from extension workers, both women and men farmers experienced substantial improvements in their access to climate information. Firstly, the quantitative survey revealed that over 80% of the trained farmers accessed local historical climate information for the first time. More than 90% of both women and men trained farmers reported using the information and finding it useful. In terms of seasonal forecasts, nearly 80% of farmers had accessed them previously, but over 90% reported a better understanding of them and an appreciation of their usefulness after the training. While it's not surprising that trained farmers gained better access through training, the qualitative study highlighted changes in farmers' information-seeking behaviour. Post-training, farmers paid more attention to climate information due to a better understanding of interpretation and usage, setting goals for adaptation following PICSA's decision-making process, and developing trust in climate information through their own experiences.

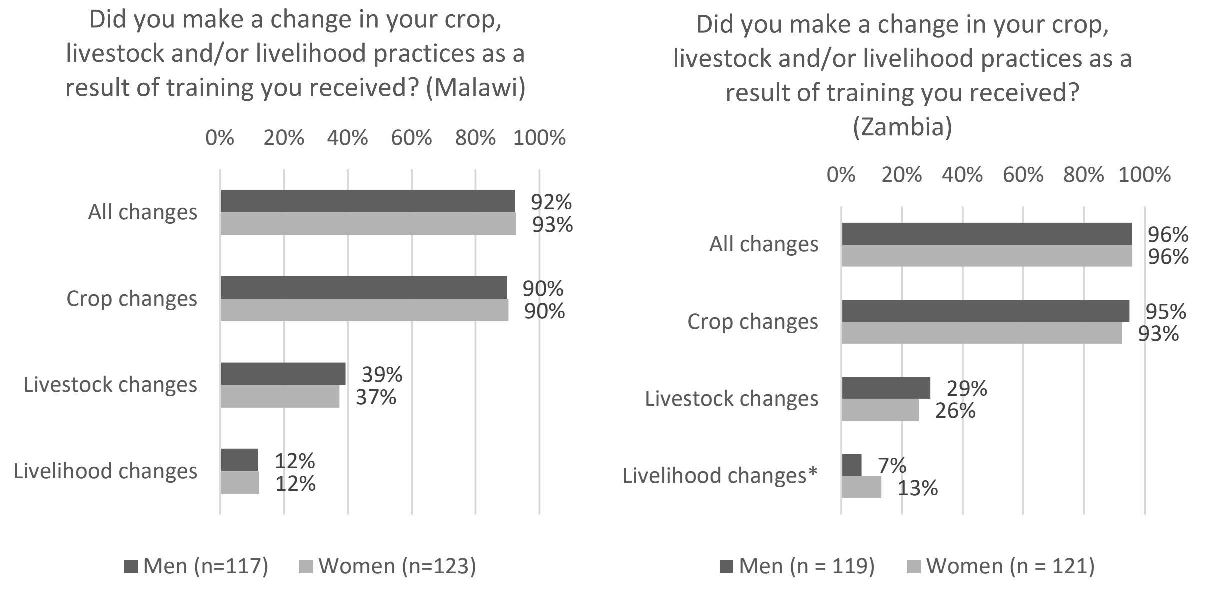
“It (access to climate information) has improved in past years. I used to hear about climate information on the radio, but we were not even paying attention. But now I’ve started following all issues concerning weather.”

(CP119 Female head of household, Zambia)

The increased trust in climate information compared to before training aligns with the results of the quantitative survey, with the majority of farmers expressing trust: 92% for historical climate information, 93% for seasonal forecasts, and 88% of short-term forecasts.

Importantly, as a result of gaining access to climate information and its interpretation through training, together with participatory decision-making tools that enable farmers to plan for their own individual farms, over 90% of trained farmers reported having made changes in their farming practices (Figure 1). The majority made crop-related changes, while 38% of farmers in Malawi and 28% in Zambia made livestock-related changes, and 12% and 10% of farmers in Malawi and Zambia, respectively, made other livelihood changes. Among crop-related changes, growing a new or different crop variety had the highest percentage of farmers, followed by changing land management and planting date.

Figure 1. Changes made as a result of PICSA training



The case studies, conducted through participatory storytelling, revealed the processes of change that took place after the training, how farmers learned, shared, and agreed within households, and made decisions on and implemented the changes (see the example extract from one below).

"After learning about how the rainfall pattern was going to be, I had a discussion with my husband to buy seed that is early maturing and does well. We chose DK 777; I am the one that brought the idea, and my husband agreed. It was our first time planting DK 777; we were just hearing it on the radios, and we thought they were just making noise, but after trying it, that's how we realised that it is a very nice crop variety. We did some piecework and bought the seed. He asked for manure from his friend who has cattle because our soil is not fertile. We got fertilizer from our cooperative and bought some ourselves. We wanted to have enough food for our home; that is why we decided to plant DK 777."

(CP04 Youth Wife Poor)

As a result of the training and changes farmers made, the majority reported that these changes brought better household food security and income. Their perceived capacity to cope with climate challenges improved, with 88% and 96% of sampled farmers in Malawi and Zambia, respectively, reporting improved household food security, and 81% and 92% of farmers in Malawi and Zambia, respectively, reporting improved household income. Despite positive results, the impact on household income for women farmers was lower than that for men farmers. The ability to cope with climate challenges was perceived as lower for women farmers than men, despite the majority reporting the improvement in this ability.

In summary, our findings indicate that the majority of farmers had previously lacked access to site-specific climate information, and that the existing climate information had been underutilised. The evaluation of e-PICSA demonstrated that it had stimulated extension workers' learning on climate change and variability, and enhanced their use of digital tools to support climate-informed and participatory extension services. This, in turn, resulted in behavioural changes among farmers and fostered context-specific climate adaptation. Moving forward, the approach should be further developed to enable more consideration of changes in livestock and other livelihoods, and to enhance household income, especially for women farmers, who currently have more limited opportunities than men.

Practical Implications

This adaptation support intervention, PICSA, exemplifies how existing extension systems in a country can significantly enhance complex and context-specific adaptations for both women and men farmers with a high success rate. The scalability and effectiveness of this intervention are further enhanced through digitally empowered extension workers. To effectively support farmers' adaptation, it is crucial to move beyond simply providing climate information. Nurturing farmers' information-seeking attitudes and behaviours, along with building trust, becomes essential for them to utilise and find the information useful. This involves facilitating farmers in how to use and contextualise the information for their specific situations through the step-by-step participatory decision-making processes in PICSA, rather than adopting a prescriptive Transfer of Technology (ToT) approach.

Furthermore, our findings underscore that digital tools and skills hold significant potential to promote knowledge bridging among extension workers and farmers. However, care must be taken to ensure inclusive access to digital information, avoiding exacerbation of the digital divide among different socioeconomic groups especially for women and elderly farmers with limited access to digital devices. Despite the evaluation being limited to one season, our experiences emphasise the importance of viewing adaptation as an iterative learning process rather than a one-time technology supply push (TSP). Interventions in providing Climate Information Services (CIS) should integrate facilitation for the interpretation and contextualisation of climate information in their services.

Theoretical Implications

Smallholder farmers' climate adaptation involves highly complex processes, particularly within diverse farming and livelihood systems. The study's findings highlight the importance of adopting a systems thinking perspective to understand these complexities and subsequently support farmers' Agricultural Knowledge and Innovation Systems (AKIS) for climate adaptation through the PICSA approach. Digitally empowered intermediaries play a crucial role in bridging various information available in the digital sphere with two-way communication flows, which allows farmers' timely access to relevant weather and climate information. The farmer-centred and context-specific extension approach can be further enhanced and scaled up through the digital empowerment of intermediaries, resulting in positive effects on smallholder farmers' learning and adaptation.

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METHODS & TOOLS I

Theoretical-methodological proposal to study family gardens with a biocultural approach and socio-ecological systems

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Abstract:
The aim of this work was to design a holistic and systemic methodological proposal for the study of socioecological systems, the method was applied to the analysis of the Family Garden (FG) because it is highly complex. The study of the FG has involved various disciplines, different methodological approaches, as well as research techniques that have favored the approach of the social system and the natural system separately. Therefore, an integrative method that analyzes the environmental conditions of the territory and the sociocultural context is essential, from a systemic vision that explains how individuals interpret their environment and relate to it to take advantage of biodiversity, due to the close biocultural link that they maintain. The unit of analysis is the agroecosystem, in which attributes of resilience, adaptability, ecosystem services and their relationship with the household unit are analyzed as a basis for understanding local knowledge, based on the spatiotemporal interaction of society, nature and culture in a specific territory. The method incorporates various disciplines, Environmental Sciences; Geography; Cultural Ecology; Ethnobotany; Ethnoecology; Sociology; and History as a common thread that nourishes the structure and interconnects the cosmos, corpus and praxis existing in the cultural group that develops the agroecosystem.
Keywords: socio-ecological system, family garden, biocultural approach

Purpose

The main aim was to design a methodological proposal from a holistic perspective and systemic vision for the study of socioecological systems, which was applied to the analysis of family gardens as a highly complex productive system.

Design/Methodology/Approach

Understanding the environmental, social, cultural, economic and political complexity of a territory requires a method that promotes the meeting of various disciplines, theories, methods and tools. A systematic review of research on research on society and nature identified the dichotomy between the Social and Natural Sciences (Berkes et al., 1998).

It was also found that numerous cultural groups have developed other valid ways of generating a body of knowledge that tends to observe the integrality of socioenvironmental phenomena, knowledge that has allowed them to develop very diverse forms of appropriation of natural resources through very varied production systems, many of them valid to this day. Traditional production systems are highly complex, but they have been studied in a fragmented manner by various branches of science such as biology, ecology, geography, anthropology, economics or history. It is required to visualize the object to be studied as a whole, for which a transdisciplinary perspective is needed. For this reason, we propose a holistic, systemic and integrative methodological approach, which returns to the concept of socio-ecological systems to jointly examine the natural and social system, due to the intrinsic co-evolution of humans with ecosystems (Berkes et al., 2000). The conceptualization of the socioecological method returns to the complex system approach (García 2006), since it considers the entirety studied, thus avoiding scientific reductionism (Cerón et al 2019). The unit of analysis is the agroecosystem in which it is possible to explore attributes of resilience, ecosystem services and local knowledge, key parameters to understand the spatiotemporal interaction of the human group, the environment and culture. The biocultural approach seen as the intrinsic result of the social system and nature in the territory inhabited by a cultural group, due to the indissoluble link between human groups and the environment. In the territory, mythical and experiential experiences coexist that in space and time configure and organize societies, establish norms of coexistence, agreements and give a sense of belonging to its inhabitants, who combine worldviews, practices, knowledge, with norms and institutions. The theoretical-methodological proposal is a transdisciplinary ensemble; of Environmental Sciences contribute to multidisciplinary integration; The contributions of Geography characterize the territory; Cultural Ecology examines the value of plants used in traditions, rituals and symbolism; Ethnoecology explores people's use of biodiversity; and Agroecology characterizes management practices. Furthermore, the methodological proposal allows for the incorporation of other sciences, for example, Ethnobotany describes the structure and composition of species, highlighting the ways of use, preparation and consumption of these; Sociology contributes to the understanding of the organization of the family that manages the agroecosystem; and History is the common thread that interconnects the cosmos, corpus and praxis of each society with the environment, culture and space. The proposed phases are: Bibliographic review, for the comprehensive characterization of the territory; Field work, in the diagnosis of socio-environmental problems, the description of the social group and the agroecosystem; and Systematization, to reflect on the information collected through the biocultural approach. Ethnographic techniques implemented through participatory research include: participant observation, systematic tours, in-depth interviews, questionnaires and participatory workshops. Data is obtained in accordance with a Code of Ethics. Before entering the locations, the project is presented to the authorities and their authorization to carry out the study is requested. The methodological proposal was applied in the study of family gardens in various locations in Mexico. The FG is a complex traditional agricultural system managed by the domestic unit, where its location, surface, composition, structure, management and maintenance basically depend on the decisions of women, which is why it is considered an eminently feminine space. Inside, ecological, biological, cultural and linguistic elements and processes converge, supported by local knowledge (Barrera, 1981; Chablé et al., 2015; Cano et al., 2016; Castañeda et al., 2020). The contribution of this methodological proposal is to study the relationship that exists between society, nature, and culture in the scenario in which it develops, which is the territory, since it is a constant that requires its understanding from various theoretical-methodological approaches, also considers the perception of those who directly participate in the management of natural resources.

Findings

Research that shows the application of the socioecological method is García and Ordóñez (2022); García (2023); García and Ordóñez (2024). The FG is characterized by having great agrobiodiversity that provides food, medicines and condiments, as well as valuable material resources and income from the sale of its products. It is an agroecosystem that promotes social cohesion, the conservation of biocultural heritage and affects food security. A detailed characterization of the territory where the FG are located was obtained, based on its geology, soil, climate, relief, hydrology and the vegetation of the investigated localities; the social, cultural and economic characterization of the localities studied as well as data on population, religion, education and economic activities. It was possible to determine the minimum and maximum size of the FG, the size of the family, the participation of family members in the establishment, management and maintenance of the FG, the structure and composition of the plant communities, the richness and diversity of plants existing in the FG, the number of botanical families, genera and species of plants present in the FG, as well as the animal species associated with this productive system; the categories of use of all plants, the most used plant structures, the way of preparation, the ways of consumption; the origin of the plants, if they are native, introduced, if they are endemic or in some risk category, if the plants are wild or cultivated. The destination of the harvest, self-consumption, sale, exchange, gift, etc. the cost of inputs, the value of the products obtained, the value of labor, traditional knowledge and the way it is transmitted. The aforementioned information was obtained from very diverse sources, organized and systematized in order to analyze it comprehensively, placing it in its local context. At the same time, it delves into the findings of the CET, the species richness and the socio-environmental resilience of FG. Workshops were organized to make the results known to the inhabitants of the localities studied and they became spaces for self-recognition of their knowledge, empowerment of women and revaluation of productive practices.

Practical Implications

The socioecological method contributes to analyse the multifunctionality of the FG, beyond the simple obtaining of food. It offers the possibility of interrelating cultural practices, environmental knowledge and biodiversity management. It also highlights the participation of women in the selection of spaces, seeds and plants cultivated in each agroecosystem. Therefore, it implies a revaluation of the FG by the locals, as well as the self-recognition of the people and the empowerment of women mainly.

Theoretical Implications

The biocultural approach applied to the socioecological method enriches the investigation of the social and natural system. The analysis of FG as a socioecological system favors understanding the complexity of traditional ecological knowledge that is integrated from the cosmos, corpus and praxis for the management of biodiversity.ading 1: use this style for level one headings

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Sociotechnical inquiry approach for innovation in agronomy

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Abstract:
Increasing food production and its sustainability is a crucial need due to population growth and environmental concerns. The application of agroecological principles enables to build innovative cropping systems, but their adoption remains limited. Agroecological transition involves complex, multi-dimensional challenges at various levels, from farming to agrifood systems. So far, sociotechnical analyses were conducted to understand historical lock-ins in agriculture, but without giving strong attention on the interactions between farmers and other actors. Based on both farming system research and sociotechnical system studies, and on 4 previously published case studies, the article proposes a new approach called "sociotechnical inquiry approach" (STIA) based on a 5-step methodology. The STIA explicitly considers how agrifood system actors influence farmers' decisions, and aim at identifying barriers and levers for agroecological transitions at territorial and value-chain scales. A cross-cutting analysis of the 4 case studies show that such an approach is likely to initiate multi-actor innovation processes that transform not only farmers' practices, but also those of a diversity of actors in the agrifood system. Its outputs are thus useful for designing coupled innovations, combining technological, organizational and institutional changes that are usually carried out independently by different actors.
Keywords: sociotechnical analysis, method, innovation, agrifood systems, agronomy, design

Context and Purpose

Food production must change to meet the needs of a growing population whilst minimizing impacts on the environment, calling for sustainable agriculture (Tilman et al., 2011). The application of agroecology principles makes it possible to limit the negative externalities of agricultural systems by promoting biological processes, and so reduce chemical inputs. Even if some agroecological practices are proven to be efficient, their application by farmers remains too scarce, as well as their promotion by value chains. Indeed, changes in farmers' practices would require change in agricultural production systems but also reorganizing food systems at territory and value-chain level, to embrace the wholeness and connectivity of systems and scales (Gliessman, 2016). Agroecological transition is therefore a complex problem (Schut et al., 2015) involving multiple levels of agrifood systems (primary production, food distribution and household consumption) and multiple actors, from the value chains and/or territories (Cholez and Magrini, 2023; Pachoud et al., 2022). Researchers supporting these transitions engage with actors in long-term innovation processes, seen as co-evolutionary processes that combine technological, social, economic and institutional changes (Klerkx et al., 2012). The challenge is to consider the interdependencies between agrifood actors at territorial scale (including farmers) in order to (i) understand the conditions for the development of innovations in agrifood systems and (ii) contribute to their design, jointly with agrifood actors.

Past work has extensively applied the Multi-Level Perspective framework (Geels, 2004) to the analysis of technological transitions towards sustainable systems in agriculture (El Bilali, 2019; Elsner et al., 2023). Such studies, from a historical perspective, highlight the current lock-ins limiting sustainable transition, and show that the study of sociotechnical systems, and their interactions with actors and rules, is potentially a major cognitive resource for identifying the barriers to agricultural innovation. Some recent studies carried out by agronomists explicitly link sociotechnical analysis of agrifood systems to cropping, farming and agrifood systems design (Boulestreau et al., 2021, 2023; della Rossa et al., 2020; Della Rossa et al., 2022; Meynard et al., 2017). Indeed, an agronomist seeking to design innovations at plot and farm level has to widen his angle of view, by considering the level of the sociotechnical system and the interdependency between agrifood system actors in agricultural territories. Such analyses are not, however, part of the agronomist's classic know-how. Moreover, the methodological approach in sociotechnical analysis studies is poorly described, limiting its application to other case studies. In this article, we aim to provide agronomists with a methodology based on sociotechnical analyses and encompassing the scale of farming systems, in order to help them innovate further and better with the diversity of agrifood system actors. We propose an original 5-step approach, called “sociotechnical inquiry approach” (STIA), and inspired by 4 published sociotechnical analyses relative to the agricultural and agrifood sector. We show that such an approach has been used to identify the barriers and levers of change at the scale of the territory and/or value chain in which the farming system operates, in order to initiate and steer an agroecological innovation process in agrifood systems.

Approach

2.1. A theoretical framework at the crossroads of farming system research and sociotechnical studies

Farming system research (FSR) initially focused on developing and testing innovative sustainable farming systems. However, the adoption of such systems does not depend only on their performance but also on farmers' practices and their drivers (Giller et al., 2015). This led agronomists to redesign cropping and livestock systems tailored to farms’ specificities. Moreover, farmers’ innovation not only depend on internal factors, but also on external factors such as market dynamics, knowledge access, or institutional support. So, farmers’ technical innovations often depend on practices of other agrifood system actors (Wigboldus et al., 2016).

Sociotechnical system studies offer a promising conceptual framework to move from a farmer-centered approach to an agrifood system-wide approach, since it considers farmers as part of larger actors' network that jointly impact agrifood system transitions. According to Geels (2004) sociotechnical systems (STS) are linkages between elements (*i.e.* resources such as artefacts, knowledge or labour) necessary to fulfil societal functions (e.g. agricultural production and consumption). STS shape the context, the rules, and social norms for actors' actions and vice versa. In some cases, different actors form networks with strong interdependencies, because they share values, knowledge, organizations and technologies. This coordination between groups of actors can thus create self-reinforcing mechanisms in technology choices. It creates strong inertia to change and by excluding alternative technologies that could be better for society, it creates lock-in situation (Arthur, 1989). In agrifood systems, technologies are combination of agricultural techniques and/or of processing techniques that achieve an objective, with the material conditions and know-how that make them possible.
We assume that describing and analyzing the interrelations between STS (resources, material aspects), actors (involved in maintaining and changing the system), and rules (which guide actor's perceptions and activities) lead to a deep understanding of the drivers of change of agrifood systems actors, including farmers. On the other hand, FSR helps to characterize in detail technologies, their underlying agricultural techniques, and the drivers of their implementation in farms. Combining both approaches is thus promising to understand the conditions for the development of innovations in agrifood systems and further design multi-actor innovations at the agrifood systems level.

2.2. Methodological approach

Based on the analysis of 4 previously published case studies (Tab. 1) that carried out a socio-technical analysis of agrifood systems, we provided two types of results: (i) a generic socio-technical inquiry approach (STIA), relying both on FSR and STS approaches, that gives methodological guidelines to decipher the complex systemic phenomena that frame agrifood innovation process and (ii) a cross-case analysis of the outputs of the case studies to show how such sociotechnical analysis lead to the identification of barriers and levers to sustainable innovations in agrifood systems.

Table 5 - Description of the case studies (problem under study, inquiry scope - geographical area and studied value-chain(s)), and references.

Case study denomination	Problem under study	Geographical area	Studied value-chains	References
1. Diversification in France	Development of minor crops to improve crop diversification	France	Arable crops	Meynard et al. (2017, 2018)
2. Corsican Clementine	Maintaining the typical characteristics of Corsican clementine	Corsica	Clementine orchards	Belmin et al., (2018a, b)
3. Watershed in Martinique	Reduction of herbicide use in weed management	Galion watershed in Martinique	Sugar cane, banana, market gardening	Della Rossa et al. (2022, 2020)
4. Vegetables in Provence	Soil pest management in sheltered vegetable systems	Provence	sheltered market-gardening	Boulestreau et al., (2023, 2021)

The 4 case studies (Tab. 1) shared common features: (i) they analyze the interactions between STS, actors, and rules, (ii) they study drivers of practices of farmers and other agrifood system actors and (iii) they identify barriers and levers to sustainable agrifood transitions. In order to propose a generic approach, we have chosen contrasting case studies with regard to the problems under study and the inquiry scope (Table 51). The case studies concern innovation processes at the level of agrifood systems; they differ in the scale of the territories concerned and the complexity of the value chains involved (Tab 1). By comparing and analyzing those approaches, we came up with a generic proposal that grasps the different methods and tools that are useful for identifying barriers and levers to sustainable innovations in agrifood systems and contribute to a further innovation process. The 5 steps emerged as a coherent organization reflecting both the different case studies and the literature.

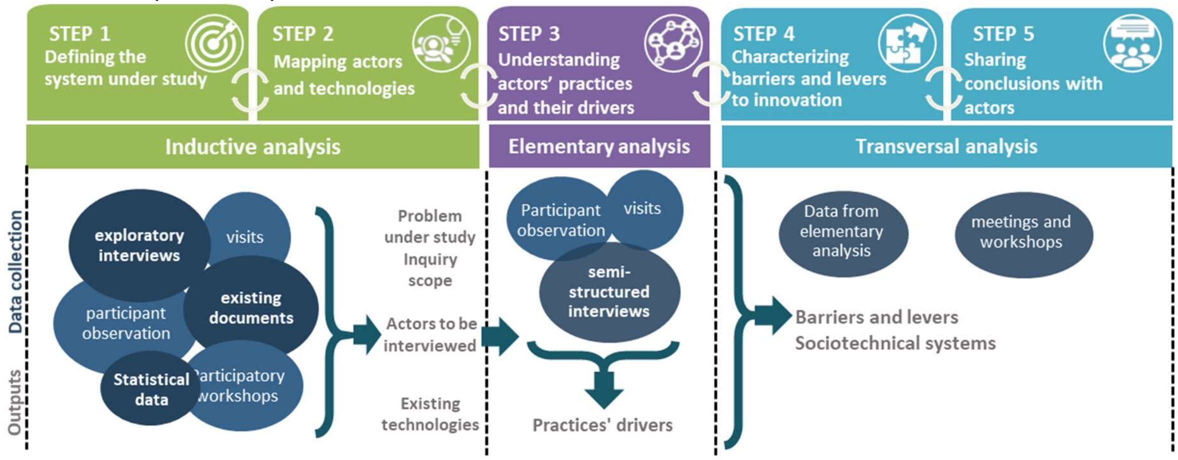
We also cross-analyzed the results of the 4 case studies, iterating between the in-depth analysis of each case study and the comparison with the other case studies. We paid particular attention to (i) the identified STS, (ii) the highlighted lock-ins, (iii) the identified barriers and levers to innovation process and (iv) the contribution of the inquiry approach to the overall innovation process towards sustainable transition.

Findings

3.1. The Sociotechnical Inquiry Approach (STIA)

We proposed a sociotechnical inquiry approach (STIA) whose key feature is to characterize the practices, strategies and networks of actors involved in innovation processes, and reveal how the sociotechnical system(s) shape those processes. The STIA is based on 5 steps (Fig. 1): (i) Delimiting the system under study and the inquiry scope (problem under study, concerned territory and value-chain(s)), (ii) Mapping the actors and existing technologies involved in solving the problem or locking it (iii) Understanding the drivers of actors' practices in relation to existing technologies (iv) Characterizing the barriers and levers to the innovation process and (v) Sharing the results with actors.

Figure 5 - Sociotechnical inquiry approach (STIA). The approach is divided in 3 analysis stages (inductive, elementary and transversal analysis) that provide intermediary or final outputs (in brown). It relies on a diversity of data collection methods (in blue).



The first two steps are an immersion phase relying on exploratory interviews with key actors and the collection of existing data (e.g. reports, statistics). The third step is an in-depth elementary analysis, based on semi-structured interviews with agrifood systems actors (including farmers), that aims at characterizing five types of elements related to STS: (1) the previously selected actors and all the drivers that guide their practices, (2) their relationships with other actors (e.g. flows of information, commercial partnerships, alliances or conflicts), (3) the formal and informal rules they follow (regulatory, normative or cognitive rules (Geels, 2004)), (4) the knowledge and (5) technologies they use. The interviews, strongly influenced by FSR methods, aim at characterizing actors' practices, and the driving forces behind practices, including the relationships with other actors that influence them. The last two steps lead to the analysis of the sociotechnical systems and their interactions with actors and rules, mainly based on previously collected data. Step 4 enables to identify barriers and levers to innovation around the problem under study. The objective of the fifth step is not only to present the conclusions, but also to discuss and revise them if necessary, according to the actors' point of view. The five steps follow a chronological logic. However, the inductive nature of the approach and the complexity of the multiple interactions of STS and actors' networks might imply feedback loops between steps. The STIA, its steps, the data to be collected, the tools and methods of analysis are described in detail in a methodological guide published in French (Casagrande et al., 2023).

3.2. Outputs of the STIA

All case studies identified a dominant STS -i.e. a stable network of actors that favors the development and maintenance of technologies- that results in specialized cropping and farming systems and/or the maintenance of unsustainable technologies (e.g. intensive use of pesticides). Except in case 3, niches- i.e. sociotechnical systems that develop their own dynamics around alternative technologies, diverging from the dominant STS- were identified in each case studies. In addition, the 4 case studies showed one or more lock-ins, that could be intertwined, around specialization in major crops (cases 1 and 4), restrictive crop quality standards (case 2 and 4) and pesticide use (case 3 and 4). Highlighting the lock-ins helped to identify (i) factors that favor the current dominant STS, (ii) barriers to the development of alternative technologies and (iii) how STS, actors and rules interactions shape innovation process. The 4 case studies revealed barriers to the innovation process at different levels (field, farm, value-chain and/or territory). Each of the 4 case studies also identified some levers to overcome the mentioned barriers such as coordinating farmers or actors.

3.3. Contribution of the STIA to the overall innovation process

The STIA outputs helped initiating a multi-actor design process as they contributed to support: (i) the group of actors that will participate in the design process (i.e. forming and managing the group that implement design activities) and (ii) design activities themselves (e.g. understanding of the situation, formulating a design target, exploring and evaluating solutions).

Step 2, 3 and 5 contributed to foster group activities. Indeed, step 2 (mapping actors and technologies) provided a first overview of actors that might be enrolled in design activities (all cases). Step 3 (understanding actors' practices and their drivers) gave information on the current room for maneuver of actors to innovate, which was a selection criterion to choose the key actors for exploring innovative solutions (cases 1, 3, 4). Step 5 (sharing the results of the STIA) was an opportunity to share knowledge among the whole set of involved actors (case 2, 4).

The STIA contributed to further design activities through a better understanding of the situation in each case study, because it provided an analysis of the elements that shape the innovation process. The exploration of solutions was supported by the identification of: (i) existing technologies and/or niches that might contribute to address the problem (step 2, cases 1 and 4), (ii) barriers to be overcome (step 4, all cases) and (iii) existing levers (step 4, cases 1, 3 and 4). Sharing STIA conclusions with the actors (step 5) was an opportunity to discuss and nuance findings, but also to commit actors in future design activities (case 4). In case 3 and 4, serious games, based on data and analysis from the STIA, were developed and used during participatory workshops to facilitate the agrifood actors' understanding of linkages across levels (field, farm, value-chain and territory) and help them find some leeway to unlock the system. The STIA was thought as a preliminary step before designing innovations: respectively innovations across scales (field, farm, territory) (case 3) or coupled innovations (case 1, 4). In case 4, the STIA outputs, embedded within a serious game, led to the design of coupled innovation prototypes that were further refined during additional participatory workshops.

4. Practical and theoretical implications

The diversity of case studies revealed invariants: considering a diversity of actors to understand the problem to solve, identification of dominant sociotechnical systems, and some niches, characterization of barriers and levers to change. These invariants between the case studies are linked to the highly systemic dimension of the agroecological transition. However, some steps were more important in some cases than in others, depending on the way STIA outputs were used in the research process. This suggests that the inquiry approach is flexible, adaptable and robust. Methodological challenges during implementation included tensions in discussing sensitive topics like pesticide use reduction. The non-normative, inductive nature of the approach could destabilize the researchers conducting the inquiry. The application of STIA might benefit from interdisciplinary collaboration, that could be developed further, especially with social sciences (e.g. to better consider power asymmetries between actors). STIA offers the opportunity to agronomists to enlarge their capacity of supporting innovation processes, by studying how technical innovations are either hampered or supported depending on the inter-relations between farms and other actors of the agrifood systems, and identifying the actors to be involved in future innovation workshops. The STIA outputs could be a first step to fuel the further design of “coupled innovations” (Meynard et al., 2017), i.e. combinations of genetic, agronomic, technological, and organizational innovations that are usually carried out independently by different actors (as it was done in case 4).

In conclusion, STIA results from the combination of FSR and STS approaches and brings together different tools to help agronomists understanding the way sociotechnical systems promote or hinder innovation processes. The main results are the identification of one or more sociotechnical systems concerned by the complex problem under study, and their interrelationships. The approach leads to understand the lock-in mechanisms that prevent changes expected by society. The approach is currently being applied to a larger number of cases, which will make it possible to: (i) verify the relevance and genericity of the approach and overcome methodological difficulties, (ii) analyze the extent to which it has contributed to the exploration of innovations, particularly coupled innovations, and (iii) improve the approach with contributions from other disciplines as part of interdisciplinary research.

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Participatory research to investigate soil-related challenges in different contexts: Lessons learnt from the European Union and Türkiye

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Abstract:
The degradation of agricultural soils in the European Union (EU) and Türkiye poses a significant threat to both human well-being and ecosystems, with around 60-70% of agricultural soils found being unhealthy. While agriculture has the potential to mitigate soil degradation through practices such as agroecology, organic farming and extensive farming, current policy instruments are insufficient to drive meaningful change. This underscores the need for a coherent soil strategy that integrates agricultural and environmental policies, tailored to regional realities and equipped with effective instruments to address contingent problems. In this regard, the present study develops and implement an original participatory research design to investigate policy solutions addressing soil-related issues in 5 regions from around Europe and Türkiye, Data collected through a survey from around 70 farmers are complemented with focus groups. Multi-criteria assessment procedures and cluster analysis are combined with qualitative analyses to summarize results and draw practical and theoretical implications. Different pathways to face soil-related challenges are identified in the different contexts and the study provide evidence of the key role played by policies in

legitimating farmers roles and played by farmers' networks in facilitating the implementation of the required solutions.
Keywords: Soil health, Participatory Design Research, Mixed methods, Case studies

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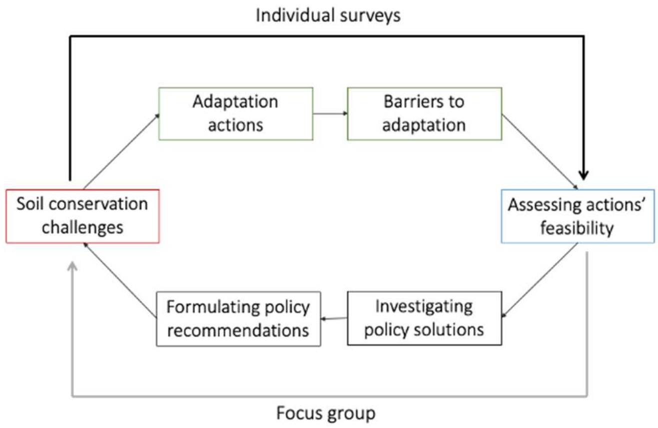
Purpose

The degradation of agricultural soils is a serious problem in Europe and Türkiye (according to the EU Soil Observatory around 60-70% of the agricultural soils are unhealthy in these areas). Inadequate agricultural and forestry practices in these areas prevent the soil from performing its broad range of functions and services to humans and ecosystems.
The European project Into-DIALOGUE, funded by the EJP-SOIL program, explores these problems by focusing on soil-related challenges identified in five case study regions, putting the key stakeholders at the center of its research through a Participatory Design Method (PDM), with the aim to explore feasible solutions. In the following sections we describe the method adopted for the selection of case study regions, the procedure used for the PDM and the data analysis. Results follows providing information on agricultural soil-challenges at the local level, actions that are though to contribute facing such challenges, barriers that oppose to their implementations and policy solutions that can contribute overcoming existing barriers. Lesson learnt and limits of the study are finally provided in the discussions and conclusion.

Design

The PDM developed in the present study to investigate soil-related challenges and policy solution in agriculture consists of a two-step approach based on direct interviews addressed to farmers from different study regions, followed by a focus group involving some of the farmers participating to the survey together with agronomists and/or soil scientists. The selection of study regions is guided by the authors' documented knowledge of soil-related challenges existing in the territories in which they operate. The interviews are addressed to a selection of farmers particularly sensitive to the soil challenges mostly represented in the region in which they operate and aim to explore the solutions and barriers to their implementation. The focus group aims to discuss the results of the interviews to highlight how farmers perceive solutions and barriers, to enrich the exploration of possible solutions with the opinions of specialists, and to investigate how policies can contribute to accompany the implementation of the envisaged solutions (e.g., by promoting collective/individual actions). Figure 1 provides the general framework of investigation adopted in this study.

Figure 1 – Workflow of the PDM developed in the study



Source: our elaboration based on Burgess et al. (2007)

The workflow depicted in Fig. 1 fits into a structural-functionalist framework of investigation (Ormerod 2020). In this framework, it is assumed that farmers perceive responsibilities in addressing environmental challenges according to the function society assigns to them. These functions are supposed to be a consequence of the conditions in which farmers operate, i.e., their characteristics. Data analysis is carried out based on the following procedure. Data from individual surveys are first clustered with respect to structural aspects related to farmers' (e.g., gender, age, income share from agriculture) and farms' characteristics (e.g., farm size, prevailing crops, average field slopes) to generate farming systems typologies and to assess how challenges and barriers are differently perceived by farmers from each cluster (further detail about the clusterization procedure used in the study are provided in appendix A). This is followed by a multicriteria analysis addressed to the stakeholders involved in the focus group to investigate how to face existing barriers in each case-study region. Here, experts are first asked to evaluate the performances of a predefined list of policy solutions with respect to the set of barriers investigated in the first step. Then, a synthetic performance score is calculated through a weighted mean using barriers weights assigned by farmers in the first step. A discussion follows highlighting convergences and divergences of opinions and alignments of farmers needs and the societal challenges they contribute influencing.

Findings

3.1 Description of study regions

The investigation procedure described above is implemented in 5 study regions from Türkiye (TR) Lithuania (LT), Latvia (LV), Spain (ES), and Italy (IT). Sicily is the Italian study region, characterized by a high risk of desertification, with increasing phenomenon of soil compaction, erosion and loss of organic matter. Samogitia is the Lithuanian study region, characterized by the presence of loamy and clay soils and intensive farming systems that contributing to causing soil acidification, soil compaction and the loss of organic matter. Vidzemnieki is the Latvian study region with very serious soil acidification issues that sometimes requires the correction with lime to enable cultivation or the conversion to crops that are tolerant to soil acidity and the proper management of fertilizers. Carrícola is the Spanish study region, a hilly area in the south with high slopes that poses serious problems of soil degradation by erosion. Şanlıurfa is the Turkish study region, a plain area located in the north-east with serious problems of soil salinization facilitated by the massive us of groundwater resources for irrigation, the misapplication of which (prevalence of surface irrigation systems) causes soil erosion phenomena accelerating the process of salinization of the cultivated layer.

3.2 Results from national surveys: classification of farm typologies

A total of 70 questionnaires, of which almost a third from TK and the others evenly distributed among the reminder study regions, was collected through direct interviews. 60 questionnaires were then used to cluster observations in different farm's typologies.
The structural variables listed in Table 1 represent the instruments used to cluster observations. The three farm typologies significantly differ from each other for most of the variables (i.e., the fisher exact test p.value is always below the 0.05 significance threshold, rejecting the null hypothesis of equal values). With respect to farmers' characteristics, the first typology differs from the others because of the prevalence of male conductors, with low school education, the presence of young family members and high income share from agriculture. The third typology is characterized by the prevalence of non-family labor, differently from the others. With respect to farms' characteristics, the first typology differs from the others mainly because of the altitude and the prevalence of arable crops, the second typology differs from the others for the presence of livestock, the third typology differs from the others because of the high field slopes and the large size.

Table 1. Median values of the structural variables used to cluster observation for each group and fisher exact test to assess differences in values

Structural variables	**Groups (median values)**			**Fisher exact test (p.value)**
	1	**2**	**3**	
Gender (0 – male; 1 - female)	0.0	1.0	1.0	$3.26e^{-06}$
Farmers education level (0 – low to 3- high)	0.0	2.0	2.0	$1.90e^{-06}$
Age of the farmer (0 – young to 2- old)	1.0	1.0	1.0	$5.27e^{-03}$
Presence of young members (0 – no; 1 - yes)	1.0	0.0	0.0	$6.83e^{-04}$
Land tenure conditions (0-shared to 3-owned)	3.0	2.9	3.0	$1.39e^{-01}$
Labor force (0-family to 3-nonfamily)	0.0	0.0	2.5	$9.95e^{-03}$
Income shares from agriculture (0-low to 2-high)	2.0	0.0	0.0	$7.54e^{-04}$
Altitude (0 – low to 2- high)	1.0	0.0	0.5	$1.25e^{-05}$
Utilized Agricultural Area (ha)	30.2	20.1	100.0	$4.56e^{-02}$
Permanent Crops (% on UAA)	0.0	0.4	0.18	$1.12e^{-04}$
Average fields slope (0-low to 2-high)	0.0	0.0	1.0	$5.69e^{-12}$
Livestock Standard Units (n.)	0.0	9.0	0.0	$8.22e^{-02}$

Context variables are represented by the farmers' geographical location and their perception of soil-related challenges. The geographical location plays an influence on the characteristics of the farms, on a biophysical perspective, and on the characteristics of the farmers, on an institutional perspective. Soil-related challenges allows to further

explore the biophysical level. Most of the farmers from the first typology are located in TR, from the second typology in LV and LT and from the third typology in IT and ES. Water pollution and soil compaction are found to be particularly relevant for the first typology, soil acidification and soil and water pollution for the second typology and soil erosion and habitat deterioration for the third typology.
The first tier of functional variables is related to the production method and the practices adopted by farmers. With respect to the production method, the second typology differs from the others because of prevalence of organic farms. With regard to the practices adopted by farmers to face soil-related challenges, the first typology refers to the use of sustainable irrigation and drainage management techniques to limit erosion and counteract the progression of soil salinisation; the second typology differs from the others in the sustainable management of grasslands and pastures, but inadequate mechanisation. In addition, the first two farms' typologies differ from the third because of the conversion of farming systems to adapt to the changing soil conditions and the care of the landscape, although their landscape care is limited to drainage management for the first typology and the presence of mixed farming for the second.
In terms of barriers, the first and second typologies differ from the third in the presence of high implementation cost barriers and lack of equipment. All typologies perceive significant yield uncertainties brought about by new management techniques and incompatible market demands for more diversified production systems.

3.2 Results from focus groups: envisaged policy solutions

Table 2 provides summary results of multicriteria exercise carried out in the second step to investigate feasible policy solutions with the focus groups. The table reveal that the most relevant policy solutions are new for the first typology of farmers. In general, the first typology reveals a greater need for policy intervention in different areas, including financial aids, provision of advisory services and policies that promote better coordination among farmers and sharing equipment. Nevertheless, all typologies reveal a greater sensitivity of farmers to direct aids and a lower sensitivity to advisory services, market initiatives and monitoring than the expert group does.

Table 2. Median values of the second tier of functional variables for each group and fisher exact test to assess differences in values

Second tier of functional variables	**Groups (median values)**			**Fisher exact test (p.value)**
	1	**2**	**3**	
Subsidizing the adoption of the envisaged solutions (scores 0-5)	3.3 vs 4.4	2.8 vs 2.6	2.3 vs 1.7	2.68e-08
Facilitating farmers access to advisory services (scores 0-5)	3.0 vs 2.3	2.5 vs 0.6	1.3 vs 1.2	2.10e-04
Facilitating farmers on sharing equipment (scores 0-5)	2.5 vs 1.7	2.3 vs 0.6	2.0 vs 0.6	4.27 e-03
Facilitating farmers on coordinating interventions (scores 0-5)	3.8 vs 1.3	2.9 vs 0.5	2.2 vs 0.6	1.73e-04

Funding certifications and awareness campaigns (scores 0-5)	3.8 vs 0.6	2.6 vs 0.2	1.2 vs 0.0	2.20e-02
Strengthening monitoring activities (scores 0-5)	3.7 vs 0.2	2.3 vs 0.0	1.3 vs 0.0	1.84e-02
Novelty of policy initiatives (from 0 to 1)	0.2	0.0	0.0	1.50 e-06

Note: Policy solutions scores ranges from 0, no influence on the barriers, to 5, very effective in addressing the barriers. Left-hand side values are average values from the group and right-hand side are weighted average accounting of the relevance of the barriers perceived by farmers. The novelty of policy initiatives score is a composite index ranging from 0, relevant policy solutions are existing, policies to 1, relevant policy solutions are not existing.

For the experts participating in the focus groups in the TK region, the lack of public support and the absence of environmental regulations contribute to facilitating the overexploitation of agricultural soils. In this context, market forces play a decisive and overriding role in influencing farmers' behaviour, and any kind of environmental restriction is perceived as a threat to farmers. Here, policy-makers should take account of existing market conditions in their initiatives and focus their efforts on addressing those environmental problems that are likely to threaten the agricultural sector.
For the experts participating in the focus groups in the LT and LV regions, it is in principle in the farmers' own interest to maintain nutrients in the soil, to avoid leaching and to use liming to correct soil acidity, and there is no need for public support in this respect, even for those agricultural areas where very costly improvements are needed. Existing CAP measures are not well adapted to the local context. For example, the inclusion of catch crops in the crop rotation as a greening requirement has not contributed to limiting nutrient leaching, but rather has induced farmers to increase fertiliser application to compensate for nutrient depletion. Another example is the promotion of minimum tillage in the region through CAP measures, which has not achieved the desired objectives because the soils are heavy and ploughing is necessary to avoid soil compaction. EU environmental regulations are applied, but are not adequately supported by science and are poorly understood by farmers. The above considerations highlight the lack of dialogue between farmers' representatives and politicians. In the view of the experts, public support should be targeted at both promoting soil health and farmers' competitiveness, and should be accompanied by effective extension services to make farmers aware that this will help to improve their conditions.
For the experts participating in the focus groups of the LT and LV regions, public support is considered essential to promote the adoption of these practices, to enable farmers to purchase the equipment and to accompany their implementation. However, public support for this measure is not consistent. This hampers its diffusion, despite its proven effectiveness in terms of both soil health and production. Inadequate provision of extension services also contributes to this. Crop rotation and diversification are more problematic. Market requirements force farmers to guarantee a minimum supply, and their production decisions are driven more by contracts than by agronomic needs. Support for the development of new value chains through the promotion of new certification schemes and/or public procurement initiatives should therefore be further promoted to trigger the transition to new farming systems. Finally, the abandonment of

livestock farming in the regions contributes to specialisation and dependence on mineral fertilisers, while the lack of young family members undermines the future of the agricultural sector. There is therefore a need for greater dialogue between territorial and sectoral policies in order to properly address soil-related issues in the regions.

Practical Implications

The preliminary results obtained so far show the existence of three typologies of farmers, who face different soil-related challenges and different barriers. The very different structural conditions of the farmers belonging to the three groups indicate different paths of transition. In general, farmers belonging to the first group show great difficulties in dealing with soil salinity and water pollution, hampered by poorly regulated market forces and lack of public support. Farmers in the second group have great difficulties in dealing with soil acidification and water pollution, mainly due to biophysical issues and the need to implement practices that are sometimes not compatible with market needs and not eel supported by policies. Farmers in the third group have strong difficulties in dealing with erosion and organic matter loss because of the progression of desertification, the low adaptation of farming systems and the lack of continuity and integrity in the provision of public support. Extension services and demonstration fields are seen as essential to address the key issues in all regions involved in the study.

6. Theoretical Implications

The structural-functionalist framework used in this study distinguishes between structural variables, i.e. the conditions under which farmers operate, and functional variables, i.e. the actions farmers take to address existing challenges. Here, it is assumed that the challenges perceived by farmers are influenced by the socio-economic system in which they are embedded and which legitimises their actions by identifying policy solutions. In this perspective, we have provided some evidence of how the expert groups, representing the social system in which farmers operate, contributed in different ways to conditioning the role of farmers and guiding their operational choices.
Although not explicitly mentioned, all expert groups perceive the influence of policy as essential in shaping farming systems, as policy is nothing more than the instrument through which the social system legitimises challenges and actions. In this respect, the three groups analysed in this study reveal the existence of two different social systems: a closed system, which leaves few alternatives for farmers other than intensification of production; an open system, which offers more alternatives of choice and provides physical, cognitive and market instruments to face the existing challenges that drive the transition of farming systems towards models that incorporate the co-production of ecosystem services. The latter system is, however, limited to market niches.

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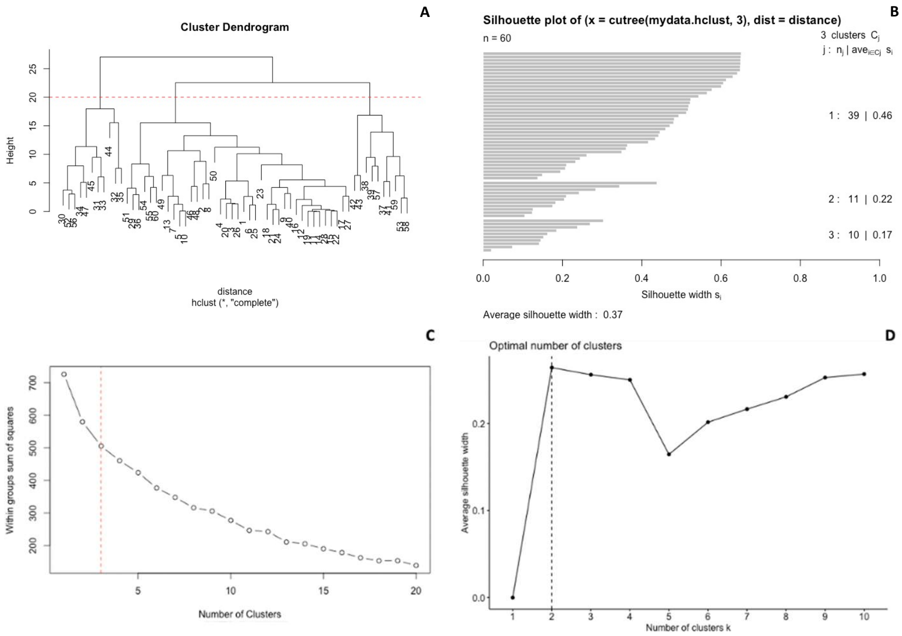
Appendix A

Figure A1 shows the results of the procedure used to cluster the observations. Specifically, Figure A1 a) shows the results of the dendrogram of observations generated following a hierarchical clustering procedure using the Manhattan distance to assess similarities. The use of the hierarchical procedure is motivated by the fact that it outperforms the non-hierarchical procedure for mixed variables. The Manhattan distance is the one that guarantees a better clustering in socio-economic studies. Figure A1 b) shows the value of a performance indicator called Silhouette calculated for each observation. The silhouette is a performance indicator that ranges from -1 to +1 and is influenced by the difference between the maximum distance of each observation from other observations in the same cluster and the minimum distance of the same observations from observations outside the cluster. The higher the value, the better the performance. Observations with negative silhouette scores are considered outliers. Seven outlying cases were found and removed from the set of observations to improve the performance of the cluster analysis. Figure A1 c) shows the within group variance for increasing number of clusters. This indicator decreases with the number of clusters until it reaches zero (when the number of clusters equals the number of observations). As highlighted in the figure, the variance is significantly reduced with three clusters, while there is a small reduction in variance with further clustering. Nevertheless, a significant part of the variance remains unexpressed with three clusters. Finally, Figure A1 D) shows the average silhouette for increasing numbers of clusters. The higher the average silhouette, the better the clustering. Here the Pick value is reached at two clusters. Nevertheless, a good silhouette is also achieved at three clusters, Figure A1 b), which improves the explanatory power of the analysis, Figure A1 c).

Figure A1 – A) Hierarchical cluster analysis dendrogram results with a cut at 2 clusters (dashed red horizontal line). B) Average Silhouette for increasing number of clusters with a pick value at two clusters (dashed black vertical line). C) Within group variance for increasing number of clusters. D) Silhouette plot.



How to approach actionable knowledge co-production for transformative change? Applying a principles-focused evaluation for learning

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Abstract:
As planetary boundaries are increasingly transgressed, more researchers are turning to the transdisciplinary paradigm in order to link knowledge and action, and develop practical 'sustain-ability solutions'. A main feature in this endeavour is the co-production of actionable knowledge (AK). Here, AK aims to support actors in their understanding and pursuit of 'transformative change'. AK co-production, as such, is primarily a social process through which researchers and stakeholders develop shared understandings, build trust, and mobilize or co-create contextually-relevant knowledge. The 'how to' of this complexity-ridden process remains poorly understood, both practically and theoretically. This paper contributes to middle-range theory building for the wider community of practice in which researchers and other societal actors grapple with the question of how they can approach AK co-production for transformative change. Using a principles-focused evaluation framework, we identify the main *learning principles* that guide AK co-production in an ongoing Horizon Europe project focused on agroecological transformation, and assess the articulation of principles in terms of organizational narratives and processes, and their implementation in terms of outputs. Building on this back-and-forth between theory and practice, we suggest a preliminary set of 'generic principles' for guiding researchers and stakeholders through the process of AK co-production for transformative change, and invite others to critique, test, refine, and debate these principles, with the aim of fostering understanding and practical support. Next, we high-light tension points between ambitions laid out in the principles and the practice of implementation, identifying barriers to transformative change in AK

co-production that emerge at various institutional levels. Finally, in light of these tensions, we make recommendations for policy makers and institutions who are inclined to support such research.
Keywords: actionable knowledge; transformative change; co-innovation; agroecology; co-production

Purpose

It has been more than three decades since the 1987 Brundtland report, 'Our Common Future', conceptualized a vision for sustainable development. Over this period, the overshoot of planetary boundaries – what scientists have referred to as the 'safe operating space' for human life on Earth – has worsened considerably (Richardson et al., 2023). In the face of this stagnation (Kaika, 2017), more researchers (and their funders) are motivated and open to exploring different methods, asking different questions, and collaborating with different interlocutors in order to join the search for sustainability solutions in practice (Fazey et al., 2020; Mauser et al., 2013; Rossing et al., 2023). A main feature of this search is the co-production of actionable knowledge (AK), which, in this context, is often (implicitly or explicitly) driven by the aspirational goal of transformation (Jagannathan et al., 2020, 2023; Turnhout et al., 2020). Importantly, the practical and methodological questions of 'how to' organize and implement co-production processes (Beier et al., 2017; Fazey et al., 2018, 2020; Rossing et al., 2023) are rarely assessed in terms of contributions to aspirational goals of transformative change (Turnhout et al., 2020). This is key as without such critical assessments, projects and other participatory interventions run the risk of reproducing the status quo and "reinforcing the problems they intended to solve" (Turnhout et al., 2020, p. 15).

In this paper, we apply a principles-focused evaluation (PFE) framework (Patton, 2017) to assess how an ongoing Horizon Europe project focused on agroecological transformation (Agroecology-TRANSECT, AE-T) approaches AK co-production for transformative change. Our PFE contributes to further middle-range theory development: i.e. concrete and complex theory of how AK co-production for transformative change can be effectively pursued. Principles, in turn, are guidelines informed by practical experience and corresponding literature of engaged researchers and practitioners that 'explain' what is effective (Norström et al., 2020). A key component of middle range theory is iteration between empirical research and theory development (Haxeltine et al., 2017). It is through this back-and-forth process between practice and theory that principles are articulated, tested, refined, and debated (Patton, 2017). Our assessment has practical implications for AK co-production in AE-T and other projects, and also contributes to theory development on AK for transformative change more generally.

Case study, conceptual basis, and methodology

Case study: Agroecology-TRANSECT (AE-T)

Agroecology-TRANSECT (which stands for Transdisciplinary approaches for Systemic Economic, ecological and Climate change Transitions) is a Horizon Europe project that aims to contribute to unfolding the potential of agroecology (AE) for European agriculture through strengthening knowledge, fostering collaboration, and providing evidence of AE's impact on climate, biodiversity, and farm resilience. The project is connected to 11 'innovation hubs' (IHs) in 10 EU countries, which are pre-existing, action-oriented and territorial AE initiatives that are working (to varying degrees) on AE transformation. AE-T uses a complexity-aware approach to project governance called 'co-innovation' (Rossing et al., 2021), which is executed in the project by WP3. Co-innovation is an approach based on a complex adaptive systems view, monitoring and evaluation aimed at reflexivity, and social learning. In particular, co-innovation's focus on formative monitoring and evaluation (M&E) – i.e. M&E for learning – answers the calls of scholars for knowledge co-production pro-cesses that "support adaptative learning while acknowledging complex and unpredictable im-pact pathways" (Chambers et al., 2021, p. 992). In the project, the co-innovation approach is hypothesized as a way to navigate the complexity of AK co-production for transformative change, and as such, forms the basis of the principles-based framework that we asses in this paper.

Conceptual basis: defining AK for transformative change

Any attempt to effect change in the social world (which is axiomatic for AK) requires an understanding of what the social world is, and how and why it changes. Therefore, it is first important to make explicit what exactly we mean by transformative change, and how we understand it to take place. We conceptualize transformative change as "the process of challenging, altering, or replacing dominant institutions in a specific socio-material context" (Pel et al., 2020, p. 2). This understanding is, in turn, informed by critical realism and the strategic-relational approach (SRA) (see also Jessop, 2005, Leitheiser and Vezzoni, 2024). Here agency and structure (*inter alia*, *qua* dominant institutions) are understood relationally: on the one hand, socio-material structures selectively shape (in an evolutionary sense) the possibility space for agents to act and manoeuvre freely in the world; on the other hand, socio-material structures are contingent, as they are (in part) the product of human agency. This means that both maintenance and transformation of institutions as structured selectivities are action-dependent. Agents act strategically (in our case, as they work towards transformative change) based on their reflexive understandings of themselves in relation to the wider socio-material context (see Sum and Jessop, 2013). Here, transformative "change is seen to reside in the *relationship between actors and the context in which they find themselves*" (Hay & Wincott, 1998, p. 955, emphasis added), and the multiple, context-dependent ways in which these actors work to challenge, alter or replace dominant institutions.

In the context of sustainability science, actionable knowledge is understood to support "actors' understanding of how to create transformative change towards sustainability related to the de-sign, agency, and realization of their actions" Knowledge is, in turn, understood in a broad sense that includes "data, information, and wisdom" (Utter et al., 2021). Following the above, we hypothesize that actionable knowledge for transformative change (could) encompass (cf. Caniglia et al., 2021, Hölscher et al., 2023) outputs that contribute to:

how actors understand themselves and their context

how actors recognize, imagine and create opportunities for strategic exercise of agency

how actors go about designing and planning actions

concrete data and information for actors to make decisions and realize their actions

Methodology and data collection

Our PFE is based on a variety of qualitative data collected throughout the course of the ongoing AE-T project. These data allow us to understand inputs, processes, and outputs

(Luederitz et al., 2017) within the context of co-innovation project governance. Inputs were investigated as organizational narratives. Narratives selectively combine explanations and lines of reasoning in order to give a shared meaning to social experience and set expectations for future interactions (Flyvbjerg, 2006). Our analysis extracts lessons and insights to inform learning within and be-yond the project. Data were coded, analysed and interpreted to evaluate the evidence and importance of principles, the ways in which they were adhered to, and the outputs and outcomes that resulted from their implementation.

Table 1. Co-innovation interventions carried out in the AE-T project, and the methods of data collection and analysis that the authors used to conduct PFE.

Co-innovation interventions	**Description**	**Dates**	**Methods for data collection and analysis**
Action plan (AP)	Document for IH to strategize and design their activities in	September-October, 2022; May, 2023	Document analysis
Learning history (LH)	Structured, written reflection process for IHs to develop an understanding of how IH activities have resulted in effects, and how these have brought them closer to their mission.	February, 2023; March, 2024	Document analysis
Co-innovation workshops (CiW)	CiW1 was a physical gathering that marked the beginning of the IH 'exploration phase'. The IH here get to know each other and the WPs. Workshop facilitation encourages IH to define specific points to innovate on, and connect to (new) stakeholders	October, 2022	Participant observation and informal interviews
	CiW2 was a physical gathering where IHs began to address points of innovation they would like to foster. Connection to the project WPs and development of the action plan formed the core program. IHs were clustered into two groups	March and April, 2023	

	based on shared interests and problems.		
Reflection calls and check-in calls	Video calls between cluster leader, cluster monitor, and IH facilitator	December, 2022; June, 2023; December 2023	(Semi-)structured interviews
Annual Meeting (AM)	Physical gathering where all project partners met to learn about developments across the project, continue to develop shared understandings, and plan actions for the coming year		

Findings

Table 2. Principles that GUIDE AK co-production for transformative change in AE-T, along with inputs (what was invested to enable processes and actions), processes (what sequences of action or methods were implemented), and outputs.

Principles	**Organizational narratives (inputs)**	**Co-innovation governance (processes)**
Create knowledge that is locally salient	Complexity and adaptive management: expecting and anticipating adjustments Trandisciplinarity: collaboration and open, horizontal dialogue	Regular scheduled calls for reflection WP3 as a 'broker' Critical IH facilitators invited into Executive Committee Validation rounds in research process as a norm
Think in the long-term, and think about creating legacy early in the project	Mission-oriented project Temporary travel companion	Monitoring for learning cycle (Figure 3)
Learning our way to transformative change	Relational thinking 'Project family' Gliessman's (2016) 5-levels of food systems change	Structured processes of critical reflection and reflexivity in the learning cycle, also at CiWs and AM
Outputs		

NL facilitator moves from 'I don't have a theory of change' to explaining and ultimately adjusting one, building on learning from new network connections
HU facilitator comes to understand the importance of acting beyond writing papers; from 'I'm just an ecologist' to authoring a critical policy intervention, and connecting research more with farmers' needs and concerns
Critical debate about political-economic dimensions of AE at AM that introduces much of the consortium to Nyéléni and AE as a social movement leads to conflict, and resolution (DK)
DK facilitator comes to understand the IH as a 'niche in the regime' through T4.1 research; developing a new and clarifying understanding of the IH and barriers and levers in its context
ES IH organized an event bringing together policy makers, and regional food actors to discuss the role of supportive policy; this would 'not have been possible without AE-T'
GU IH articulating and implementing a new knowledge governance scheme for micro-farm research
BE IH recognizes division in the farmer group they work with; separates into two groups instead: organic and conservation agriculture

Implications

Our paper builds on previous principles-based frameworks for approaching the complexity of AK co-production for transformative change, suggesting three 'generic' principles (see table 2) that can guide researchers and other societal actors through this complex process. We have also contributed to middle-range theory of 'how to' effectively implement these principles in pursuit of transformative change in a real-world setting by detailing (1) organizational narratives and processes through which principles are articulated; and (2) domains of impact, with concrete examples of what AK co-production for transformative change might expect and aim for.
The individual and institutional barriers emerging from our analysis (including perceptions, institutional norms, resources and research policy design) are consistent with experiences in similar projects (Rossing et al., 2022). In addition to making the explication and implementation of principles more concrete for future practitioners, the identification of barriers also allows us to inform adaptive governance and learning within the AE-T project, and make recommendations to researchers and funding institutions.

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Nitrogen in agricultural systems: Towards a renewal of nitrogen management through innovative design

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Abstract :

The article addresses the complex challenge of sustainable nitrogen (N) management in agriculture to both meet environmental issues and production targets. We emphasize on the need for innovative approaches to overcome the traditional paradigms of N management, using innovative design theories and methods to explore new pathways for efficient and environmentally friendly nitrogen use in agricultural systems. Based on design workshops and literature review, we analysed the polysemy of the term "autonomy" and we identified five main pathways for achieving nitrogen autonomy: improving nitrogen use efficiency, minimizing N losses to the environment, reducing dependency on exogenous N inputs through crop nitrogen sobriety, seeking autonomy from synthetic forms of nitrogen, and designing systems that are autonomous from all forms of exogenous nitrogen. Each pathway was then further explored using innovative design framework. Our findings illustrate the diversity of research avenues and underscore the potential for innovative design in addressing N management challenges. We conclude by advocating for a holistic approach to N management that combines efficiency, sobriety, and system redesign, contributing to the sustainability of agricultural systems and the global agri-food system's ability to feed future populations while respecting natural nutrient cycles.

Keywords: Nitrogen; fertilization; innovative design; C-K theory; knowledge

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Context description, practical and theoretical background:

The Nitrogen wicked problem

Modern agriculture faces complex challenges, especially regarding sustainable nutrient management. Among them, nitrogen (N) management is of paramount importance. On one hand, it is an essential element for plant growth and plays a central role in agricultural productivity. On the other hand, its inappropriate management poses serious environmental issues: nitrates leaching into groundwater and surface water, as well as the volatilization of ammonia and nitrogen oxides, contribute to the degradation of water quality, eutrophication of aquatic ecosystems, and the exacerbation of climate change (Robertson and Vitousek, 2009). In addition, the inefficiency of nitrogen use by crops leads to substantial economic losses for farmers and an increasing dependence on exogenous nitrogen sources, often expensive. Given these challenges, it has become necessary to rethink nitrogen management from a sustainable and innovative perspective, to open up new innovation avenues outside the dominant paradigm.

Method and approach: A need for innovation

Moving away from the dominant paradigm of N management requires an innovative approach. In this context, innovative design theories and methods (Hatchuel and Weil, 2009) offer a favorable scientific framework to imagine new ways of thinking, breaking out of the frameworks developed decades ago. The methods and theories of innovative design are more and more frequently mobilized for agronomic issues (Prost et al., 2016; Ravier et al., 2018; Toffolini et al., 2020) and, in our case, would allow to imagine new ways of reasoning nitrogen management in agricultural systems.

We hypothesize that analyzing the production of knowledge and concepts on nitrogen management will highlight potential fixation effects on concepts explored by scientific research. In a complementary way, C-K framework will be used to overcome fixation effect and propose new avenues of research on N management and N-centered production of knowledge. To do so, we carried out workshops with participants from different scientific backgrounds (Table 1) to generate concept trees of nitrogen management in agricultural systems. The aim of this abstract is to present the diversity of concepts explored in research on nitrogen management until now, and identify research paths that were not explored and could pave the way for further research.

Table 1. Description of workshop participants and their areas of expertise

Institute	**Area of expertise**
INRAE[a]	Crop nutrition, intercropping, N deficiencies in crop growth and production
INRAE	Crop nutrition, N deficiencies in crop growth and production
INRAE	Adaptation and sustainability of agricultural systems at territorial scale
INRAE	Multidisciplinary approach to innovation for agroecological transition
INRAE	Nitrogen leaching and water quality
INRAE	Dynamics and management of nitrogen in cropping systems
Institut Agro[b]	Multi-criteria evaluation of production systems and agricultural areas

[a] French National Institute for Agronomic Research

[b] Higher Education Institution in Agriculture

The workshops were organized in two sequences: the first sequence consisted in answering the following question: what strategies do you think can be used to move towards nitrogen autonomy in agricultural systems? Participants were invited to propose ideas freely in a Post-it-style ideation phase. The ideas were sorted and grouped thematically to create homogeneous thematic research avenues (Figure 6). Some topics were also excluded as being outside the scope of this study (e.g., decision-making autonomy or know-how autonomy). The second phase consisted in examining the different research avenues and developing for each avenue: (i) the main concepts existing in this research avenue, which could be described as the dominant paradigm, and (ii) concepts not yet explored or to be explored, which could be described as breakthrough concepts. These concepts were subsequently refined through more in-depth work with some of the participants, or through a review of the technical and scientific literature.

Findings

Exploring new pathways for N management

The research avenues identified by this work have been classified according to an exploration tree (Quinio et al., 2022) illustrating the diversity of avenues for N management. To achieve nitrogen autonomy in agricultural systems, five main pathways were identified (presented from left to right in Figure 6):

(1) ***Nitrogen use efficiency.*** This pathway describes ways to improve of nitrogen fertilization practices efficiency. It aims to optimize nitrogen use by crops, reducing surpluses and improving input use. It mainly relies on providing farmers with knowledge and decision support tools for better predicting crop fertilizer N requirements and improving methods for optimizing N top-dressing timing and placement.

(2) ***Avoid or limit N losses to the environment.*** This involves exploring practices that minimize nitrogen leakage to the environment, through a better synchronicity between soil nitrogen availability and plant uptake, the use of catch crops, more precise N management and application technique or strategies to recapture N lost from fields on scales beyond the farm.

(3) ***Nitrogen sobriety.*** This pathway questions nitrogen needs and how to satisfy them. It is based on reducing dependence on external nitrogen inputs, promoting balanced and resilient production systems. Compared to nitrogen efficiency, this path is mainly based on adding rotational complexity to cropping systems to lower crops N dependency (e.g., introducing low-N-demanding species).

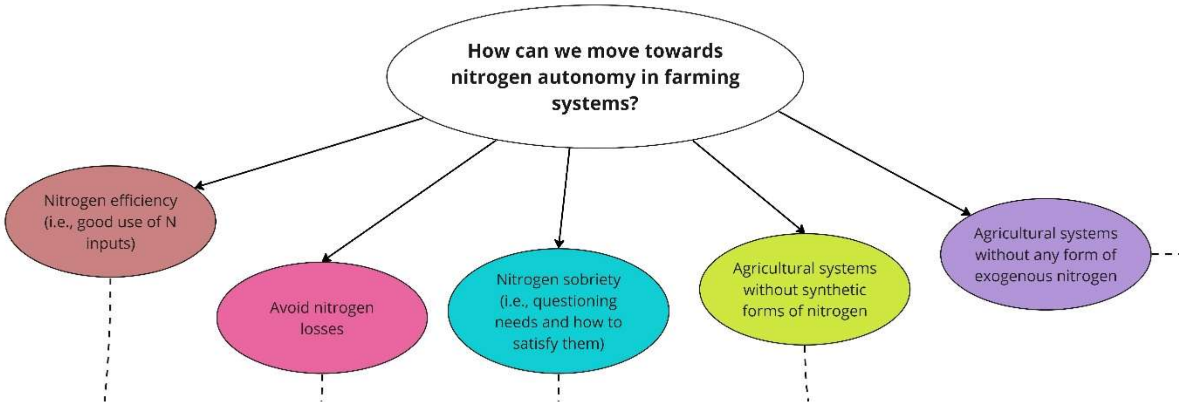

Figure 6: The five main avenues explored in the concept expansion phase

(4) ***Autonomy from synthetic forms of nitrogen.*** This strategy involves exploring alternative methods and practices that can supply required nutrients to crops, enhance soil fertility, and maintain high levels of productivity without relying on synthetic nitrogen fertilizers. Pathways explored were mainly organic fertilizers, from a variety of sources: agricultural (livestock manure), urban (products from wastewater and household waste treatment, etc.) or agro-industrial.

(5) ***Autonomy from all forms of exogenous nitrogen.*** Developing agricultural systems without any forms of exogenous nitrogen, including both synthetic fertilizers and organic inputs sourced from outside the farm (Cf. supra), addresses a significant challenge. A shift towards entirely self-sustaining systems that would mainly rely on internal nutrient cycling and/or ecological processes such as biological nitrogen fixation.

Each of the branches presented in Figure 6 was explored thought literature review and innovative design workshop, to highlight existing ways of achieving the main concept and identify potential future research axes. One pathway is presented as an example in Figure 7.

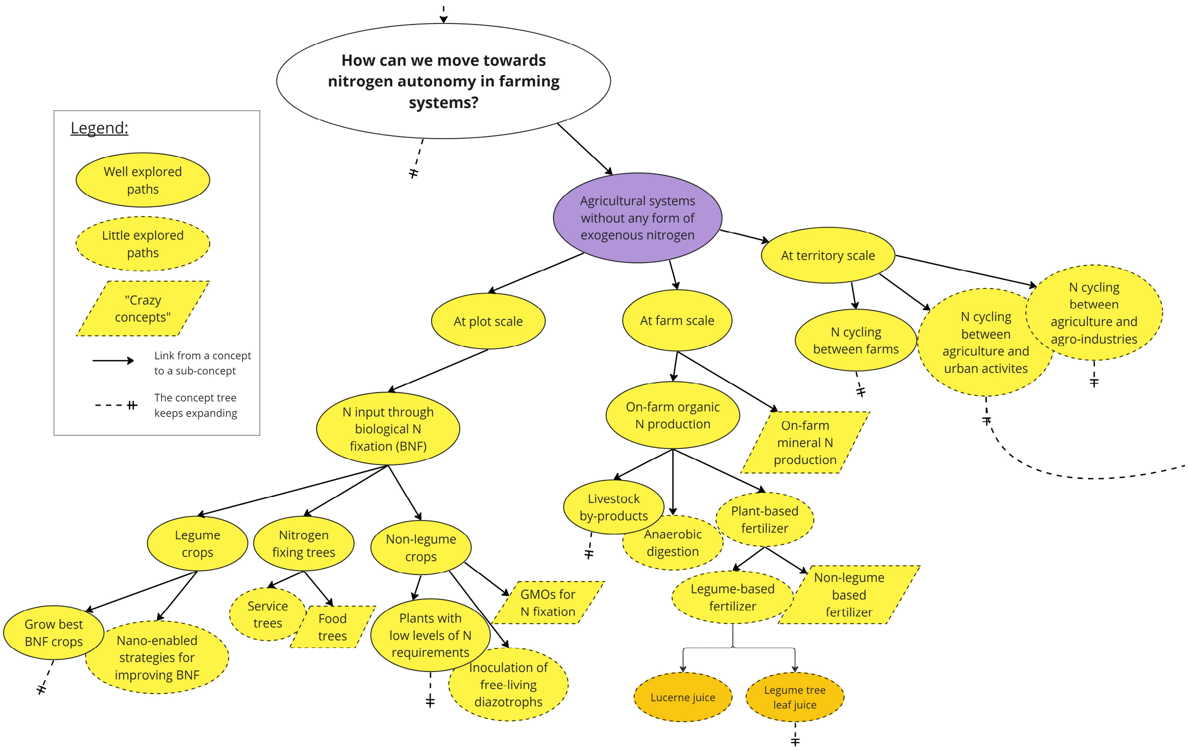

Figure 7: Extract from the fifth concept expansion tree. Paths qualified as well explored are in shown solid lines, concept considered as little explored are in dotted lines, crazy concepts are diamond-shaped (i.e., concepts that may initially appear impractical for exploration in a design process, but that can actually contribute positively to the overall design strategy by providing additional insights to further define a more "sensible concept" and lead to its eventual conjunction)

Practical and theoretical implications

The aim of this article was to provide a comprehensive overview of the challenges and opportunities associated with nitrogen management in agricultural systems, while identifying innovative pathways for further research. Though innovation design workshops and literature review, we highlighted fixation effects on knowledge production and showed that research has mainly focused on soil nitrogen dynamics and site-specific studies on the variability of response to nitrogen fertilization. In a complementary way, we identified potential research avenues, such as (i) plant-based N nutrition monitoring to help decision-making on N topdressing; (ii) post-harvest diagnosis to adjust decision rules for the following year; (iii) farm-scale nitrogen monitoring and reasoning and (iv) the design of nitrogen-sufficient cropping systems.

These results may provide cognitive resources for organizations and individuals to improve their capacity to design new nitrogen reasoning in agrosystems. However, several critical points need to be considered.

Firstly, as workshop participants explore concepts, they generate different avenues and hypotheses based on their knowledge and ability to imagine new solutions. This exploration can lead to divergent or even contradictory solutions. For example, the five main avenues mentioned in Figure 1 imply varying and sometimes contradictory levels of dependence on synthetic nitrogen fertilizers. The scale of study can also lead to antagonistic solutions, for example when nitrogen autonomy is sought at the farm or regional level. Due to the variety of paths explored and knowledge mobilized, solutions to the agricultural nitrogen problem will require a systemic and portfolio approach in which different technologies are used in combination to address site-specific challenges (Guillier et al., 2020).

Secondly, most innovative pathways explored face socio-technical lock-ins — strongly interconnected obstacles occurring at every link of the value chains (Meynard et al., 2018)— that need to be overcome. The avenues present some ideal destinations, but do not always offer details of the paths to take to reach them. This may be due to the lack of available knowledge or the absence of similar previous experience, limiting the ability to draw a precise path. The complexity of the problem, combined with the exploratory nature of the concepts and the uncertainties of radical innovation, also makes it difficult to define a single route to these destinations.

Finally, an essential issue for work studying possible futures concerns the need to discuss potential impacts associated with the innovative solutions identified. As any redesign process, it involves potentially positive impacts (for example, on water or air quality) and negative impacts (for example, on farm economics or food self-sufficiency). The impact of each pathway could be evaluated either ex-ante or ex-post to assess their real potential.

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The effect of one-to-one structured support in enhancing farm strategic planning

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Abstract

Farmers' strategic planning is important for the adaptation and transformation of farm businesses and yet few studies have explored this topic. In the Australian dairy sector, the *Our Farm-Our Plan* (OFOP) program provided farmers with an opportunity to develop and implement strategic plans for their farms. The OFOP program provided supported group learning, online resources and follow up advisory visits over a 24-month period to complete and act on plans. This paper describes early findings from research which is investigating whether the provision of the structured one-to-one follow-up advisory support alters the chance of the farmer having a plan, increases the quality of their plan, improves decision-making and/or changes perceptions of the value of planning. Qualitative analysis from interviews and surveys of 20 farmers involved in the program suggest that advisory support was crucial for the completion of plans, improved the quality of plans and assisted in farms acting on their plans irrespective of their stage in farming, use of other advisory services or levels of routine planning prior to completing OFOP. Therefore, policies and practices seeking to support longer-term farming systems change should support the strategic planning process as part of building adaptive capacity.

Keywords: farm visions, farm strategy, advisors, goal setting, planning, adaptive capacity.

Purpose

Strategic planning is part of the management process which clarifies the long-term vision of an organisation to increase the likelihood of success in meeting objectives (Olson, 2004). Farm strategic planning has been described as a non-routine, non-programmable, unique and creative process, which is more ambiguous, uncertain and complex than operational management (Shadbolt, 2008). Few studies have examined farmers' strategic planning or what supports it, leading to calls for more research (Lansink et al., 2003; Stanford-Billington and Cannon, 2010). Historically, the effects of strategic planning have been focused on production and economic performance (Stanford-Billington and Cannon, 2010), however challenges such as climate change creates a different perspective for farmers and their strategies. Therefore, understanding how farmers can be supported in their strategic planning is of increasing importance.

This paper describes early findings from research in an Australian farm strategic planning extension program in the dairy sector, '*Our Farm, Our Plan*' (OFOP). The research is investigating whether the provision of structured one-to-one follow-up advisory support alters the chance of the farmer having a plan, increases the quality of their plan, improves decision-making and/or changes perceptions of the value of planning.

The OFOP program is a national flagship program in dairying supported by the national government and the dairy sector as part of support to improve drought resilience and increase farm business skills. The program uses an intensive extension model involving significant investment in online content, group-based workshops, advisory support provision, and a marketing campaign to encourage involvement. Participating farmers have access to structured follow up support over 24 months, including one-on-one sessions with experienced and trusted 3rd party professionals (e.g. well-known and respected farm management consultants) to establish and review their plans. Such involvement of private-sector advisers within industry and government programs is a common feature of Australia's pluralistic agricultural extension system (Nettle et al., 2021). Since 2019, more than 1,050 dairy farmers have participated (i.e. +15% of the industry) with 53% of participating farmers doing so online in the 2021/22 years.

Design/Methodology/Approach

The research draws on theories of adaptive capacity (Walker et al., 2004) to frame advisory support as contributing to farmer self-efficacy and enhanced risk management (Herrera et al., 2019) in the context of Australia's climate and other challenges. The study involves a controlled trial design whereby farmers completing the OFOP program between 2021-2023 were invited to participate and were then allocated to receive one to one support provision within either the first 3 months following a first workshop (Schedule A) or after 4 months (Schedule B). The program is mainly delivered as group-based learning and so all research participants from the same OFOP group received the same schedule (A or B). As at December 2023, 50 farmers had agreed to participate in the study. All participants completed questionnaires (on-line or over the phone) and phone interviews at 2 or 3 time points (i.e. 1, 6 and 12 months following their first workshop). Questions relate to their existing planning practices, self-efficacy, confidence in planning and the role of advisory support in developing and implementing their plans, and actions taken. A copy of their written strategic plan ('plan on a page'), if provided, was independently assessed for quality with criteria of: a) completeness of the plan; b) evidence of SMART goals and actions (i.e. specific, measurable, attainable, realistic, time-bound) in the short and longer term; and c) steps towards achieving goals are visible and the likelihood that those goals and actions will assist the famers in managing uncertainty and risk.

This paper reports preliminary findings from responses of 20 farmers (13 farm owners, 2 farm managers, 3 sharefarmers, 1 employee, 1 'other') all of whom had one-to one structured advisory support. Of the respondents, 11 were male and 9 female, 8 held a bachelor or post graduate qualification and the remainder had finished high school (5) or had a certificate or diploma (7). Herd sizes varied with 4 farmers having less than 300 cows, 9 farms between 300-700 cows (7 respondents didn't complete this information).

With respect to involvement in decision making, thirteen farms, in addition to the respondent had 1-2 other people on the farm involved and 5 farms had 3 or more other people involved. The respondent's stage in farming also varied with 7 identifying as 'well-established', 3 'starting out', 3 'expanding or growing' and 2 'handing to the next generation'. This paper reports on the qualitative data analysis which applied the grounded theory techniques of coding and constant comparison (Charmaz, 2017) to examine processes and patterns in the text from interviews and completed questionnaires related to the influences of advisory support in planning. To examine the role of advisory support at different stages of the farm family business life-cycle, we selected 3 farms to examine in depth.

Findings and Discussion

3.1 Motivations for involvement in the OFOP program

There were a large range of motivations for participating in OFOP amongst respondents. Some were motivated to join because of the specific phase their business was in including farm succession, farming entry, farm retirement and farm growth.

3.2 Levels of confidence in planning prior to participating in OFOP

Survey responses at the start of the program indicated many were confident already in their planning capacities being 'moderately to mostly confident' in: a) Describing a vision for the future for the farm and yourself; b) Assessing the farm enterprises' current position in relation to a 'farm fitness checklist'; c) Conducting a situational analysis ('SWOT') to identify the current strengths and weaknesses of the farm enterprise, as well as opportunities and threats; d) Identifying and expressing 'SMART' personal and business goals; e) Formulating an action plan to achieve goals; f) Completing a risk register to identify hazards, confirm the risk, and develop mitigation strategies; g) Document a personalised 'Plan on a Page'; h) Clearly communicate the vision, values, goals, and actions to other members of the farm business team. Overall, respondents were more confident in conducting a situational analysis (c) and communicating with their farm team (h) and less confident in the documentation relating to a 'risk register' (f) and 'Plan on a Page' (g).

3.3 Use of advisers prior to OFOP

Most of the research participants interviewed already engaged advisers prior to their involvement in OFOP yet all were very interested in having the OFOP advisor visit.

> *'…it's good to have an extra pair of eyes' {MG, 6/11/23}*

> *'… It's easy to get the nutritionist, it's easy to get the vet, …. But not someone that will look at the whole business and get it to work cohesively together in all the aspects.' {LSC, 9/3/23}*

3.4 The goals set for the adviser visit

Participants were looking forward to the advisory visit, with many putting decision-making off until the visit, being keen to discuss ideas and plans with the adviser. For some, the advisory visit was a way to keep progressing their goals, identify changes needed and prompted 'pre-planning' for the visit. The advisory visit was also seen to involve more family members in planning. Other farmers mentioned the goal of reviewing their overall financial position and farm system changes.

3.5 Effects of the advisory visit on planning

The one-to-one structured advisory support improved the quality of planning and action in the following areas: a) Being aligned with partners or family members about the farm; b) Having more focus in the goals set in the OFOP workshops; c) Having more specificity to the priority and type of actions to be undertaken, and d) Having greater confidence and clarity to act.

While the OFOP workshops and group interaction was well received, farmers' progress in completing their plans or taking action on their plans often stalled following the OFOP workshops. For some, the time pressures had been a challenge:

> *'A little bit useful whilst there, but we've lost it as we've got home' {DMW, 6/3/23}*

For some farmers, it was the discussion around the planning, and not writing the Plan, that was the most important and useful dimension of OFOP:

> *'The 'plan on a page' will end up in a drawer…but doing it [the plan] will be a nudge. The visits will nudge us – but not make decisions– the value is in the questions we don't ask ourselves' {RC, 18/11/22}*

For others, the Plan on a Page was directing the actions taken:

> *'… we've already started to action some steps, … ' {AM, 6/12/22}*

To elaborate these effects of advisory support on strategic planning at different farm stages, three farms were selected for further elaboration of the role of advisory support in strategic planning implementation.

Farm 1 – Entering farming

Jim and Jo were no strangers to formal planning because of their professional backgrounds, however they got involved in OFOP to be better able to build their vision and plan to enter a dairy farm business in 2024. The adviser visit was aimed at clarifying the realism of their objectives. For Jim, the accountability provided through OFOP and knowing the adviser visit was coming up stimulated revising the plan:

> *'…I am keen to drive a bit of change now. … follow through with something, … setting these goals…having that meeting set with [the adviser] … having that accountability'.*

While the plan was partly completed prior to the adviser visit, the visit stimulated the completion of the objectives. The visit also gave confidence to Jim and Jo that their plan was achievable (through detailed financial analysis), and it gave direction to specific next steps with respect to savings goals and conversations with the family with the goal of entering dairy farming. At the final interview, Jim said they had acted on the Plan, and were speaking to family members about starting farming on the family land and buying cows to begin their farming career.

Farm 2: Getting on the same page with my partner

Jake (33 yo) has always been business focused on his farming and involved in farmer groups. He has also regularly used farm business consultants to test his ideas, to conduct monthly cash flow actuals over budget and to plan investments. Joining OFOP then was not too different from his routine practice, however he found it an important process for helping his partner to understand the business and share the vision, as prior to this it was mainly he and his father having these discussions:

> *'…it was …more beneficial that I had [my partner] doing it with me…it was good just to be on the same page, as a couple, rather than it just being …separate to what's going on in our own lives, …'*

Jake admits, that even though they had a plan, if the adviser visit wasn't included, the plan would not have been acted on. Jake conveyed that the adviser visit gave him more clarity on the steps to take. The advisory visit had exceeded his initial expectations and clarified the priorities for action.

Farm 3: Prioritising and focusing effort

Len and Sally found that writing the plan came easier with the adviser visit and clarified what they wanted to do. They found that choosing the areas to focus on was the hardest part, and discussing this with the adviser helped:

> *'after [the adviser] visit, I changed a couple of focus areas, …fresh eyes see things even better than yourself.'*

They were surprised at how beneficial the adviser visit was:

> *'It was fabulous, very informative, wonderful assessment and direction for future… good timing… helped to identify things that could be worked on in the more immediate.'*

Sally found conversations with the others on the farm easier after the adviser visit:

> *'.. it was easier and better once [the adviser] visit had happened…everyone was on a clearer vision.'*

The adviser visit helped focus the plans and better identify weaknesses, risks and the actions to prioritise.

Discussion

Although the planning intent among the farmers in the research was high, developing a plan was delayed by a combination of time pressures, the confidence to complete the plan and/or the relative priority afforded to the task. The advisory visit was thus a key factor in completing plans and increasing confidence for the actions to take. In most circumstances, without the adviser visit, the plans would have been unfinished, incomplete, unfocussed, or lacking prioritisation. Previous studies have also identified that time is a principal constraint to the development and creation of farm strategic plans, and that few farmers review their plans (Stanford-Billington & Cannon, 2010). Structured advisory support should therefore be considered a key step in strategy implementation, which is recognised as the area in which strategic planning often fails (Twum, 2021).

That the advisory visits helped farmers at a range of stages in their farming life (e.g. entering, leaving, growing) and was also helpful even if farmers already paid for advisers and/or participated in planning, was an interesting finding. This implies that, in the context of pluralistic advisory and extension systems as in Australia, advisor involvement is a critical element of programs aligned with public-good visions to enhance the resilience of farmers. Whether strategic planning will become a routine and sustained practice among all participating farmers is unclear from the research to date and thus an important area for future evaluation. Further, the commitment of advisors to collaborate and partner in such programs is an important area for future research.

Practical Implications

The design features of the OFOP program could be applied to interventions related to longer-term farming systems change. All the elements of the OFOP program, including advisory support, were noted as useful to developing the strategic plans of the research participants (i.e. workshop content, tools and resources, interaction with other farmers). This finding reinforces the importance of combinations of methods to develop integrated programs to support change (Nettle, et al., 2022). Additional features in the OFOP program important to research participants was ensuring more than 1 family member was involved, providing choice in the delivery format (on-line, small group, intensive or spread-out over months) and providing the space and time for farm partners to understand each other and work on a joint direction for them and the farm. Farmers found value in the opportunity to reflect and refocus. While some farmers pay for strategic planning advice, initiatives such as OFOP provided access to strategic planning input for a wider group of farmers (e.g. entering farmers) who wouldn't necessarily pay for advice.

Theoretical Implications

Our findings contribute to theories of adaptation and resilience relating to farming futures. Farmers' adaptive capacity is considered a key attribute for ongoing resilience in the face of challenges such as climate change, however theories of adaptation and resilience do not strongly focus on strategic planning and implementation as a mechanism through which adaptive capacity is built (Walker et al., 2004). Our findings suggest that successful strategic planning is an important aspect of farm adaptive capacity with the focus on farm visions, aligning farm family goals, risk management (Herrera et al., 2019) and strategic priorities. Our findings also highlight the importance of the advisory system and farmers' multiple contacts with information and advisory services as part of adaptive capacity (Nettle et al., 2015).

Originality/value

There are only a small number of studies that have focused on farm strategic planning and the processes that support planning and implementation. The insights from this study should support the design of interventions to support farm strategic planning and an increased focus on strategic planning as part of building adaptive capacity among farming communities.

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Crossing researchers' perspectives for an evolving systemic representation of local food system

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Abstract:
In France, the 'Anti-waste for a Circular Economy' and 'Climate and Resilience' laws, are steering our society towards greater sustainability by transforming our lifestyles. These laws promote a comprehensive shift in local agro-food systems towards circular models, involving revamped food systems and enhanced agricultural and urban bio-waste management. However, the current AKIS is considered ill-equipped to support the transition of the food system. Thus, we have developed a participatory approach aiming to create tools and methods that enable the inclusion of all actors in a collective reflection on the food system's transition. The participatory approach involving scientists explores various graphic representations of the food system, assesses their potential for guiding the transition to circularity and proposes graphic representations that take account of the obstacles and limitations identified. The systemic representation of a food system and its evolution that we have developed provides a framework for reflection for potentially all stakeholders. It shows the levers that stakeholders can use to move towards greater circularity. These tools deviate from prescriptiveness and disrupt the traditional linear approach, aiding in the development of a systemic view essential for contemplating the system's transformation.
Keywords: transition, waste, tool, participatory approach, circularity, Clermont-Ferrand

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Purpose

In France, the 'Anti-waste for a Circular Economy' (Feb. 2020) and 'Climate and Resilience' (Aug. 2021) are steering our society towards greater sustainability by transforming our lifestyles. These laws promote a comprehensive shift in local agro-food systems towards circular models, involving revamped food systems and enhanced agricultural and urban bio-waste management. However, according to a review by Spendrup and Fernqvist (2019), the current Agricultural Knowledge and Innovation System (AKIS) still relies on a linear transmission of knowledge. These authors also highlight the insufficient exchange among these agri-food sciences. To address these limitations, we have developed a participatory approach aiming to create tools and methods that enable the inclusion of all actors in a collective reflection on the food system's transition towards greater circularity.

Methodology

Following the prescription of Guzzo *et al.* (2022) for the study of transitions toward circularity, we adopted in 2023 a participatory approach for creating both a current and transition-oriented representation of the food system with twelve researchers, diverse in disciplines such as anthropology, agronomy, geography, economics, logistics, computer science, and management science. They are engaged in the Grand Clermont and the Livradois-Forez Regional Nature Park Territorial Food Project (GC and PNRLF TFP in France) (Lardon *et al.*, 2022). The participatory approach sought to explore graphical representations of the food system, evaluate their potential in guiding the transition towards circularity, and propose graphical representations addressing identified barriers and limitations. It shares similarities with the work of Van Schoubroeck *et al.* (2022).

Given the complexity of the food system, our focus centered on transitions associated with the reduction of food loss and waste management. Indeed, this topic is of importance since 20% of food are lost or wasted in Europe (FAO/Inrae, 2020). Then, only edible flows and actors directly linked to these flows were considered, omitting indirect governance actors like agricultural services or local authorities.

We implemented a two-stage methodological itinerary. The first stage included:

- A preliminary survey to capture researchers' perspectives on local food systems and circularity.
- A participatory workshop (WS1) with researchers to discuss diverse representations of the food system through graphical representations (such as the one of the CIAT[11] or the figure 1 of Tzachor *et al.* (2022)), identify elements for a shared representation, and consider the system's transition regarding food loss and waste management.

The first stage revealed limitations in the many current representations of the food system.. Indeed, despite their variations, representations often depicted the system linearly, with partial considerations due to societal issues. In contrast, circularity requires an integrated approach considering micro, meso, and macro levels (Merli *et al.*, 2018). The study of the transition to territorial and circular food system therefore requires the construction of a global systemic vision considering flows, actors and their links (Esposito *et al.,* 2020).

To address these complexities, **the second stage** involved:

- Individual interviews with each researcher to specify food flows and reasons for observed losses and waste. The objective was exploring waste management and empirical approaches for enhancing system circularity.
- A second participatoryworkshop (WS2) with researchers to evaluate and validate the new representation tool, linking actors and functions (output 1), causes and proposed actions for reducing wastage (output 2), and testing multi-scale complex actions (output 3).

After each task, the representation tool was updated, and knowledge organization led to the development of an initial "helping to think about transition" method.

Findings

Output 1. A representation tool of the functions and actors within a local food system.

[11] https://www.iisd.org/sites/default/files/2021-01/ciat-na-food-system-figure.jpg

The first methodological stage has made possible to identify the stakeholders in the food system, their attributes and their functions. Our first list of functions has been thought as the simplest as possible to address the representation of the system and actions against wastage: production, transformation, transport, storage, marketing/commerce, cooking, serving, inside or outside consumption. These functions link the actors, not only in terms of the food or organic materials they exchange, but also in terms of the information, commitments, partnerships, collaborations and organizations.
From there, we conceive a first tool (partially inspired from Hy & Nicolas, 1983) which propose to represent a stakeholder as a set of functions linked together by a food flow (figure 1). The actor may perform one or more functions. For example, a retailer performs marketing/commerce, storage and sometime transport functions. Our representation tool delineates the transition of flows from one function to another, utilizing chosen flow locations to facilitate subsequent actions aimed at minimizing losses and waste. A crucial aspect of this process involves identifying both the actor responsible for the loss or waste and the specific function associated with it. Future developments of our tool will further enhance its capabilities by incorporating a more nuanced representation of issues tied to inventory and time. We aim to leverage principles from Value Stream Mapping (VSM) graphs commonly used in logistics to portray a production process in conjunction with the commercial exchange it influences (see, for example, Rother & Shook (1999)).

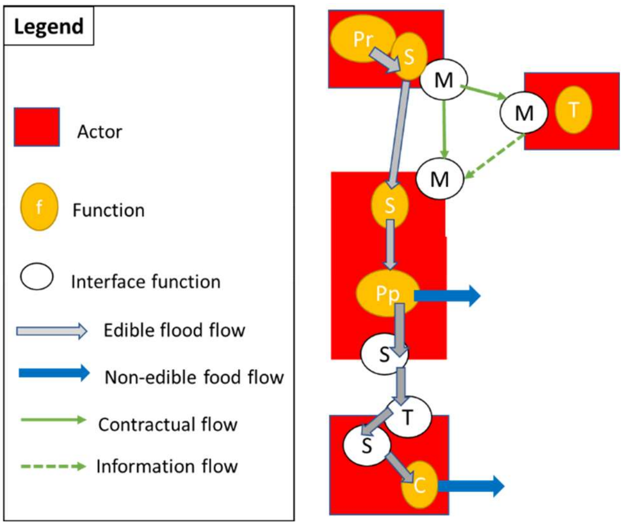

Figure 1. Systemic representation of actors and their relationships.

A Farmer produces (Pr) and stores (S) for selling (M) to a Caterer. He/she contracts with a Transporter (T) who inform the Caterer about the delivery. The Caterer receive the edible food flow in his/her storage before preparing the meal (Pp), that is stored to be presented to the Consumer. A Consumer buys and transport the edible flow that is stored before consumption (C). (Realisation: Sylvie Huet, 2023).

Output 2. Wastage: linking reasons to actions to define possible wastage-actor
Building upon the organizational insights derived from the initial stage results, we proposed researchers to employ a graphical approach (called ARLA) for identifying the actors or functions accountable for wastage, the wastage itself, underlying reasons, and potential preventive actions. This involves creating a schematic representation of an Actor (in the center) who have Reasons (on the orange circle), for both edible leftovers' (blue circle on the right) and non-edible leftovers' (blue circle on the left), and envisage associated possible Actions (external green square) to decrease wastage.

We provide an illustrative example of this approach, showcasing its practical application for consumers (Figure 2). The identified reasons offer insights into the functions and actors contributing to wastage. For instance, inadequate storage may prompt consumers to discard edible leftovers, attributing the responsibility to the storage function of the consumer. Conversely, overbuying involves both the commercial function of the consumer and, potentially, the retailing's commercial function that encourages bulk selling. This recognition enables the identification of actions that an actor can directly undertake by modifying its functions for correction or improvement. Additionally, examining the actions makes possible to identify other actors, such as associations or public institutions, that can play a role in reducing wastage.

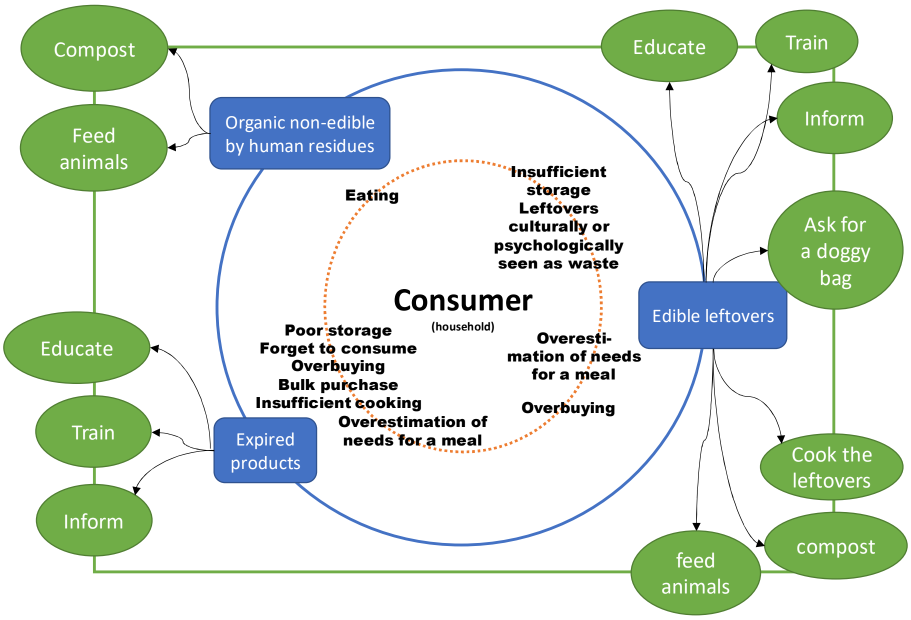

Figure 2. Systemic representation of ARLA graph for a consumer (Realisation: Sylvie Huet, Sylvie Lardon, Juan-Felipe Mendieta, 2023). Leftovers are intentionally not detailed for visualization purpose

The information extracted from these ARLA graphs was consolidated into a trajectory of change database to unveil the relationships between actors, functions, types of wastage, and possible actions.

The research has brought to light numerous factors contributing to losses and wastage, encompassing issues related to the unique organization and infrastructure of individual actors, the coordination among multiple actors (contractual arrangements, adherence to health standards, absence of actors for collection and/or recovery, lack of adaptability, etc.), and a 'mismatch' between production, subject to climatic constraints and uncertainties, and the demand for the product (in terms of timing or product quality misalignments). Our study can be complemented and compared with similar research or reviews (e.g. Ishangulyyev et al. (2019), Salvador et al. (2022), Merli et al. (2018), and Urbinati et al. (2017)).

Output 3. The tool for prioritizing actions for a more circular
Each potential trajectory of change within our database can be effectively prioritized using existing typologies (e.g. Kirchherr *et al.* (2017) or Papargyropoulou *et al.* (2014)). Notably, Papargyropoulou *et al.* (2014) introduces a decision tree for actions based on the type of object (fit or not for human consumption) that we can compare with our (edible or non-edible) type and the nature of waste (avoidable or unavoidable). We can enhance our database by incorporating the type of waste, guided by rules that classify unavoidable waste with reasons such as meteorological or climatic events, regulatory constraints, and inedible parts. Con-versely, avoidable waste can be attributed to methodological or material processes, cognitive or cultural causes, and the nature of relationships among actors. Figure 3 illustrates the relation between our approach and the framework from Papargyropolou *et al.* (2014).
Ultimately, classifying and prioritizing actions in alignment with regulatory frameworks illuminate intricate, multi-scale territorial action systems. We easily identify the preventive actions that wield significant impact across various levels of the system. These findings can be deliberated upon to formulate a comprehensive and shared plan for advancing circularity.

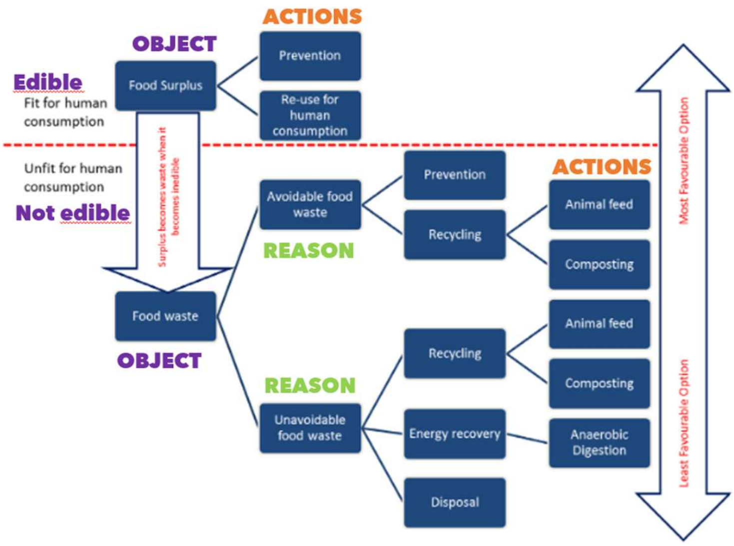

Figure 3. Systemic representation of food surplus and waste framework. The right arrow indicates the level of priority to give to the actions (according to the regulations in favor of circular systems of many countries).

Practical implications

The systemic representations of a food system and its evolution provides a **framework for reflection for all stakeholders** and show the levers that stakeholders can use to move towards greater circularity. The three main results obtained are all "tools and resources for taking action and making decisions in territories", in the same perspective as those developed in partnership research projects (Torre *et al.*, 2021).
The tool designed to illustrate the connections between functions and actors (output 1) empowers stakeholders to identify their roles within the system, enabling them to discern the functions they contribute to and understand the interconnections

with others. For instance, a majority of actors actively participates in storage and transport activities.

The ARLA tool (output 2) enables the reasons on which the actors can act to be discussed collectively, and therefore to coordinate in order to implement these actions. For example, several types of action are possible for the consumer.

The tool for prioritizing actions for a more circular system (output 3) can be discussed by the various stakeholders, considering their unique interests, capabilities for action, and shared objectives for system improvement. For instance, a centralized kitchen project necessitates seamless coordination among all intermediary actors. Each of these actors possesses the potential for individual action, and this potential is amplified when actions are collaborative and address issues at the territorial scale. Considerations include enhancing access to quality food, preserving biodiversity, and sustaining employment.

Theoretical Implications

Our three outcomes, despite their defaults, contribute to enhance the AKIS for the food system transition. Their usage may engage all stakeholders in collaborative deliberation on the system's transition, extending beyond the confines of the agricultural sector. They manifest as tools and methods facilitating the co-construction of a systemic representation. These tools deviate from prescriptiveness and disrupt the traditional linear approach. Moreover, our method facilitates the development of narratives for waste management by adopting a systemic and dynamic perspective on the system in need of transformation. It surpasses existing methods that merely categorize causes, solutions, or actors in isolation, lacking interconnections. The framework, designed to guide the formulation of action trajectories within a specific context, bolsters discussions around these trajectories within a multi-level action context. Testing it across various processes and domains remains to do.

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Using social network analysis to understand stakeholder engagement in agricultural-based innovation systems

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Abstract:
This study explores the dynamics of collaboration within agricultural innovation systems, crucial for addressing global challenges like food security and climate change. While prior research offers insights into network composition and structure, empirical evidence supporting resultant network theories is limited. We bridge this gap with a descriptive analysis of social networks across East Africa, West Africa, Central America, and South Asia, using data from 202 respondents collected via structured questionnaires. Findings reveal varying dominance of stakeholders across regions, with government entities prominent in West Africa and South Asia, and the private sector prevailing in East Africa and Central America. Academic institutions, national agricultural research systems (NARS), and domestic NGOs emerge as central actors in respective regions. Strong triadic closure is observed in East Africa, West Africa, and South Asia, indicating a tendency for organizations with shared partners to form connections. These insights offer guidance for policymakers, researchers, and practitioners to develop targeted interventions and strategies aimed at enhancing collaboration, innovation, and knowledge diffusion within regional agricultural innovation ecosystems.
Keywords: Social network analysis; Horticulture; Network structure; Collaboration

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Purpose

In an era of increasing global challenges such as food security, climate change, and rural development, agricultural-based innovation systems have emerged as pivotal instruments in addressing these multifaceted issues (Brooks & Loevinsohn, 2011). These systems involve a diverse set of stakeholders, including farmers, researchers, policymakers, and private sector actors (Seifu et al., 2022). However, the complex nature of their interactions often remains obscured, making it challenging to identify potential collaboration opportunities, knowledge flow, or barriers within the system.

Building on previous studies that investigated the structural characteristics of networks and the positions of actors within them, this paper uses Social Network Analysis (SNA) to explore the dynamics of stakeholder engagement in the horticultural sectors of West

Africa, East Africa, Central America, and South Asia. SNA is a methodological approach used to study social structures through the visualization and analysis of relationships among individuals or entities. Previous studies consistently underscore the importance of network structure and its profound impact on network functionality (Levy & Lubell, 2018; Rank, 2008). It indicates that analyzing network structures could offer a strategic starting point for utilizing social network analysis to understand stakeholder engagement within any innovation system.

A significant body of literature has explored the strength of connections, as indicated by structural holes or network closure, emphasizing the potential importance of weak ties within the network (Kalish & Robins, 2006; Patacchini & Zenou, 2008; Tan et al., 2015). Furthermore, previous studies revealed that actors may occupy different positions within the network, ranging from peripheral to central positions (Ingold et al., 2021). It is important to note that the position an actor occupies in the network influences their impact and effectiveness, depending on what they contribute within the network. For example, actors who serve as knowledge sources may make their most substantial contributions when positioned centrally within the network (Ingold et al., 2021). In contrast, coordinating actors may achieve greater effectiveness when situated in brokerage positions, and collaborators can still make meaningful contributions even from the periphery of the network. Moreover, previous research proves the crucial role of inclusive networks in fostering complementarity among network actors, as they possess diverse skills that complement one another (Hermans et al., 2017). This dynamic is particularly pronounced in agricultural-based innovation systems, where the reality of interdependence is paramount, as no single actor can possess all necessary resources or expertise.

Although prior research provides valuable insights into how network composition and structure influence network strength, there remains a notable gap in empirical evidence substantiating most resultant network theories. Particularly lacking are indicators that effectively distinguish successful networks that facilitate the development of effective innovation systems in agriculture. To address this gap, we use primary data to gather empirical evidence on: What network structural properties drive operational efficiency in collaborative activities within agricultural innovation systems? To address the research question, we tested hypotheses relating to centrality and influence, homophily, preferential attachment, and triadic closure. By delving into this analysis, our research aims to offer a nuanced understanding of innovation network dynamics, thereby laying a robust foundation for more impactful interventions in agricultural-based innovation systems.

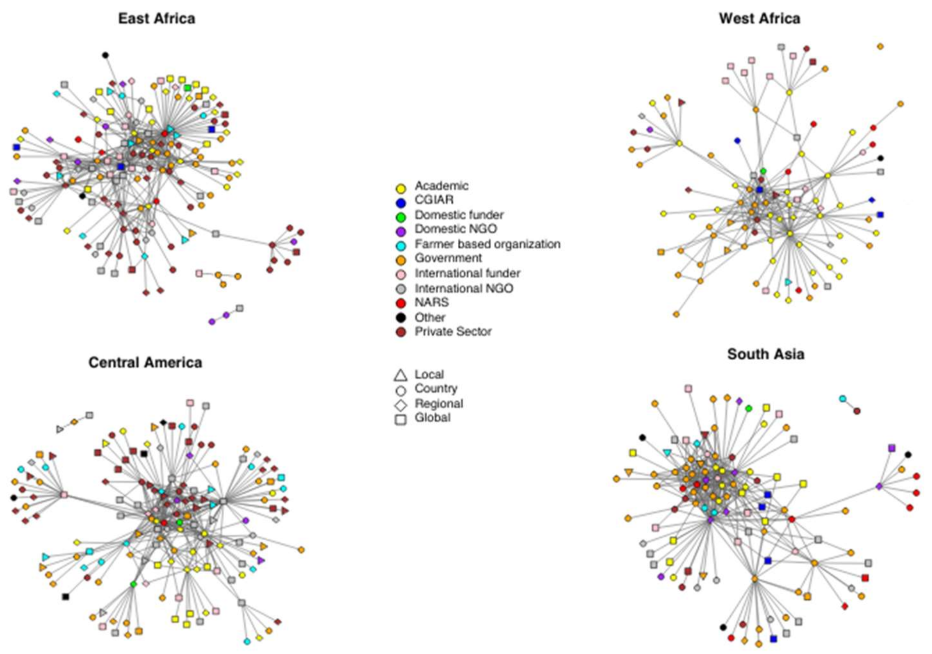
Methodology

Data Data was collected through a structured questionnaire during stakeholders' workshops across four regions: East Africa, West Africa, Central America, and South Asia. Hence, our research design enables a comparison of the structure of innovation system networks across four different contexts. Respondents represented institutions actively promoting innovation within the field of horticultural production in the context of Feed the Future Innovation Lab for Horticulture. The Horticulture Innovation Lab is a global research network that advances fruit and vegetable innovations. Stakeholder workshops were organized and hosted by in-country partners of the Innovation Lab for Horticulture which includes the following: International Center for Development and Evaluation (hosted in Nairobi, Kenya), University of Ghana (hosted in Accra, Ghana), Zamorano Pan-American Agricultural School (hosted in Tegucigalpa, Honduras), and FORWARD (hosted in Kathmandu, Nepal). Each organization was tasked with identifying and inviting a blend of private, public, and governmental actors across the horticulture value chain, including experts in gender, youth engagement, and nutrition, from countries in their region where Feed the Future works. Thus, participants invited to attend the workshop and take the survey were dependent on each organization's network and influence. In East Africa, respondents were from Ethiopia, Kenya, and Uganda. West Africa had respondents from Benin, Burkina Faso, Gambia, Ghana, Liberia, Mali, Nigeria, Senegal, Sierra Leone, and Togo. Central America had respondents from Colombia, El Salvador, Guatemala, Honduras, and Nicaragua. South Asia had respondents from Bangladesh and Nepal. Structured interviews were used to systematically gather relational information within the horticultural sector. These interviews were strategically embedded within regional stakeholders' workshops, serving as platforms for engaging key stakeholders across different facets of horticulture. To facilitate a structured approach to data collection and subsequent analysis, respondents were systematically guided through a series of questions aimed at obtaining comprehensive information about both the organizations they are affiliated with and those they collaborate with. Firstly, they categorized their represented organizations based on typologies such as Academic, CGIAR, Domestic funder, Domestic NGO, Farmer-based organization, Government, International funder, International NGO, NARS, Private Sector, or Other, along with specifying the geographic scope of operations. Secondly, they listed organizations they communicate or engage with, employing similar typologies and geographic scopes. We used R, specifically the igraph package, for conducting descriptive analysis and visualizing differences in observed networks. Moreover, we used the statnet and ergm R packages to test hypotheses relating to network structures (Levy & Lubell, 2018).

Findings

Results indicate that Government entities dominate the West Africa and South Asia Innovation Networks, while the Private Sector prevails in the East Africa and Central America Innovation Networks. According to the average degree centrality, Academic institutions in West Africa, NARS in East Africa and Central America, and Domestic Non-Governmental Organizations (NGOs) in South Asia are positioned centrally within their innovation networks. Likewise, based on the average Eigenvector, local funders in West Africa, National Agricultural Research System (NARS) in East Africa and Central America, and domestic NGOs in South Asia demonstrate significant influence in their respective innovation networks.

Figure 1: Visual representation of respective innovation networks



The ERGM results showed strong evidence that organizations often establish network connections based on their similarity in types, however, did not indicate significant support that collaborations occurred exclusively among organizations operating at the same administrative levels. Supported by the positive coefficients derived from the "gwesp" term in the ERGMs, findings indicate a significant tendency for East Africa, West Africa, and South Asia to exhibit robust triadic closure within their networks, a pattern absent in Central America. These results support the hypothesis that organizations with shared partners tend to have a higher probability of forming connections within the network in East Africa, West Africa, and South Asia. There was no significant proof that organizations tend to establish connections with influential and popular actors.

Table 1: ERGM results

ERGM Terms	**East Africa**	**Central America**	**West Africa**	**South Asia**
edges	-4.043 ***(0.219)	-3.117 ***(0.337)	-5.556 ***(0.442)	-4.139 *** (0.413)
Homophily effects				
Homophily - Type of organization	0.364 **(0.121)	0.498 ***(0.136)	0.511 ***(0.119)	0.367 ** (0.126)
Homophily - Scale	-0.103 (0.110)	-0.018 (0.115)	-0.624 (0.347)	0.259 (0.142)
Likelihood to connect by organization type				
Academic	0.452 **(0.156)	0.721 ***(0.173)		0.773 ***(0.169)
CGIAR	0.852 ***0.256)		0.486 * (0.225)	-0.009 (0.297)
Domestic NGO	0.186 (0.234)	-0.281 (0.231)		1.029 ***(0.192)
Government	0.412 **(0.143)	0.368 *(0.180)	0.004 (0.053)	0.224 (0.152)
International funder	0.535 **(0.173)	0.253 (0.184)	-0.035 (0.170)	0.277 (0.185)
International NGO	0.503 **(0.160)	0.563 **(0.177)	-0.108 (0.221)	0.385 (0.260)
NARS	0.972 ***(0.181)	1.210 ***(0.282)	-0.292 (0.236)	0.990 ***(0.183)
Private Sector	0.104 (0.147)	0.456 **(0.163)	0.204 * (0.090)	-0.025 (0.173)
Domestic funder		0.447 (0.242)	0.065 (0.208)	
Other	0.178 (0.300)			

Likelihood to connect by scale of operation				
Country	-0.289 (0.149)	0.644 ***(0.143)	0.679 * (0.323)	-0.040 (0.198)
Regional	0.052 (0.145)	0.405 **(0.134)	0.079 (0.201)	0.191 (0.210)
Global	-0.505 **(0.166)	0.034 (0.147)	0.222 (0.237)	-0.604 **(0.208)
Network structural terms				
Preferential attachment (gwodeg)	0.042 (0.454)	-2.346 ***(0.513)	0.360 (0.487)	0.115 (0.588)
Triadic closure (gwesp)	1.134 ***(0.107)	-0.300 **(0.091)	2.107 ***(0.198)	1.108 ***(0.166)

Practical Implications

The results validate the use of social network analysis as a valuable tool for understanding stakeholder engagement within agricultural innovation systems. These insights serve as a guide for policymakers, researchers, and practitioners in developing targeted interventions and strategies to enhance collaboration, innovation, and knowledge diffusion within regional innovation ecosystems. Moreover, the significant influence demonstrated by local funders, NARS, and domestic NGOs underscores the importance of local stakeholders in driving innovation and shaping the network landscape. Additionally, the findings suggest that organizations tend to establish connections based on similarities in types, implying that fostering partnerships with entities of similar profiles could enhance collaboration opportunities within innovation networks. The lack of significant evidence supporting connections with influential actors implies a potential challenge in achieving diversity and accessing resources beyond immediate networks, highlighting the need for strategies to promote broader engagement and knowledge exchange.

Theoretical Implications

Our findings do not offer conclusive evidence to support the hypothesis that farmers or government entities occupy central positions within innovation networks, nor do they confirm that international institutions hold influential positions. This contradicts the common perception from stakeholder analysis studies, which typically emphasize the central roles of farmers and government (Chinseu et al., 2022). Interestingly, academic institutions, which appear central and influential in this study, are rarely identified as key stakeholders in agricultural innovation systems. It is worth noting that many past studies on stakeholder analysis relied on basic descriptive methods rather than considering how these stakeholders are interconnected within the network. In traditional stakeholder analysis, "key stakeholders" are typically identified as those deemed important within the network. This implies that, when applying a network approach, these stakeholders would likely emerge with either higher degree centrality or eigenvector centrality.

Our findings align with Hermans et al. (2017), as they also emphasize the significance of shared structures, functions, or objectives over operational scale in influencing interactions between organizations. However, this finding contrasts with Hong & Su (2013) observation, where universities operating within the same administrative unit substantially increase the likelihood of collaboration. Some studies may not directly address the influence of organizational types and operational scale on innovation network formation. Instead, certain scholars link this topic to the wider conversation on institutional and organizational proximity effects in academic literature. Institutional proximity, as commonly defined in the literature, underscores the importance of shared norms, practices, and incentives among organizations of similar types.

Our research revealed a significant presence of the popularity effect (preferential attachment) in Central America, where the significance of shared partnerships (triadic closure) leading to connections was not observed. Conversely, in regions where shared partnerships leading to connections held significance, there was no apparent popularity effect. This trend contrasts with observations made in networks of wine grape growers (Levy & Lubell, 2018a), where both popularity and shared partnerships were found to be significant factors. It is possible that where the popularity effect is significant, there may be a stronger emphasis on individual reputation or prestige within the network, leading to preferential attachment to highly connected actors. In contrast, in regions where shared partnerships are significant, there might be a greater emphasis on collaborative relationships and mutual trust. The literature discusses both preferential attachment and triadic closure as indicators of social processes happening amongst network actors such as trust and social capital.

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METHODS & TOOLS II

New approaches to monitoring, evaluation and learning (ME&L) for systemic change in agricultural practices.

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Abstract:
This paper explores new approaches to monitoring, evaluation and learning (ME&L) for systemic change in agricultural practices. Monitoring and evaluation are commonplace and usually understood as a continuing systematic process of documenting and assessing ideas, events, activities and outcomes over time using criteria and indicators. However, rooted in systematic framings, tools and processes, existing M&E processes and approaches by design are unable to fully engage with the complex dynamics and interdependencies of many agricultural situations. Systemic change requires ME&L as a systemic learning process. Based on a tradition of systems thinking and practice, this paper draws on ME&L experiences in three research projects using open innovation processes of Living Labs (LL) and Communities of Practice (CoPs). The findings to date suggest that ME&L leads to new insights into the role and use of social learning spaces to strengthen capacity for new practices in agricultural contexts. However, a learning focus can challenge researchers' and stakeholders' traditions, understandings, expectations and experiences of both ME&L and their current practices. To be meaningful, ME&L requires careful co-design, clear aims and processes and dedicated resources, including training, to ensure it becomes a central part of enabling systemic change in agricultural practices.
Keywords: Monitoring, Evaluation & Learning (ME&L); systems thinking; Living Labs; Communities of Practice; social learning

Purpose

This paper explores new approaches to monitoring, evaluation and learning (ME&L) for systemic change in agricultural practices. The considerable literature on M&E is accompanied by equal variation in concepts and processes depending on sector and purpose. Monitoring is usually understood as a continuing systematic process of observing, measuring and documenting ideas, events, activities and outcomes over time using criteria and indicators. This information is used by various stakeholders to the determine the extent of progress and achievement of objectives to support decision-making (OECD, 2002; TAP, 2016a). Good practice involves stakeholders in the design and process of monitoring (and evaluation) to promote ownership and build trust in the indicators used and data collected (TAP, 2016b; Serpe et al., 2022; Amin et al., 2023).

Evaluation is the systematic process of assessment using criteria related to objectives which represent the perceived importance, worth and success of the intervention or activity (after OECD, 2002). There is no set process and it can be both formal and/or informal. Monitoring and evaluation of projects and initiatives is commonplace in many sectors, but until recently, very little explicit attention has been paid to associated notions or processes of learning as the logical next step of M&E.

Learning is usually associated with a change in an individual's understanding and/or practices, but determining 'what kind of change is a delicate matter' (Bateson, 1972). Often understood as the acquisition of ideas knowledge, skills, practices, learning can also involve giving up habitual thinking, concepts, understandings and framings. Maladaption – where learning results in continuation or acquisition of inappropriate knowledge, skills and practices contrary to expectations or desired outcomes – is also possible (see Juhola et al., 2016). Based on a tradition of systems thinking and practice, this paper explores how engaging in ME&L can help support systemic change in agricultural practices and AKIS.

Design/Methodology/Approach

A case study approach is adopted to inform some of the key aspects of ME&L in relation to Living Labs (LL) and Communities of Practice (CoPs) (Lave and Wenger, 1991) in agricultural contexts.

LL represent a potential shift in the research-practice-policy dynamic. Although definitions vary, LL can be conceptualised as learning spaces for 'real-life' interactions between stakeholders (including researchers) to build capacity for addressing complex socio-ecological situations of direct concern to those involved. The 'empty container' notion of a LL offers considerable flexibility for their scope, design, content, purpose, process, duration and outcomes. LL have become a key part of public policy initiatives in many sectors (see, for example, von Wirth 2019; Sahakian *et al.*, 2021) and in agricultural research (EC, 2023a, b) while the *EU Horizon Soil Health and Food Mission* 23/24 aims for 100 LL to transition towards healthy soils to benefit food, people, nature and climate (EC, 2023c). Similarly, CoPs have been used in many contexts. Characterised by a shared domain of interest; ongoing interactions among its members; and development of shared practices, CoPs have a similar tradition with LL as collaborative learning spaces with very similar challenges for ME&L.

The case studies centre on ME&L in one completed and two ongoing international research projects involving the authors in different configurations: Agricultural Knowledge: Linking farmers, advisors and researchers to boost innovation (AgriLink); Sustainable Approaches to Land and water Management in Mediterranean Drylands (SALAM-MED) and Climate Smart Advisors (CSA).

The Horizon 2020 AgriLink project focussed on the role of innovation support and advisory services in agricultural innovation processes using six LL in Spain, Romania, Latvia, Italy, Norway and a joint living lab in the Netherlands and Belgium. This 3-year project completed in 2021. The PRIMA funded SALAM-MED project explores sustainable approaches to land and water management using six LL in Egypt, Tunisia, Morrocco, Greece, Spain and Italy. Its aim is to engage stakeholders in the design and testing of Nature Based Solutions to restore degraded dryland ecosystems and improve social and economic resilience for youth and women in agriculture. It completes in 2025. The Horizon Europe funded CSA project spans 27 countries across Europe to explore and strengthen advisors' capacities through creation of 260 CoPs to accelerate climate smart farming. This project is 1.5 years into its 7-year duration.

Agrilink and SALAM-MED refer only to M&E in their technical material, but their evaluation processes aim to identify learning and thus all three cases can be considered as using a form of ME&L to assess and determine a cycle of interventions, emerging lessons and outputs and impacts to improve agricultural practices in a range of European farming systems in Europe and North Africa.

The design of the ME&L in the first two case studies is based on a combination of design thinking and systems thinking where the LL is assessed using the 3 Es criteria from soft systems traditions (see Checkland et al., 1990):

1. **Efficacy** - has the LL achieved its specific purpose (as defined by the stakeholders)?
2. **Efficiency** - has the LL used resources well (including budget, time, energy, skills and enthusiasm)?
3. **Effectiveness** - has the LL contributed to the overall purpose of the project?

The use of the 3 Es provides generic criteria for evaluating the LL at project level, allowing cross-comparison between LLs and also meta-analysis. The 3 Es also allow for flexibility. For example, an indicator of Efficacy for a specific LL focussing on restoring groundwater could be 'irrigation use' and measurement adapted to available data: number of days irrigated/year, or ML of water used, or fuel usage for groundwater pumps. Although not always precise and quantifiable in all cases, such data can be used to monitor and evaluate the performance of the LL within an overall narrative. Any initial criteria developed by the LL convenors (e.g. researchers) are reviewed, revised and/or wholly co-created with other participants in the LL to develop co-ownership and understanding of progress.

In the CSA project, a different approach has been adopted, centred on an explicit theory of change where interventions aim to boost advisors' capacities to advise on climate smart farming. A ME&L conceptual framework has been developed which includes a Dynamic Learning Agenda (DLA). This is a set of questions developed by the project related to key elements in the theory of change to help inform training within CoPs; inform practices across CoPs; and also gain insights to inform subsequent CoPs. The DLA questions are updated and answers added over time.

Whichever criteria are used, a key issue of ME&L in complex situations, with multiple actors and activities over extended time-frames, is determining cause and effect and impact (Noltze et al, 2021). To address this, all of the case studies include scope for reflective narrative accounts by researchers as part of the ME&L process to record and make sense of system-level interdependencies focussed on sense-making and meaning. This is to avoid over reliance on abstract measurement and on log frame lists of separated criteria, indicators and data (van Wessel, 2018; Haldrup, 2023).

Despite different aims, context and size, all three projects conceptualise ME&L as a continuous, 'real-time', reflexive learning process intersecting with other project activities at key points to learn from and shape further activities and interventions within the projects and beyond.

Resourcing for ME&L processes vary. In AgriLink, each LL had a facilitator and a coordinator supported by a project-wide work package team responsible for liaising with each LL, coordinating cross project training and cross-project learning and reporting. A more emergent process has developed in SALAM-MED as researcher experience, skills and training relating to ME&L have developed. In CSA, a very large project, a dedicated Work Package team supports and coordinates ME&L throughout the project. In all three case studies, qualitative and quantitative data include: scientific data: economic data; statistics; surveys and interviews; comments; exchange of correspondence; and observations.

Findings

Two of the case studies are ongoing and the insights reported here are a partial snapshot of our current understanding and are subject to future revision. The CoP element of the CSA project is only just beginning and is not reported here.

ME&L in AgriLink and SALAM-MED to date suggest that LL are important spaces for developing insights into complex situations and strengthening capacity for new practices in agricultural contexts. ME&L reveals that LL can enable individual as well as social learning – the latter involving groups of people agreeing about their purpose, goals and co-creating knowledge leading to new behaviours and actions to transform situations through concerted actions (Collins and Ison, 2009). This can lead to new insights about the situation and possible improvements. But the success of LL depends on many contextual historical, social, economic and environmental interdependent factors at start, during and end which are not always immediately apparent or even within scope of the initiating organisations or stakeholders to address.,

Even where trust is established, ME&L show that LL are not easy to continue without support and resourcing, including facilitation. In AgriLink, the LL ended with the research project. This may be appropriate if the LL have served their purpose (as defined by participants). In SALAM-MED, insights from ME&L have highlighted the importance of the coordinating and facilitating role and focussed attention on LL longevity after the research ends.

Whatever their lifespan, a key insight from ME&L reporting is that LL (and by extension similar initiatives) can be understood mechanistically and used as an applied tool: 'an outdoor lab' with all its connotations of replicability and experimentation- to endorse research aims, generate results and to disseminate ideas and practices *to* stakeholders. This can generate considerable valuable information and data, but offers less scope for and insight into the learning dynamics required for LL and CoPs to effect *systemic* change in agricultural practices. The 3Es criteria used in AgriLink and SALAM-MED LLs contribute to system level thinking, but their flexibility also requires careful and skilled interpretation.

It is clear from ME&L that understanding '*living'* as synonymous with ongoing co-learning has been more challenging for researchers without social science traditions or backgrounds. Similarly, ME&L in AgriLink reveals, the 'lab' element of LL was problematic for many stakeholders who were unreceptive to the idea that they and their livelihoods were available for study and experimentation. In SALAM-MED, the LL terminology has to date had varied reception and purchase amongst stakeholders.

In AgriLink, a clear commitment to ME&L across the project with dedicated resources enabled key lessons to be identified about the roles, functions, timings and conditions required for LL in agricultural contexts (see Potter, et. al, 2022). In SALAM-MED, researchers with less prior experience of ME&L have required additional training and support to design and use. In the CSA project, the emphasis on learning is explicit and ME&L is a key part of the project set-up and activity. However, in all of the case studies, the disciplinary mix of the researchers means understandings, expectations and experiences of ME&L differ significantly.

Focussing on 'living' is to recognise that LL and similar open innovation processes such as CoPs are *learning* spaces. Existing M&E processes and approaches rooted in a systematic framing, tools and process, by design are unable to fully engage with the multiple and complex dynamics of inter-dependencies of learning, especially social learning. This limits options for transformative insights. Systemic change in agricultural practices means effective ME&L must be equally systemic in design and use. This imperative and its implications for the design and role of ME&L have yet to be fully understood within agricultural research.

This is because effective ME&L requires 1st order *and* 2nd order reflective practices. 1st order thinking – how can an existing agricultural practice be improved? - is in often already 'baked into' the concept and ethos of standard M&E processes. However, there may be limited appetite for 2nd order thinking – why are we doing agriculture this way? - because agricultural contexts tend to emphasise the need for practical and incremental solutions within existing ecological, economic and socio-cultural framings and traditions.

Insufficient familiarity, training, skills or capacities in ME&L within the research community adds to these difficulties. While generally supported, ME&L is not yet regarded as a systemic learning process for researchers and practitioners, but instead something functional, additional and the remit of 'others' to undertake and assess. In some cases, the scientific tradition of experimentation and learning from, for example, field experiments in a LL, means additional time and effort on ME&L is deemed 'unnecessary' and 'repetitive'.

Practical Implications

M&E is a convenient label for a variety of established practices which vary considerably in scope, effectiveness and application. The addition of *learning* places a new emphasis on what ME&L can and should encompass and the role of researchers. However, learning is both a complex concept and phenomenon and rarely a straightforward linear process, particularly in situations involving multiple actors and perspectives. Learning can take time to emerge and is often stochastic.

A key practical implication is that ME&L requires people and processes able to document, evaluate and use the different facets and complexities of learning over time. These requirements may not be 'in step' with the timetabling, skills base, resources or expectations of participants, researchers or funders. For example, in AgriLink, ME&L revealed that the set up of a LL initially experienced as an unhelpful delay, was later reassessed as beneficial in refining the aims and ambitions of the LL.

ME&L also requires a shift away from expecting only linear outcomes, to capturing context, complex socio-ecological interactions, and allowing for uncertainty. This can be unsettling for those expecting ME&L to provide 'easy' answers. Good project design ME&L involves situating ME&L as a core and ongoing activity within projects, with clear roles and responsibilities for all participants to contribute and use. Additional resources and investment in skills and capacities may be needed, especially at project inception.

Theoretical Implications

Our ME&L processes in two of the case studies to date suggest that LL are not a panacea, are not without challenges and may not be appropriate in all contexts. They require appropriate conditions, effort, skills, capacities, investment, time and dedicated resources as well as a clear commitment to co-learning if the *living* dimension of LL is to be realised. As LL become a key feature of agricultural funding, a more critical view of their conceptualisation and practice is needed in a similar vein to the expansive literature on CoPs. ME&L is essential for this to happen.

Where there is a high degree of trust, ME&L can proceed collaboratively within (and between) learning spaces such as LL and CoPs based on mutual respect, fairness, transparency and professionalism (Luli, 2024). Challenges remain on how and by whom learning is interpreted, recognised, assessed and evaluated to improve systemic practices in agriculture. Currently, learning is poorly conceptualised and practised in a tradition of M&E dominated by log frames and criteria. Additionally, expectations of linear and replicable impacts ignore systemic and complex process occurring in agricultural contexts. But a new approach to ME&L based on learning brings greater potential for enacting systemic transformation of agricultural practices.

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Using Real-World Laboratories to Foster Learning on Digitalization: Experiences from the German Lab AgDiBi

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Abstract:
In a growing number of sectors and disciplines, researchers and practitioners are collaborating in transdisciplinary groups to solve real-world problems, particularly in the context of novel innovations and sustainability. Recent policies at the European and national levels aim to foster the sharing of knowledge and innovation in multi-actor settings related to digital agriculture. Despite the growing interest in multi-actor living labs in the field of digital agriculture, there is still a dearth of scientific literature that provides practical insights into the implementation of such a multi-actor group. This article aims to bridge this gap by providing a brief introduction to different conceptualizations of multi-actor labs and a detailed description of the implementation of a Real-World Laboratory in the context of digitalization and education. To this end, we employ a case study methodology and draw on empirical material generated during the co-design phase of the German lab AgDiBi. The reported experiences provide insights into the process of setting up a multi-actor lab to promote knowledge exchange and learning about digitalization and give impulses for organizing collaboration within such a lab.
Keywords: Digitalization, Living Lab, Skills, Multi-actor approach, Knowledge, Learning

Purpose

Keeping up with the latest developments in digital agriculture is a challenge in itself, given the scope of technologies available and the complexity of processes generating and distributing them (Lioutas & Charatsari, 2022), or the knowledge required to implement and use them (Higgins et al., 2017). The German strategic plan for the Common Agricultural Policy (CAP) states that a lack of knowledge about requirements, application scenarios, opportunities, challenges, and costs is one reason for the slow uptake of digital innovations in agriculture, but also emphasizes that this can only be solved by better connecting innovation actors such as research, education, advisory services and farmers (BMEL, 2023). Regarding the latter, previous work shows that such innovation and knowledge processes are driven by multiple actors (Kernecker et al., 2021). In this context, Zscheischler et al. (2021) suggest to use multi-actor approaches in order to promote mutual learning and reflection about digitalization among different actors. Two of the most well-known concepts of such multi-actor groups are Real-World Laboratories (RWL), especially in Germany, and Living Labs (LL) on the European scale (Wanner et al., 2018). While lab-like research infrastructures have been used in different sectors and disciplines (Luu et al., 2022), including agriculture (Cascone et al. 2024), there hasn't been much focus on applying this approach in the context of digital agriculture and education. Against that background, this work aims to provide an insight into the process of setting up such lab-like infrastructure that connects science and practice, with a focus on improving education on digital technologies in agriculture. To this end, we describe the co-design phase of the German RWL AgDiBi (Agri-Digital Bildung, in English Agri-Digital Education). A case study designed to foster multi-actor engagement in digitalization by establishing an educational format based on collaboration between academia, an experimental demo farm, vocational and technical schools, agricultural authorities, and a loose network of technology providers.

Living Labs and Real-World Laboratories

In the literature, different conceptualizations can be found to describe multi-actor lab-like approaches (Wanner et al. 2018). Since describing them in detail is beyond the scope of this article, we provide an introduction to two of the most well-known concepts.

According to the European Network of Living Labs (ENoLL, 2024), LLs "are open innovation ecosystems in real-life environments using iterative feed back processes throughout a lifecycle approach of an innovation to create sustainable impact". Key characteristics of LLs are (i) co-creation, (ii) real-world setting, (iii) multi-method approach, (iv) orchestration, (v) multi-stakeholder participation, and (vi) active user involvement. Conceptually, the LL approach places particular emphasis on collaborative innovation co-creation, prototyping and up-scaling through the involvement of citizens, research organizations and businesses, and government agencies. Malmberg et al. (2017) argue that an LL process follows a scheme consisting of an exploration, experimentation, and evaluation phase. During the exploration phase, the LL analyses the current state and envisions a future state. This is followed by testing solutions that help move toward the future or preferred state during the experimentation phase, while evaluation focuses on assessing the outcome of the experimentation by comparing the current state to the future or preferred state.

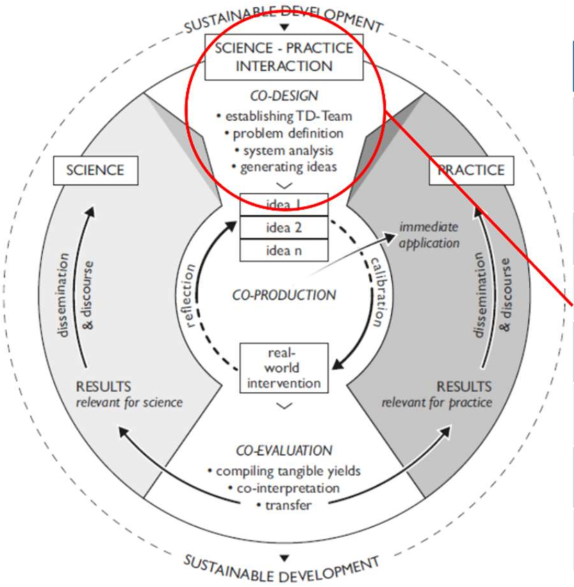
There is no final consensus on what defines a RWL. German scholars such as Parodi et al. (2016, p. 16, translated) argue that a "real-world laboratory is a transdisciplinary research facility that conducts sustainability experiments in a spatially defined social context in order to initiate transformation processes and to perpetuate corresponding scientific and social learning processes". Wanner et al. (2018) outline that a RWL is characterized by three major phases - co-design, co-production and co-evaluation, incorporating eight key components: (i) normative framing: contribution to sustainable development (C1), (ii) production of (contextualized) knowledge (C2), (iii) real-world problems as a starting point (C3), (iv) defined laboratory boundaries (C4), (v) transdisciplinary collaboration with clear roles for science and practice (C5), (vi) real-world intervention (so-called experimentation; C6), (vii) cyclical learning process through reflection and variation (C7), and (viii) empowerment of change agents and capacity building (C8) (see Fig. 1). In phase 1, called co-design, the focus lays on group formation, problem definition, system analysis, and idea generation. Phase 2, referred to as co-production, engages with real-world intervention by applying ideas, reflecting on the outcome, and calibrating applied ideas in a cyclical learning process. In phase 3, co-evaluation, a final evaluation of the produced results shall be undertaken, which yields a compilation of the scientific and practical outcomes. Additionally, produced results shall

be co-interpreted and co-evaluated by the involved actors and transferred back into practice and scientific communities.
A comparison of both concepts makes clear that they share some similarities, such as collaboration of different actors, real-world orientation or experimentation and evaluation loops. This is partly due to the fact that both concepts have their origins in the same field of transdisciplinary research (Wanner et al. 2018). As the RWL concept has received more attention in Germany, the current work focuses on this concept and its practical application in the context of digital agriculture and education.

Material and methods

The lab AgDiBi was initiated by the Communication and Advisory Services research group at the University of Hohenheim in the frame of the EU project CODECS (www.horizoncodecs.eu). The lab was started because previous research showed that there is a lack of education on digital technologies in agriculture in South Germany (Paulus et al., 2023). The RWL concept has been used to set up AgDiBi during the co-design phase, but can also be used to describe it based on eight key characteristics (see Fig. 1).

Figure 1. RWL framework and application (based on Wanner et al., 2018)



Characteristics	Code
Normative framing: contribution to sustainable development	C1
Production of (contextualized) knowledge	C2
Real-world problems as a starting point	C3
Defined laboratory boundaries	C4
Transdisciplinary collaboration with clear roles for science and practice	C5
Real-world intervention (so-called experimentation)	C6
Cyclical learning process through reflection and variation	C7
Empowerment of change agents and capacity building	C8

AgDiBi can be seen considered a case study that examines a specific problem through the integration of different social science methods in depth (Priya, 2021), using the RWL concept as a unifying framework. Group discussions and interactive methods promoted engagement within the multi-actor group during the co-design phase in the first year. These activities were used to iteratively establish the transdisciplinary multi-actor group, define the problem of interest revolving around digital agriculture and education, and generate ideas to address this problem. The main topics of this process were: i) to better understand the individual challenges and interests of the actors involved in digital agriculture education; ii) to identify opportunities for action based on available resources; iii) to develop a joint action plan reflecting the common interests of the lab members.

The documented results of the offline and online interactions are presented in the results section based on the eight key characteristics of the RWL concept (C1 to C8).

Results

In the first year, the focus of AgDiBi was on the co-design phase, especially activities related to group formation, joint problem definition, system analysis, and idea generation (Wanner et al., 2018). Table 1 provides an overview of the co-design phase based on the eight key characteristic (C1 to C8). The process of group formation was initiated by the authors (C5: social science researchers) of this work and an experimental farm (C5).

Table 1 Description of the the AgDiBi co-design phase based on the eight RWL characteristics

Code	Activities in the co-design phase	Results/ Observations
C1	• Discussion of the needs to educate on digital education; common understanding of mission	• Development of digital skills required to fully exploit the potential of digital technologies and improve sustainability of farming practices.
C2	• Systems knowledge: discussion of previous experiences to educate on digital agriculture and on the elements of the system. • Target knowledge: discussion of interests and objectives to participate in RWL/development of educational format. • Transformative knowledge: discussion of potential activities to realize the desired outcome	• Systems knowledge elicited: low engagement of vocational and technical schools to educate on digital and precision agriculture, limited access to educational materials, limited knowledge of teachers about precision agriculture, limited consideration in agricultural curricula. opportunities of collaboration with research, education and private sector • Target knowledge formulated: formulation of common objective to develop a multi-year series of educational formats that contribute to better understanding costs and benefits, building trust and interest in digitalization, and support capacity building. • Transformation knowledge started: Designing a multi-year series of educational formats on different types of digital technologies in arable farming: fertilization, crop protection, integrated technologies.
C3	• Discussions of individual challenges to educate on digitalization	• Delimited the main problem to be addressed: What digital agriculture topics are currently taught, what should be taught from a scientific, educational and practical viewpoint
C4	• Jointly defining contents, spaces, and time	• Delimited the boundaries of actions: (1) space: farm as hub for educational activities, (2) contents: focus on precision and digital agriculture technologies; time: 3 years running time with an annual field day
C5	• Mapping of already existent actors in the RWL, their roles and further required collaborations • Knowledge integration between researchers and practitioners	Assignment of different roles for science and practice: Experimental farm as host of demonstrations, technology provider and intermediary to Agtech actors • Social science research as lab facilitators, promoting co-production of ideas and co-evaluation. • Teachers with didactical and agronomic expertise to support real-world intervention • Agricultural authorities (collaborating digitalization projects) as actors providing organizational support and technical expertise Further required collaborations (not included in co-design phase) • Agtech sector as provider of technologies and expertise, advisors on the implementation of technologies
C6	• Conceptual discussion about the set-up of the education format • Implementation of preparatory activities to conduct the first major activity	• Determination of prior preparatory knowledge-related activities, distribution of responsibilities for field day, definition of relevant learning objectives of the field day, organizational duties and requirements, conceptual implementation of evaluation loops among RWL members, participants of educational format
C7	• Coupling interventions and reflection (planned)	• Repeated discussion of activities, constant documentation, and repeated reflection
C8	• Enable cross-institutional networking and access to resources	• Connecting and supporting private-public and public-public interactions related to the topic of agricultural education and digitalization

The topic attracted the interest of various actors in agriculture and education, such as local vocational schools, technical schools, local authorities, a state agricultural institute, and members of another research project (C5: actors and roles). A key issue at the outset was to establish a common understanding of the problem, including a discussion of why the current level of vocational training in digital technologies may not be sufficient to fully exploit the potential of digital technologies to support the implementation of more sustainable production methods in the long term (C1: normative framing). At an early stage of AgDiBi, the different actors provided information about previous teaching experiences and challenges related to digital agriculture technologies, which helped to outline the problem (C3: real-world problem) and gain an understanding of the current situation (C2: systems knowledge). Beyond the analysis of the current situation, further group discussions were held on the actors' interest in teaching digital agriculture, leading to the production of a common vision for the lab (C2: target knowledge). Discussions about educational interests led to the idea of developing a multi-year educational format that would allow students and teachers to learn about different types of digital technologies in agriculture. More specifically, the actors jointly generated the idea of organizing an annual field day to present different types of digital technologies in arable farming at the experimental farm, combined with prior preparation in the classes of the vocational schools (C6: (planned) real-world intervention). The concept of the educational format (field day and previous lessons) can be also considered as a "boundary" object as it delimits the scope of AgDiBi (C4: space, time, content of real-world interventions). During the first year of AgDiBi, the roles of the actors became clearer (C5): social science researchers as group facilitators, experimental farm and agricultural authorities managing another digitalization project as organizers of the first field day, and vocational and technical schools and teachers as intermediaries linking AgDiBi with the target audience - agricultural students - but also preparing them in the previous lessons due to the complexity of the topic. In addition, lab-internal reflection was implemented by the researchers at an early stage to improve mutual understanding, while broader (including RWL-external) cyclical learning and reflection (C7) will be more relevant once the first field day takes place. In addition, capacity building can be expected to become more important once the first field day is held and the outcome is jointly evaluated.

Implications

In this article, we briefly contrast two different lab-like multi-actor concepts and describe the application of the RWL concept from an analytical perspective. Based on the description of the co-design phase of AgDiBi, it becomes clear that lab concepts are useful to organize the multi-actor process of setting them up, but also that they can be used to characterize them based on key characteristics. The case study illustrates that beyond the actual problem of interest, such as digitalization and education, the establishment of a lab is a challenging process for scientists and practitioners taking place at the same time. We assume that lab-like concepts can be particularly useful for facilitating small-scale transformation processes in agriculture and rural development due to their limitation to local conditions and actors. Jointly narrowing down the specific problem under consideration and using this as an anchor point may be one of the most important aspects, along with repeated group discussions and reflections to foster mutual understanding within the transdisciplinary working group.

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Quantifying agroecology learning with the SErious Game for AgroEcology (SEGAE) in a 4-hour lesson.

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Abstract:
The current agricultural system fails to meet global challenges, leading to the rise of agroecology as a relevant alternative. Agroecology delivers ecosystem services, develops social relationships, and holds economic potential. Incorporating this new paradigm into agricultural education is a step toward the transition. However, its complex, interdisciplinary nature poses learning challenges. Conventional teaching methods lack effectiveness in cultivating interdisciplinary skills.
To assist in the teaching of agroecology, the "SErious Game for AgroEcology" (SEGAE) was developed (*see* www.segae.org). It simulates a mixed crop-livestock farm in which players can modify agricultural practices to improve sustainability. This paper aims to evaluate the effectiveness and efficiency of this game within a brief lesson period (4 hours). Our approach is based on the evaluation of three parameters: (1) knowledge acquisition in agroecology, (2) the level of 'flow' (a concept used to measure engagement in a task), and (3) the potential additional benefits of different lesson formats (online versus face-to-face)."
Results indicate a significant improvement in agroecology knowledge after the game. Lesson type did not significantly impact knowledge gain, but the online session negatively affected the "flow" level. Most students enjoyed SEGAE and believed it enhanced their agroecology knowledge.
Keywords: serious game; agroecology teaching; interdisciplinarity; knowledge; bioengineering

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Purpose

European agriculture faces numerous challenges, prompting an urgent call for a transition (IPES-FOOD, 2018). Negative impacts such as forest loss, freshwater depletion, and greenhouse gas emissions highlight the need to balance food production within ecological limits (Gerten et al., 2020). Agroecology, aligned with food sovereignty principles, offers a promising alternative by promoting sustainability, efficiency, and social equity (Gliessman, 2014).
Despite the demonstrated benefits, transitioning to agroecology requires overcoming scientific and educational barriers (Vanloqueren and Baret, 2009). Agroecology encompasses a complex array of interacting components, such as environmental, social, and economic sciences (Francis et al., 2011). Traditional teaching approaches compartmentalize content by discipline, which fails to foster a systemic approach. Hence, Agroecology should be taught in a manner that offers a more holistic perspective on its diverse elements (Francis et al., 2008). Efficient learning involves engaging in active, hands-on, problem-solving methods, complemented by prompt feedback (Al Hakim et al., 2022; Boyle et al., 2011; Kiili, 2005).

Serious games address these considerations by offering immersive, interactive educational experiences (Wu and Lee, 2015). The SErious Game for AgroEcology learning (SEGAE) simulates a crop-livestock farm, allowing players to implement agroecological practices aimed at enhancing the farm sustainability indicator (Jouan et al., 2021). In practice, players can select from strategic dimensions such as (1) soil, (2) crops, (3) landscape, (4) land use, (5) cows, (6) fertilization (7) strategic decisions (8) heifer and fattening cattle, and (9) feeding system. They have access to the related practices and can make changes accordingly (a maximum of 5 changes per year, and the simulation can be run for up to 10 years). Previous research highlighted SEGAE's effectiveness in enhancing agroecological knowledge and facilitating systemic and interdisciplinary learning in a 5-day international workshop setting (De Graeuwe et al., 2020).
This study aims to assess SEGAE's suitability for a short 4-hour lesson led by a single teacher, offering a more feasible educational format for university courses. We hypothesize that SEGAE enhances agroecological knowledge and enjoyment during the session. We will analyze three lessons to evaluate knowledge acquisition and flow levels (a notion aimed at gauging the degree of engagement in a task), considering the impact of lesson delivery mode (face-to-face vs. online). Additionally, we will explore the relationship between knowledge performance and flow experience. This research contributes to understanding the effectiveness of serious games in agroecology education.

Design

The research draws on an analysis of three 4-hour lessons using the serious game SEGAE. One lesson took place entirely online in March 2021 due to the COVID-19 pandemic, while the other two were face-to-face, held in March 2023 (in France) and May 2023 (in Belgium). These lessons were attended by university students in their 2nd and 3rd undergraduate years, enrolled in agricultural engineering programs across four specializations: Agronomy, Forest, International Development, and Others.
Each pedagogical process included various activities: (1) a pre-survey, (2) a theoretical session, (3) a serious game session, and (4) a post-survey. The theoretical session aimed to introduce agroecological concepts, encompassing three modules: "Soil-Plant-Ecology," "Animal," and "Socio-economic". Interactions of agricultural practices are also introduced in the session. Following this, the serious game session provided hands-on experience with SEGAE, involving scenarios such as "sandbox," "system approach," and "sustainability-oriented" (for more information, *see* De Graeuwe et al. (2020, p. 6)). Debriefing sessions followed each scenario to discuss outcomes and limitations.
Additionally, an evaluation based on the use of pre- and post-tests was mobilized. It is a widely utilized methodology for examining the impacts of innovative educational techniques (Dugad and Todman, 1995). The knowledge assessment was composed of 21 questions, either multiple-choice or open-ended, including 10 focused on crop production, 4 on animal production, and 7 that were general. That allowed the research team to analyze knowledge acquisition. The pre-survey also included questions about some control variables, such as number of ECTS credits completed in agroecology, study specialization, and childhood living environment. In the post-survey, an added section

gathered feedback on the SEGAE game (which includes flow assessment). For more information on the surveys, see the supplementary materials of De Graeuwe et al. (2020). Data analysis involved cleaning the datasets, removing outliers, and managing incomplete responses. The sample sizes for each section of the surveys are presented in Table 1.

Table 1: Samples of the 3 lessons (*numbers of students*)

	Knowledge section	**Feedback section**
First lesson (March 2021)	48	74
Second lesson (March 2023)	20	20
Third lesson (May 2023)	42	49

Student scores were calculated for the knowledge section. For the multiple-choice questions and open-ended questions, students received a score of 1 when they had a correct answer, 0 when they did not answer, and -1 if the answer was not correct. The result of each question was added up to calculate the total score and was converted into percentages. In the feedback section, we resort to general pedagogical aspects and the 8 factors of the EgameFlow scale described in Fu et al. (2009), yielding an overall score. The feedback scores were computed based on students' responses to statements, scaling from 1 to 4 (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree). Each flow factor was assessed with 2-5 statements.

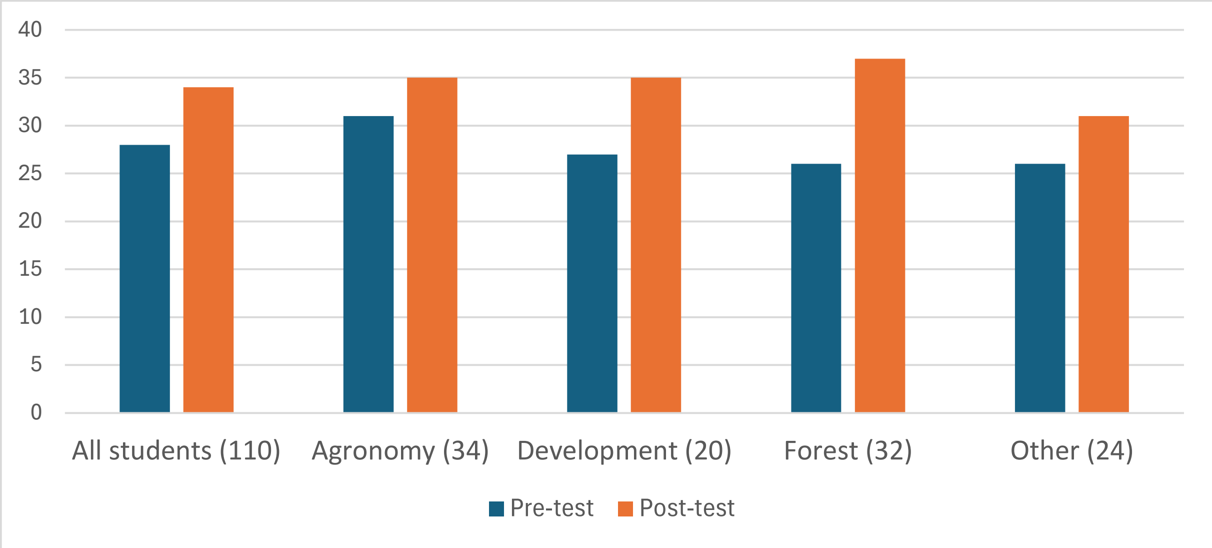
Descriptive statistics, paired t-tests, and multiple regressions were employed to analyze knowledge acquisition, specialization-wise and overall. Two-factor ANOVA and Tukey tests were used to compare flow scores among lessons and specializations. Furthermore, principal component analysis (PCA) was conducted to confirm results and explore the relationship between flow experience, knowledge change, and lesson type. This involved analyzing mean values of flow factors, absolute knowledge change, and lesson type for each student.

Findings

Seventy percent of the students experienced an increase in their scores, while 4% maintained the same scores, and 26% experienced slight decreases.

In the pre-test of knowledge, the overall average score stands at 28% (Figure 1). Each specialization ranges from 26% to 31%. In the post-test, there is a notable increase in the students' overall mean score ($p<0.001$), reaching 34%. The forest specialization exhibits the most substantial improvement, with an increase of 11 percentage points.

Figure 1. Mean of students' scores (in percentage) on the knowledge survey

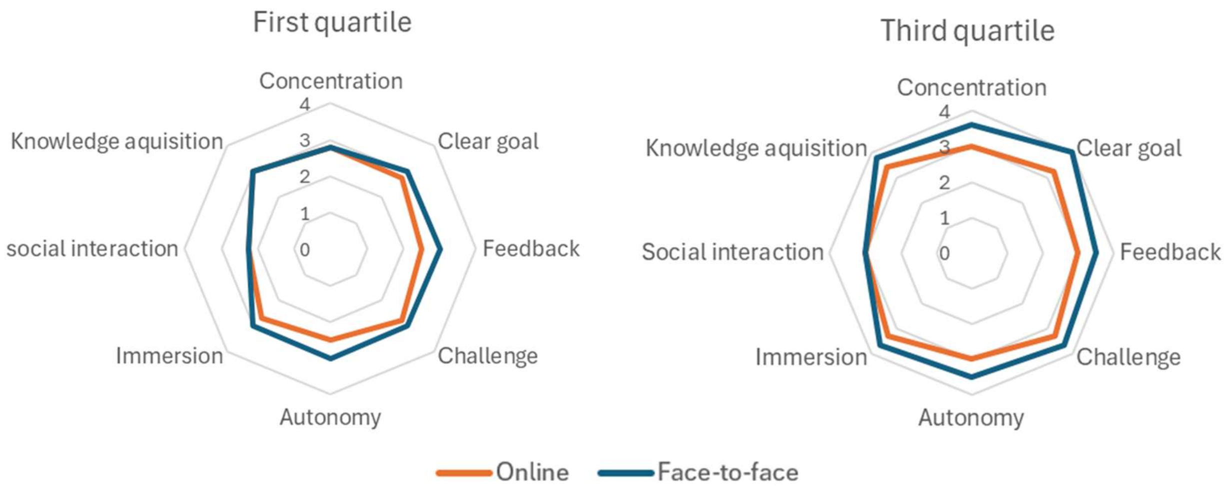


Control variables such as ECTS ((European Credit Transfer and Accumulation System) in agroecology, study specialization, and childhood living environment do not significantly influence pre-test scores (p-values>0.05). The number of books or articles read about agroecology is the only highly significant variable ($p<0.001$).

Additionally, the type of lesson (online or face-to-face) does not significantly affect post-test scores. The significant predictor is the score on the initial knowledge test ($p<0.0001$, $R^2=0.34$), with each point increase correlating with a 0.6% rise in correct answers.

In the feedback post-survey, 91% of students recommend the SEGAE game to peers. Additionally, 87% agree or strongly agree that the game was easy to play and complementary to theoretical lessons. Overall, SEGAE is well-received, with a median score of 2.99 for the overall flow, indicating a degree of immersion. However, the "social interaction" factor scores the lowest (median: 2.75). Students display higher levels of flow factors for the face-to-face lesson than for the online lesson, *see* the first and third quartiles in Figure 2. Except for the social interaction factor being similarly ranked between both types of lessons. The difference is highly noticeable for the factors of "autonomy" and "feedback".

Figure 2. Comparison with a radar chart on flow factors



To analyze the potential link between knowledge and flow, a principal component analysis (PCA) has been carried out. In essence, the PCA reveals (1) an inverse relationship between flow factors and online modality, and (2) a link between social interaction, feedback, and absolute knowledge acquisition.

Implications

As the findings show, a game-based teaching approach significantly enhanced agroecological knowledge among the students surveyed. That supports findings from prior researches that suggest educational games can advance agroecological transition, as noted by Meunier et al (2022). While the increase in knowledge is evident, it is essential to consider that the average scores on both the pre- and post-surveys were comparatively low. Conducting the post-survey outside the lesson times may have negatively affected student post-scores, with 30% of students showing no improvement or a decrease. The respective time taken by each student to fill out the questionnaire was checked, but it turned out to be insignificant in explaining the results. This corroborates the findings of Bolsinova et al. (2017) which highlighted strong differences in the way individuals process responses to a questionnaire.

More crucially, it should be emphasized that the educational framework employed enabled students to realize a change in knowledge acquisition comparable to the one achieved through a 5-day workshop[12], despite the latter requiring significantly more organizational resources and thus being more demanding in terms of time and energy. Additionally, this 4-hour method also yielded comparable levels of student satisfaction and immersion. Therefore, a concise lesson conducted by a single instructor presents itself as an effective and efficient method for agroecology education.
Additionally, the research highlights a significant impact of pre-existing knowledge on scores observed in post-tests, reinforcing the outcomes reported in earlier studies, such as, by Zumbach et al.(2020). Intriguingly, even erroneous pre-existing knowledge detrimentally influences final scores, suggesting a complex interplay between prior knowledge and performance results. These observations support Lipson's (1982) findings, underscoring the importance of strategic interventions aimed at correcting misconceptions and enhancing fundamental comprehension.
Amidst the ongoing digital transformation of educational landscapes, our analysis contextualizes the systematic integration of online courses. Specifically, it highlights the necessity for deliberate consideration of instructional design principles and their alignment with pedagogical objectives (Caliskan et al., 2020). While online education offers unparalleled flexibility and accessibility, its efficacy in promoting crucial aspects of learning, such as feedback (Anderson et al., 2010) and social interaction (Azmat and Ahmad, 2022), remains uncertain. The current study indeed underscores the potential added value of traditional face-to-face instruction in facilitating prompt peer and teacher feedback, emphasizing the multifaceted nature of effective knowledge acquisition.

[12] *see* 6.4 for "multidisciplinary curriculum" (similar student profile) in Table A1 of De Graeuwe et al. (2020)

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Multi-Actor siMulation plaY (MAMY): An innovative approach to develop the capacity of AKIS actors for communication and collaboration in co-innovation settings.

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Abstract:
The PREMIERE project, Preparing multi-actor projects in a co-creative way, is a four-year Horizon Europe project that aims to contribute to having project consortia that make best use of the complementary knowledge of their members during proposal writing, project work and beyond. PREMIERE provides learning material, tools and offers learning opportunities and networking events for proposal actors, intermediaries, and policymakers. Part of the project is the development of innovative and transformational learning experiences using among others simulation games. One of the simulation games developed is the Multi-Actor siMulation plaY (MAMY). The game aims to create an understanding of the perceptions and points of view of the other multi-actors in the consortium. The learning experience of a role-play enhances the understanding of real-live participants in this particular type of funding measure as well as for advisors supporting such multi-actor project participants. Since spring 2023, the MAMY workshop has been tested in both, online and in-person seminars. The feedback from the participants, collected after each application was very positive. They confirmed that the simulation of participation in a co-creative project setting was eye opening. They felt potential synergies and conflicts emerging naturally when the different types of actors came together to navigate the proposal development process.

Key words: Experiential learning, communication, co-creation, multi-actor, AKIS, learning tool

Purpose

The Societal Challenges addressed by European Union policy strategies such as the Green Deal and Farm-to-Fork require innovative solutions in agriculture, forestry and related rural industries. The EU Commission introduced the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) as a tool to speed up the development of innovation in agriculture, forestry and rural development. Central to the EIP-AGRI approach is the ‘interactive innovation model’, which brings together a

variety of innovation actors, such as farmers, advisers, researchers, businesses, NGOs and others in agriculture and forestry, to make the best use of their complementary types of knowledge (scientific, practical, organisational etc.) for the co-creation and diffusion of solutions ready to implement in practice. Projects funded under the EIP-AGRI are required to apply the 'multi-actor approach' (MAA). This means that "*projects must focus on real problems or opportunities that farmers, foresters or others who need a solution ("end-users") are facing*" and the collaboration of these multi-actors throughout the project from the very beginning (proposal development) to the end. The MAA is a promising instrument to speed up innovation. However, successful implementation of the MAA in project development and implementation requires a collaborative attitude and specific skills (especially functional capacity) which the potential partners involved might not have gained through their education and work/life. The MAA requires alignment of diverse interests, worldviews and modes of operation, communication on equal levels, and resources in terms of work time and effort.
The PREMIERE project 'Preparing Multi-Actor Projects in a Co-Creative Way' is a four-year Horizon Europe project that aims to contribute to having project consortia that make the best use of the complementary knowledge of their members during proposal writing, project work, and beyond. PREMIERE provides learning material, tools, and offers learning opportunities and networking events for proposal actors, intermediaries, and policymakers. Part of the project is the development of innovative and transformational learning experiences using among others simulation games. This paper presents the methodological approach for the development of one of the games developed, the Multi-Actor siMulation plaY (MAMY).

The idea for the MAMY emerged from the observation that many actors have theoretical knowledge but still have learning needs for real-life application of the MAA. Even when exposed to multi-actor (MA) settings, this does not necessarily result in an increased capacity to participate effectively in MA co-innovation processes. Hence, the PREMIERE project is exploring alternative approaches for capacity development based on game-based learning. These simulation games create a learning environment where the participants go through a discovery process, in which they acquire or improve important skills. These simulation-learning games can come in a variety of forms, including adventure, role play, action, and others, and can be designed to play as an individual or collaborative and can be either face-to-face or online (Vlachopoulos and Makri, 2017). Simulation-games in education are used in a variety of sectors including agricultural education and extension (Hernandez-Aguilera, et al.,2020, Strousopoulos et al., 2023, Hallinger et al., 2020)

Design/Methodology/Approach

The development of the MAMY started with the idea of adapting a 'murder mystery role-play' game to the multi-actor interactive innovation setting where participants were required to identify who in the room were the multi-actor 'murderers' (actors who tried to sabotage the process). Once the initial game was designed, the design was further developed through an iterative development strategy guided by play testing, evaluation, adjustment, and repeated testing. In its initial format, the MAMY was also used as a team-building exercise within the PREMIERE project. In order to develop it into a true learning experience, we decided to leave the 'murderer' concept out of the final MAMY workshop concept.

Game design

The game was designed to be played in a collaborative setting raising awareness for the different perspectives, rules and contexts of the different partners. It aims to provide a simplified representation of the challenging situation when individuals or organisations plan to align forces although specific goals and requirements differ. Through role-play and by using a real but shortened Horizon Europe farming-related call topic, participants immersed themselves in the situation of starting a MA proposal development process. The game aims to simulate the time bound and potentially conflictual environment of writing a MA project proposal combined. The participants experience to be part of a multi-actor consortium. The focus lies on the aspect of collaboration with different types of actors rather than the type of Horizon Europe project or innovations required in the call. Each participant was assigned a different character such as professor, farm advisor or a CEO of an associated business. The group also received basic information related to their characters such as main activities, interests as well as red lines for negotiations. When the characters were assigned to the players, the organisors ensured that the role-play characters (e.g. founder of IT start-up) were different from their roles in real life (e.g. researcher).

The first outline of the game had three rounds followed by a reflection on the experiences of the players and what they learned.

Round 1: 'Getting into your role'

Round 2: 'Getting to know your MA project consortium'

Round 3: 'Developing your MA project' (objectives and Work package design)

Reflection: Who was the MA murderer? What did you experience?

Game testing

From March to October 2023, seven testing sessions were organised with a variety of participants, see Table 1. The game took around 90 to 120 minutes in an offline or online setting. The number of participants varied from 6 to 25. Larger groups were divided into smaller groups. All sessions were facilitated by a member of the organising team who knew well the concept of the role-play. If needed, they also added arguments when dynamics slowed down. The facilitator needs good animation skills in order to create a friendly and dynamic atmosphere of the play. The offline testing session took place in both Germany and Belgium, online sessions were held in English for EU-wide participation or in German. After the first application of the play in presence, the organisers realised that they had to reduce the complexity for online settings.

Table 1. Overview of the iterative simulation-game development process by play-testing and evaluation.

#	Date	Type of event	Target participants	Type of facilitator(s)
1	March 2023	Offline	Researchers, advisors/consultants, Members of Innovation Support Service (ISS)	PREMIERE team (Researcher)
2	April 2023	Online	Researchers	PREMIERE team (Researcher); National Contact Point team
3	May 2023	Online	Researchers, advisors, ISS	PREMIERE team (Researcher)
4	May 2023	Online	Researchers, advisors, ISS	PREMIERE team (Researcher)
5	August 2023	Offline	Researchers	PREMIERE team (Researcher)
6	September 2023	Online	Researchers	PREMIERE team member (Researcher), consultants
7	October 2023	Offline	Managing authorities, ISS, coordinators of Operational Groups	PREMIERE team member (Researcher); National Contact Point team

The two sessions organised in May 2023 were formatted as training sessions for the partners of the PREMIERE project. The partners and their colleagues were invited to play the online MAMY session in order to be acquainted with the methodology. The sessions included time to learn how to facilitate a MAMY role-playing workshop and where to find the material for the facilitation and implementation of the game. This set of material includes:

For the offline version:

A detailed workshop scenario with extra background information and guiding questions for the facilitators;

Support material in the form of the simplified call for proposals, posters and name badges for each character;

A power point presentation in support of the introduction.

For the online version, the same material is available, but with a framework to be copied into any online whiteboard software.

As more and different types of people start to implement the MAMY workshop, we expect to collect more input on where extra support or explanation is useful in this material and gain more insight on what are the skills needed to implement this type of methodology. For example, an evaluation template will be introduced to ensure a systematic harvesting from the reflection after each workshop experience.

Findings

Game evaluation: “I had Multi-Actor in my head for a long time, but now I have much better arguments to convince my (researcher) colleagues from the institute.” and “It was very helpful as a scientist to slip into the roles.”

After each session, further refinements to the game design were made based on the facilitators’ evaluation and the feedback of the participants. Over the play-testing process, a variety of aspects of the game were improved related to the description of the different characters/roles, the duration of each round, and the reflection at the end of the game. The feedback from participants engaged in the play testing was very positive. Participants indicated that the immersion in the scenario allowed them to gain new experiences and perspectives. Playing the game in a different role and trying to express the interests of this role and understand the restrictions of the other roles was particularly effective. For example, participants who were assigned as the farmer’s representatives struggled to find their voice and felt less equal than the players who were academics/researchers and/or experienced representatives of well-established advisory organisations. This shows that simulation role-play can trigger sensitivity for the (lack of) recognition of certain partners in MA consortia and the need for the participation of partners on equal levels.

Overall, the application of the MAMY game showed that it is an effective learning tool. Moreover, the methodology used for the development of the online and offline versions of the simulation games is appropriate. Even when the conceptual frame has to be slightly different for both settings, they have in common the iterative development strategy guided by play testing and evaluation. The focus is on a tailor-made learning tool for the particular multi-actor co-innovation setting. The methodological approach for developing a learning tool is different to approaches emerging from more desk-based conceptualisations of learning tools. Furthermore, this relatively simple simulation game was developed as a ‘teaser’ for the development of a more complex online dynamic learning game by the PREMIERE project. This will be a Serious Game for single players aiming to create an online immersive environment consisting of several story pathways where the player encounters a range of key challenges central to the development of an MA project proposal. This game is currently under development by an interdisciplinary game design team and will be available at the end of 2025.

1. Practical and Theoretical Implications

The EU Commission and its services as well as national innovation support services offer regular information for consortia that are aiming for MA proposal submission. Large numbers of researchers as well as other stakeholders join these information events (often run as webinars). However, lessons learnt from the feedback of proposal developers and their consortium partners indicate that the implementation of the MAA in real group settings requires more training and self-experiencing than listening to a (theoretical) MA explanation. For that reason, the practical implication of the MAMY has great potential for the incorporation of the MAA because it provides practical learning experiences including related feelings (such as disappointment, insecurity, and addressing loyalty).

The theoretical implication of the iterative development strategy guided by play testing and evaluation represents the development of a didactical approach that represents the co-creation requirements of the MAA. This is very promising and will be further discussed at the IFSA conference.

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The use of imaginaries in debating future prospects for Flemish agriculture

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Abstract:
Global food systems grapple with 'wicked problems' demanding holistic approaches, exemplified by Flemish agriculture's challenges. There is a growing call for systemic thinking that includes co-creation, a process that involves diverse stakeholders and that inevitably encounters resistance due to differing views and values. 'Imaginaries' – i.e. well-researched qualitative scenarios of plausible futures - could be a valuable method in these collaborations. Despite their potential, the impact of employing imaginaries in stakeholder dialogues remains unclear. This study addresses this gap by exploring how imaginaries influence co-creation in two Flemish envisioning projects: Innovative dairy farm concepts and Boerenland. Data collection is gathered through interviews, meeting notes and project materials. Our initial results show that imaginaries act as valuable catalysts for discussion, making alternative futures more tangible. By working with visuals alongside an evocative story, both visual minded and non-visual minded participants are engaged throughout the process. While not a panacea for polarization, they could add nuance to discussions. Additionally, communicating scientific results through imaginaries could increase the connection with the non-scientific community. This research highlights the promise of imaginaries as a tool for co-creational food systems research, bridging the realms of research-by-design, systems thinking, and storytelling.

Keywords: imaginaries, research-by-design, systems thinking, storytelling, co-creation

Purpose

Food systems around the world are facing 'wicked problems'; highly complex issues that require a holistic approach to offset different challenges and to negotiate integrated solutions (Dentoni et al., 2012). The Flemish agriculture faces an array of challenges: an increasing competition for farmland sparked by urbanization (Beckers et al., 2020), ammonia emissions from livestock farms (De Pue et al., 2019), an aging farming demographic coupled with low succession rates (Beckers et al., 2020), etc. In response to the environmental challenges, the European Union's farm-to-fork strategy has imposed rigorous environmental standards, encouraging member states to align their policies accordingly. However, the implementation of these measures has sparked farmers protests in 2024, who express their dissatisfaction about the current situation (Cokelaere & Brzeziński, 2024). The debate in farming- and food systems is getting increasingly polarized (ProvĂ© & Crivits, 2019). Social groups increasingly perceive and describe politics and society in terms of “Us” versus “Them” (McCoy et al., 2018). The “Other” is perceived as negative, often accompanied by strong emotions.

There has been a growing recognition of systems thinking as valuable addition in food- and farming research projects. The approach aims for understanding reality and enacting change by considering the dynamic interactions among multiple interdependent social and ecological agents (Dentoni et al., 2022). Co-creating a notion of the system in collaboration with a diverse group of stakeholders is a common approach in systems thinking research.

Aligning with the call for systems thinking to food systems research, there is a growing attention in the design sciences for the methodology of research-by-design (RbD) which Roggema (2017, p.3) describes as “a type of academic investigation through which design is explored as a method of inquiry, by the development of a project and also exploring the different materials by which a design is carried out—sketches, mapping, among others”. Research-by-design corresponds with systems thinking in its desire for (sustainable) change, its suitability for researching wicked problems and co-creation with stakeholders as a common research approach (Dentoni et al., 2022; Roggema, 2017). Nevertheless, research-by-design places greater emphasis on conceptualizing solutions rather than problem definition. Research-by-design, unlike systems thinking, iteratively designs draft solutions as a way of investigating possible futures.

However, both research methods struggle with the same problem: in sensitive, often even polarized debates, it is not evident to assemble a diverse group, setting up constructive dialogue and achieving sustainable change. Stakeholders often participate with opposing viewpoints and adverse emotions towards each other (McCoy et al., 2018). Furthermore, people have a general resistance to change or opt for minor adjustments rather than system changes (Abdel-Ghany, 2014; Hubbard, 2009). The willingness of stakeholders to cooperate and engage is crucial in the research’s’ success (Vanempten, 2014). This raises questions on effective tools for stakeholder engagement in systems thinking and RbD processes.

Imaginaries could play an important role in improving the willingness of stakeholders to engage in systems thinking and research-by-design processes. Imaginaries are qualitative scenarios that are well-researched and imaginative descriptions of possible and plausible futures (EEA, 2023). It connects systems thinking with RbD through the strong focus on complex and systemic challenges, and developing means to envision future change. Furthermore, imaginaries add compelling stories about possible futures that captivate the imagination of participants - a technique used in communication sciences when collaborating with stakeholders (Sundin et al., 2018). This connection to storytelling can stimulate participants in food- and farming systems research to think outside the box and get around the typical business-as-usual way of thinking. Discussing imaginaries can bring implicit assumptions and values to the surface (EAA, 2023). They can enable participants with conflicting beliefs to collectively envision possible futures and has the potential to build a shared understanding in co-creative processes thinking about change.

The idea of imaginaries in co-creative processes is still recent (EAA, 2022), and little is known about how imaginaries influence co-creational processes. Increasing our knowledge of the issue is important because of several reasons. First, multiple studies already underlined the need for applied research in this topic (Roggema, 2017; Sundin et al., 2018). Second, many research projects include multi-actor approaches in their process. More knowledge about the execution of these collaborations will increase their success and added value. Third, imaginaries can constitute a bridge between systems thinking and research-by-design, thus enriching both approaches by providing both a different way of thinking.

The purpose of this paper is therefore to explore the influence of imaginaries on multi-actor systems thinking and research-by-design projects that explore the possible futures of farming. The context of Flanders is chosen because it is a notorious example of the accumulation of wicked problems. The study poses three research questions: a) How does the integration of imaginaries influence the experience of stakeholders in participative research projects? b) How does the integration of imaginaries influence the outcome of participative research projects? c) In what ways can imaginaries act as a bridge between systems thinking and research-by-design?

Methodology

This paper has an explorative multiple-case study design (Yin, 2009). A case study is an empirical inquiry that investigates a contemporary phenomenon in depth, taking real-life context into account. The method relies on multiple sources of data to account for the difficulties of integrating the context into the research. Since this study explores co-creative processes in complex agricultural debates, a case study design wherein the context of the broader societal debate is integrated, is a solid choice. Two Flemish envisioning projects are selected as cases, based on the research methods that were employed in the projects. These cases were accessible because the authors were involved in the project teams of both cases.

The first case is the project *Innovatieve MelkveehouderijConcepten* (Innovative Dairy Farm Concepts or IVC) which ran from September 2022 to January 2024. The goal of the project was to create innovative and sustainable dairy farming imaginaries by using the Reflexive Interactive Design approach (abbreviation as RIO in Dutch) (Bos & Koerkamp, 2009). RIO is a systems design approach, as it explicitly integrates a thorough system- and actor analysis as starting point of the project. The project team consisted of researchers within the domain of food and agricultural sciences, designers and two dairy farmers. IVC was commissioned by the Flemish Land Agency, which composed a stakeholder advisory board that consisted of 16 actors from government agencies and civil society with a broad variety of perspectives such as environment, food production, water, ammonium, etc. Throughout the process a total of five stakeholder workshops were organized.

In the second case – *Boerenland*, two landscape design offices were appointed to explore the possible futures of farming in two case study regions in Flanders through research-by-design. Contrary to IVC, this research-by-design project used a specific set of imaginaries as a starting point: The Farmers of the Future, which are 12 imaginaries on systemic future farming business models in the EU for 2040 developed by the Joint Research Centre (JRC) (Krzysztofowicz et al., 2020). The design offices engaged with stakeholders from agriculture, planning and environment in 6 workshops with stakeholders on the Flemish level and 5 workshops with farmers at the local level. This project was carried out by commission of LABO RUIMTE. It started in June 2022 and ends in February 2024.

Data collection

Data collection will follow Yin's (2009) suggestions: multiple sources of evidence are used (*triangulation of data sources*), all data is aggregated into a case study database and a chain of evidence is documented. Specifically, interviews, meeting notes and artefacts are used alternately as data sources. Individual semi-structured interviews were conducted with the participants and project team members in both projects. These interviews aimed to delve into the experiences of each interviewee within the project, selecting a wide spectrum of interviewees. Two interview questionnaires were constructed before the interviews to tailor the questions depending on the role of the interviewee in the project. Version 1 was used in the interviews with the participants of the projects and Version 2 was used for the project team members. Small changes were made in Version 1 after a few interviews to improve the questions.

Second, both cases resulted in various documents during the processes, such as meeting minutes and presentations. These records were examined to extract insights into the discussions that took place during each workshop. Lastly, pictures of the workshop-artefacts were taken and analyzed. These often were in the form of big sheets of papers with visuals, on which the participants could comment on. These comments were then written down on the sheets by a member of the project team. Thematic content analysis was used in analyzing the different sources of data.

Findings

The preliminary findings suggest that integrating imaginaries in co-creative processes is an excellent starting point for stakeholder discussions and involvement. Imaginaries intrigue stakeholders and make an alternative future more concrete. Many participants indicate that they enjoyed working with these alternative futures because the scenarios add depth to the discussions and assist them in thinking beyond stereotypes. Throughout the processes, a shared understanding was built among the stakeholders and the support for the workshop methodologies grew. Presenting various imaginaries ensured that every actor could agree to specific ideas, which further benefitted their willingness to actively participate. Lastly, closely involving farmers in the IVC project team ensured the practical feasibility of the imaginaries. Still, they were willing to think beyond the current system during the brainstorms.

Imaginaries add value compared to simple RbD-visuals because they add a systemic narrative to a visual. Many people do not think visually. As one participant said: "It was difficult for me working with these visuals. Not every element in these are clear at first sight. You try to capture a thousand words, or 10.000 words with 1 image. That is challenging." Imaginaries provide a result which is both visually intriguing, and also conveys "10.000 words". Thus accommodating the needs of non-visual minded participants.

However, adding imaginaries in co-creation workshops is by no means a guarantee for success. At one workshop, the IVC team presented some draft imaginaries that would help to guide the discussions. This evoked heavy criticism from several participants, as they expected nuanced and scientifically profound imaginaries. As one participant explained: “That meeting, I really thought: oh boy, where is this going? It was bad and poorly underpinned.”

Similarly, small errors in the visualization of the imaginaries can lead to counterproductive discussions. The researchers should therefore communicate their progress and the goal of the imaginaries very clearly. Furthermore, especially in the early part of the process, discussions between participants can get heated and presenting progress can provoke strong (emotionally driven) resistance. In addition, while the participants acknowledged the value of the imaginaries at the end of the process, frequent reminders throughout workshops were required to overcome the business-as-usual reasoning.

Integrating imaginaries influenced the outcome of the research projects in numerous ways. First, the final results were distinct future scenario’s, allowing evert participant to agree with at least one. Second, the participants indicated that the results demonstrate the feasibility of evolving towards a sustainable transition in the Flemish food system. Third, similar as the benefit mentioned earlier, combining visuals with a narrative in the results of the project will cater to both visual and non-visual readers. Regarding the longer term outcome, it seems that the participants still were engaged with the project after the project ended. For example, every IVC participant could still articulate the core ideas of the two final imaginaries, more than 6 months after they read the final report. Additionally, many participants were eager to play a role in the practical realization of the final results.

However, imaginaries are not the silver bullet solution for solving polarization. The range of imaginaries often reflected the polarized debate. Discussing the different imaginaries simultaneously in a breakout-session setting can cause a situation wherein each participant only focuses on the imaginary they align with, resulting in avoided polarized discussions and a polarized project outcome.

It is important to note that several other factors are crucial for a successful implementation. The first is finding a balance in the time-investment that is demanded of the participants. On the one hand, asking too much will result in no-shows on the workshops. On the other, the project team and participants need time to get accustomed to each other and build a level of trust. A proper assessment of the participants, a timely invitation, reminders and an accessible location are key. Second, competent moderators are needed to guide the discussions. Participants with various background often communicate using different timeframes and system levels. It takes a skilled moderator to notice these differences and guide the discussion in a way that everyone is on the same page. Lastly, balancing ambition and feasibility is important to create imaginaries that facilitate sustainable and systemic change, yet are not disconnected from reality. In sum, if done correctly, imaginaries seem to be a very promising tool to involve in future co-creational food systems research.

Practical Implications

Practically, the integration of imaginaries in co-creational project has the potential to enhance collaborations between stakeholders and researchers. This, in turn, could result in more successful projects and could contribute to more enjoyable and engaging project experiences. Additionally, positive outcomes of research-by-design projects could increase the systemic awareness among stakeholders at a broader level.

Theoretical Implications

Theoretically, the study brings insights into the connection between research-by-design, systems thinking and storytelling about food and farming. Several participants indicated that the designs were unrealistic at multiple points in process of the projects. Systems thinking can help by providing a grounded view of complex problems (Dentoni et al., 2022). Integrating systems thinking in research-by-design therefore supports the researchers in keeping the systemic issues in mind. Adding story telling in the process or the result of the study caters the needs for the non-visual participant and reader. Additionally, it can contribute to a more effective communication of the results towards a broader non-scientific audience. This approach highlights the potential for interdisciplinary research to address wicked problems in food and farming systems. Furthermore, it could extend the possible methodologies of research-by-design scientists and set out interesting avenues for co-creation in systemic food research.

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METHODS & TOOLS III

A podcast supporting alternative grain-to-bread chains deployment in Wallonia: an intermediary tool for transdisciplinary research

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Abstract :
This research addresses the challenges faced by Alternative Bread Supply Chains (ABSC) in Wallonia, Belgium, aiming to navigate through crises such as ecological, energetic, and political uncertainties. The study advocates for a deep agroecological transition for ABSC, which encounters notable obstacles, including a loss of knowledge and isolated initiatives. To overcome these barriers, the research team embarked on a participatory podcast project, using it as a multipurpose tool to also bridge the gap between academic knowledge and field expertise. The paper discusses the multifaceted nature of podcasts, exploring their potential to support ABSC deployment and how they contribute to the broader agroecological transition. The study adopts a transdisciplinary perspective, underlining collaboration between scientists and ABSC actors. The podcast serves as an "intermediary object"(IO), facilitating discussions and intertwining field expertise with scientific insights. Despite being an ongoing project, preliminary findings indicate successful collective listening events, online dissemination, and positive reception from field actors. The impact of the podcast extends beyond online platforms, fostering dialogue and strengthening networks among various stakeholders. The research highlights practical implications, methodological challenges, and theoretical implications for participatory research using podcasts, emphasizing the need for transparency, reflexivity, and sensitivity in scientific production. This paper contributes to the ongoing discourse on systemic change, advocating for unconventional research methods that embed sensitivity and foster engagement with societal issues.
Keywords: Alternative Bread Supply Chains; Intermediary Object; Participatory Action Research; Podcast; Agroecological Transition

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Purpose

In a context fraught with multiple crises (ecological, energetic, political…) it becomes imperative for food systems to move towards a deep agroecological transition (Duru et al., 2015; Meek, 2016; Meynard, 2017; Lamine et al., 2021). Some grain-to-bread chains in Wallonia are engaged with this dynamic, characterized by their local and artisanal nature. Our research aims to strengthen the viability of these Alternative Bread Supply Chains (ABSC). Indeed, ABSC are confronted by significant lock-ins, in particular a loss of knowledge and know-how and an isolation of emerging initiatives, as indicated in both the literature (Demeulenaere and Goulet, 2012; Barbier and Moity-Maïzi, 2019; Chiffoleau et al., 2021) and our exploratory research in Wallonia (Belgium), which started in 2021 (Chaussebourg et al, 2023, under review). The erosion of artisanal knowledge in craftsmanship is a symptom of the growing industrialisation, standardisation, and globalisation of the food system, including the grain-to-bread chains. Standardisation flattens local knowledge: there is less and less need for this kind of knowledge, therefore it is slowly forgotten as it is not transmitted to young generations. This loss is hindering the resurgence of localized food chains. For example, in agriculture, local crop varieties are being replaced by high-yielding alternatives, leading bakers to lose familiarity with specific traditional varieties and baking techniques. Consequently, when local initiatives reintroduce indigenous varieties suited to the soil and climate of the region, bakers may struggle to meet the normalised aesthetic expectations of the consumers (see Chaussebourg et al., 2023, under review, for further insights on this phenomenon). Furthermore, the various ABSC initiatives in Wallonia remain isolated, impeding their capacity to mutually support each other through knowledge exchange and collaborative problem-solving for shared challenges. This issue is notably pronounced in Wallonia, as evidenced by our research (Chaussebourg et al., *ibid*.). Moreover, ABSC occupy a niche position in a rather diverse and even polarized ecosystem, where the main narratives are still bound to productivism, extractivism and market-based solutions. As developed in the following sections, we chose to create a participatory podcast to overcome these issues and therefore support the deployment of ABSC.

This paper delves into the multifaceted nature of podcasts, exploring their potential to specifically support the deployment of ABSC and, more broadly, contribute to the rise of an agroecological transition. It also makes an inquiry into how to define a methodology and collect data in a participatory project. Rather than providing ready-to-go instructions for using a podcast as a research tool, this paper unfolds a reflective exploration based on three years of ongoing experience. The aim is to invite readers to consider novel approaches in knowledge production, fostering an understanding of the evolving nature of this research process. Despite its popularity, podcast is not yet commonly used as a tool to *make* research and to stimulate reflexivity. Yet, collaborative podcast seems to be a key asset for a holistic and democratic on-going science as well as one of the levers to act on the deployment and resilience of ABSC. Indeed, the podcast connects different types of knowledge. It is a bridge between academic and field insights. Our podcast is designed to enhance and promote “situated knowledge” (Haraway, 1988) from the field. Moreover, podcasts offer a certain type of learning experience: through the senses (audio) and emotions (people voices, tone...) (*e.g.* Rigot, 2021, 2022). They allow for storytelling and the transmission of narratives by nurturing « warm knowledge », in opposition to the « cold knowledge »; science based on logic, facts and proofs.

This paper primarily aims to explore the potential of podcasts as a medium in participatory research, focusing on the specific context of the Wallonian ABSC while also considering its broader theoretical implications within the context of systemic change.

Methodology/Approach

Our study hypothesizes that incorporating a multipurpose medium could effectively address lock-ins and bolster the robustness of the Walloon ABSC. In performing this analysis, we thus endorse an agroecological position, as Gliessman (2018) defined it: action-oriented in a holistic ecological thinking, to fundamentally transform the food systems. More specifically, our research builds upon a transdisciplinary perspective aimed at bringing together scientists, ABSC actors but also regime stakeholders in the production of a complex, insightful and situated knowledge (MacIntyre, 2007; Kindon et al., 2007; Mendez et al., 2013). Our research team is interdisciplinary: it is composed by two agronomists (re)trained in social science approaches, a sociologist, and an ecological economist. We have chosen to create a participatory podcast as a tool for addressing the obstacles hindering the development of ABSC chains. We consider the podcast as a multipurpose solution akin to a Swiss-army knife, as we will explain later. Podcasts have become prominent since the beginning of the 2000's and quickly became popular for communication in science (MacKenzie, 2019). However, in comparison to a medium of scientific popularization, using the podcast as a tool to *conduct* research remains little explored, notably in the field of agroecology.

In this research, the podcast serves as an "intermediary object" (IO) (Callon, 1986; Chia, 2004; Mélard, 2008, Maréchal et al., 2022). The use of an IO facilitates the convergence of diverse perspectives, encourages discussions, and effectively intertwines field expertise with scientific insights. It motivates a thorough exploration of the subject matter and promotes a reflective mindset. The podcast can bridge people and groups together (e.g. bakers, millers, farmers, scientists, decision makers), both « inside » the podcast and « outside » (for its creation, during collective listening…), and therefore it can foster dialogue. As aforementioned, the landscape of grain-to-bread chains is rather diverse and eclectic. The IO provides a space for divergent narratives to meet (conventional VS alternative) while counteracting the usual power relations through scriptwriting choices, for instance. It can carry out the voices of usually marginalized niche actors. But also, the IO can simply compel actors that usually never interact to dialogue, through the editing process.

In summary, the podcast can be used as a Swiss-army knife because it allows: (i) learning and knowledge sharing within the community, notably through sensitivity; (ii) a reflexive posture from the researchers; (iii) bringing field actors and academics to conduct research together; (iv) raising mainstream awareness and listening to marginalized actors (v) offering a safe virtual space for dialogue between often divergent narratives.

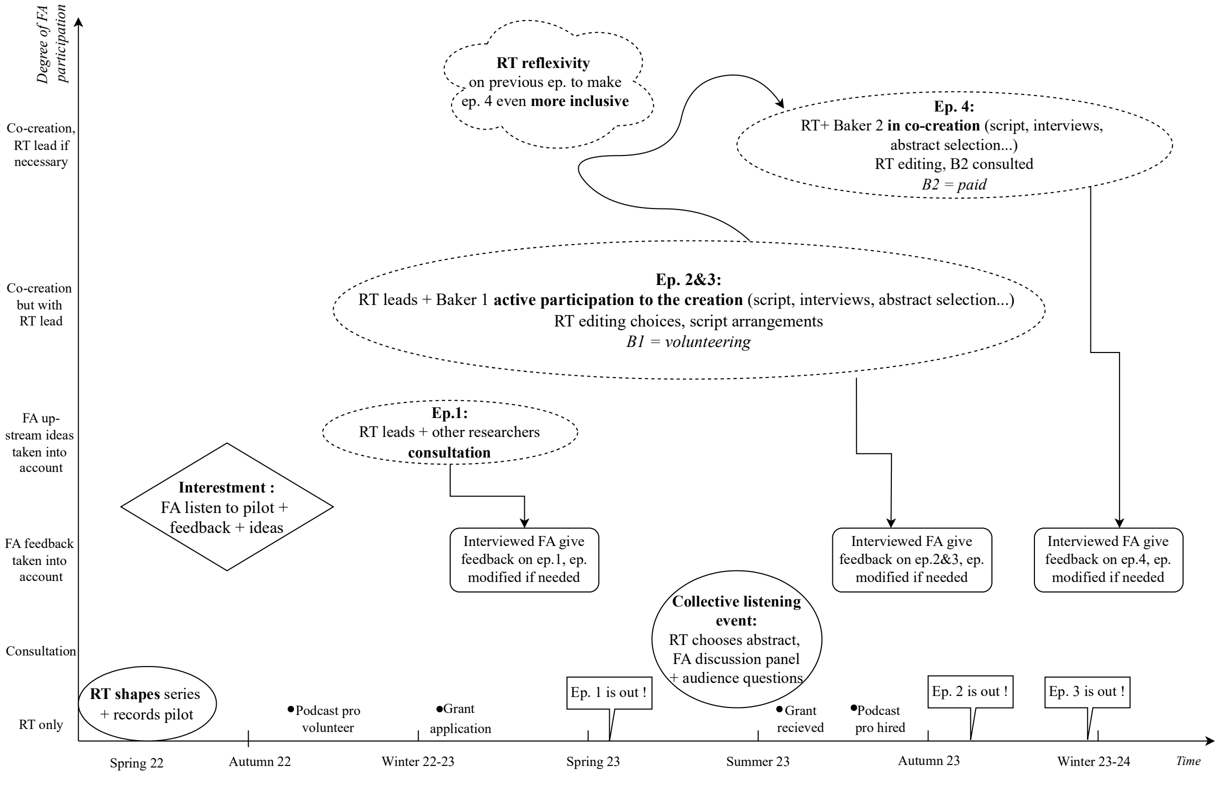
Different disciplines also use the podcast method as a multipurpose tool, including geography (*e.g.* Kinkaid et al., 2020; Scriven, 2022), communication (*e.g.* Murray, 2019) and design (*e.g.* Rigot, 2021, 2022). In agroecology, some participatory research projects were made with the help of video-making (*e.g.* Stassart et al., 2011; López-García et al., 2021; Calla et al. 2022). Art-based research (*e.g.* Greenwood, 2019) is also noteworthy for demonstrating the significance and value of a sensitive approach in participatory projects.

Design and Findings

The writing of this paper intentionally occurs during the podcasting process rather than after its completion (additional academic writing is scheduled for the conclusion of the podcast series project). This approach enables the deployment of a reflexive methodology and the identification of preliminary findings.

The research team conceived the idea of launching a participatory podcast following a year of exploratory research. During this period, the research team became closely acquainted with an informal network of artisanal bakers across Wallonia that was concurrently forming. This network emerged from a group of alternative bakers who aimed to forge connections not only among themselves but also with other stakeholders in the bread chains, including farmers and millers. They perceived a lack of understanding from themselves regarding the challenges faced by local wheat growers and small-scale millers. Recognizing this network as the type of dynamic to support in facilitating the deployment of ABSC, the research team decided to focus the action research on addressing their needs. For the reasons presented in the previous section ıe

Figure 1: Participatory process through time, according to the level of inclusivity of field actors.
RT = Research team. FA =Field actors
"Other researchers" are conducting participatory research since several years in ABSC.



Currently, two out of the three total episodes have been co-created with a baker. Here, the baker led the investigation, allowing for an intricate insight into the concerns and perspectives of actors in the field. Importantly, this gave credibility to the project in the eyes of the field actors. However, this process was sometimes quite challenging. The concerns range from practical considerations, such as time planning, to the challenge of establishing dialogue among stakeholders embedded in distinct "worlds," encompassing academia and artisanal work.

Also, each interviewee could listen to a version of the episodes before their release and make comments. These comments were truly taken into account and led to some changes of the script. For instance, due to the extensive production timeline of an episode, a year could pass between an interview and the final version of the episode. Some interviewees asked to update the given information or suggested to clarify some. This process noticeably reinforced the trust of field actors toward the research team and the project itself. But more importantly, this continuous process gives empowerment to the field actors in the realization of a project that concerns them directly.

Moreover, to allow the podcast to exist “in real life” and not solely online, collective listening events are organized. They take the form of a panel discussion. As in the podcast, different types of actors are invited, such as field actors, researchers, and decision makers. The panel and the audience listen together to abstracts of the podcast pre-selected by the research team. This paves the way for a lively start into the heart of the subject. As mentioned earlier, the podcast series has an artistic form and therefore offers a sensitive immersion in the field and empathy toward the narrative. Our experience of collective listening has so far been a great success. Diverse actors, including decision makers can meet and interact, both formally during the event and casually afterwards. Therefore, collective listening events participate in reaching the goal of our participatory action research project: they contribute to the viability by reinforcing the network of Wallonian ABSC, which is one of our targeted levers.

As regard to the online life of our podcast *Le Pain qu’on Sème*, we can quantify the number of listens to each episode on different platforms. More than a thousand listens for the two first episodes, which are 30 and 50 minutes long respectively. Beyond the numbers, we can clearly see that field actors are reposting and diffusing the podcast on their social media page. We cannot quantify (yet) how it is spread in the private sphere, but we can notice a “word-of-mouth” effect. Some field actors we meet for the first time express their eagerness to listen to the next episode. In addition, some actors use episodes in a professional capacity. Certain bakers providing baking training incorporate the podcast into their lesson plan, having their students listen to it. Looking ahead, and in the remaining year of the project, four more episodes are planned.

As our approach is reflexive, we also want to open new doors on a theoretical level about the benefits of the use of a podcast as an IO in participatory research in agroecology. Those theorical implications are exposed in section (5).

Practical Implications

We argue that using a podcast as an IO can support the deployment of ABSCs in Wallonia. In this context, the IO enables connecting promising alternatives that have remained isolated to emerge in the landscape. It also allows for rebalancing the usual power relationships between stakeholders, as mentioned in section (2). The podcast teases apart the issues these chains face. It aims to raise awareness among both the public and decision-makers about the necessity of an agroecological transition. This medium supports the networking of actors, enabling the transmission and reappropriation of knowledge and know-how within ABSC. As we showed in the finding section (3), the field actors can pursue their own goals through the podcast. However, initiating a podcast within a research action dynamic poses some challenges.

There are methodological challenges. At the beginning of our project, we wondered what methodology we should apply, as there is not much literature on the subject yet. We also called into question the quantification of our results, as the material is multiple and complex, and it plays on sensitives as mentioned in section (3). Another challenge is that the red thread of a podcast episode is completely different than the one of a scientific paper. The podcast is linear and must follow a single narrative to be understandable by the audience. In contrast, a written scientific paper is expected to be exhaustive, or so-called "neutral". Having to choose voluntarily a narrative is a thought-provoking and delicate exercise for researchers but rather interesting in the frame of an action-research.

Also, there are some challenges related to the means and time constraints of the project, like any participatory research (Calla et al. 2022). For instance, compensating field actors for the time they spend on the podcast could have made them more involved in creating it and lessened power imbalances between the research team and other participants.

In addition, sparking the interest of the field actors to engage in the participatory process proved to be a challenge. In our project, the preliminary stages were decisive: tools and actions were put in place for a strong engagement. For instance, the research team recorded a "pilot" episode to showcase our attentions, our worries and our hopes about the project. We argue that being transparent is at the core of a fair collaboration between academics and field actors.

And of course, the co-creation of the podcast episodes is itself a challenge - as mentioned in section (3). Problems of understanding, negotiations around content and form, are all features of the co-creation between stakeholders. Notwithstanding these hurdles, solutions were found, as the full paper will describe, and experience was gained each time.

Theoretical Implications

Our paper aligns the present momentum for a new way of practicing science. This implies several theorical implications. We contend that advocating for systemic change, particularly in the field of agroecology, necessitates a reevaluation of researchers' positions and their roles within the investigated project (Baltazar et al., 2017; Van Dam and Visser, 2019; Chaussebourg et al., 2023 [under review]). Without having the pretention to solve theoretical and even philosophical issues, we do hope this paper nurtures a reflection on systemic change, opens doors and supports the discussion with a vibrant case study: the use of a podcast as a tool in transdisciplinary research to support the deployment of ABSC in Wallonia.

Our paper opens a critical discussion around the production of science. We propose a form of research that values our sensitivity: both on an emotional register and related to the activation of senses. We delve into the idea that sensitivity brings a certain way of learning that allows for a strong connection to the subject, which is otherwise difficult to reach. It is argued that *sensitivity* amounts to a way of relating to one's surrounding and even to the world (*e.g.* Tsing, 2012, 2015; Haraway, 2016). Having an emotional relationship to ongoing issues such as the necessity of a deep agroecological transition of the food systems (to name just one) is a way for individuals to strongly engage with the cause and to participate in the effort of administering change (Magda et al., 2021).

Through this paper, we advocate for an exploration of participatory research deeply rooted in sensitivity. Yet, we also endorse generating "conventional" scientific outcomes, such as papers, from these experiences to foster a connection between different paradigms. This could serve as a means to enhance the legitimacy of this scientific approach. We argue that science is not neutral and is entrenched in dominant paradigms. Therefore, a shift in the way of conducting science could be a strong step for a systemic change.

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Implementation of the Systemic Innovation Readiness Level (SIRL) tool, a pro-active and action-oriented approach to support systemic solution building

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Abstract:
This paper reports on the lessons learned from the application of the Systemic Innovation Readiness Level (SIRL) tool in nine FLW solutions developed in living labs. The SIRL stimulates a structured monitoring of complex multi-actor, co-creative, systemic innovation processes; which are at the core of transdisciplinary solution building. First, the tool stimulated each SILL to identify all relevant dimensions towards a more systemic solution. Second, the tool provided support for planning and monitoring the progression in each relevant dimension. Third, the tool helped to timely involve or consult key actors to be able to address all relevant innovation dimensions appropriately. Importantly, existing readiness level scales in the literature are often too generic, hindering direct applicability. There is a need to customize these scales to the specific context of food systems, making them more easily applicable in this domain. In conclusion, this study provides valuable insights into the application of the SIRL tool within the context of food waste reduction, offering practical considerations for its optimal utilization in diverse settings.
Keywords: Systemic Innovation, Living Lab, Action-oriented tools, Food Loss Waste, Readiness Level

Purpose

Many scholars argue for more interdisciplinary and systemic thinking approaches to support the transition towards more sustainable food systems. However, the emphasis in numerous food system solutions has predominantly been unidimensional and technocentric, as indicated by the widespread utilization of the Technology Readiness Level (TRL) tool in various innovation processes. To achieve effective scaling, we advocate for systemic innovations (SIs), where solutions involve interdependent developments across various dimensions (Midgley & Lindhult, 2021). For example, while a technological innovation (e.g. a new app optimizing food logistics) can be the centre point of a food system innovation, complementary innovations – such as a reorganisation of a collaboration across value chain actors – are often equally essential for full potential realization. Therefore, building SIs necessitates a challenging transdisciplinary approach that engages diverse stakeholders and coordinates feedback loops. Next to this, it also requires a continuous consideration of different innovation dimensions in the phases of ideating, developing, and scaling systemic solutions for complex problems.

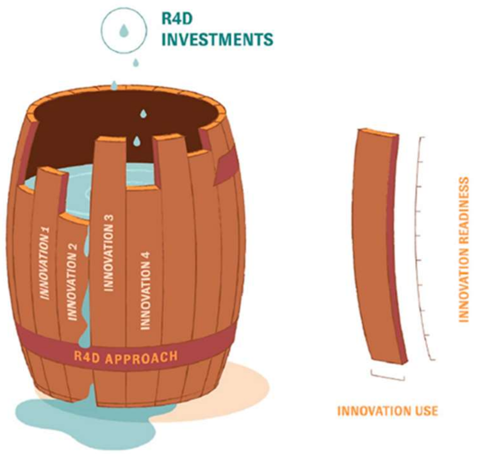
This paper introduces the Systemic Innovation Readiness Level (SIRL) tool to address these challenges and thus to stimulate more systemic food system solutions. Lessons drawn from the application of the tool in real-life living labs on food waste reduction are discussed to optimize the use of the tool in future cases. With this, we address the need for action-oriented tools that support SI solution-building processes in a proactive and anticipatory way (Schut et al., 2020).

Design/Methodology/Approach

The SIRL tool is based on Sartas et al.'s (2020) Scaling Readiness theory, which introduces 'innovation packages' representing SIs. These packages consist of core and complementary innovations visualized as staves of a barrel, where the widths indicate the current usages, and the lengths represent the respective readiness levels each innovation (analog to TRL) (Figure 1). These core and complementary innovations capture the various aspects that must be addressed to create a SI that is ready to be operational in the real world. The barrel's volume represents the innovation package's capacity to achieve impact at scale. Sartas et al. assert that the least matured core or complementary innovation acts as a bottleneck for the entire SI's potential, emphasizing the inefficiency of additional investments in more mature innovations (depicted as leakage in Figure 1). Indeed, the full innovation package's potential to scale will only rise when first the least matured innovation improves.

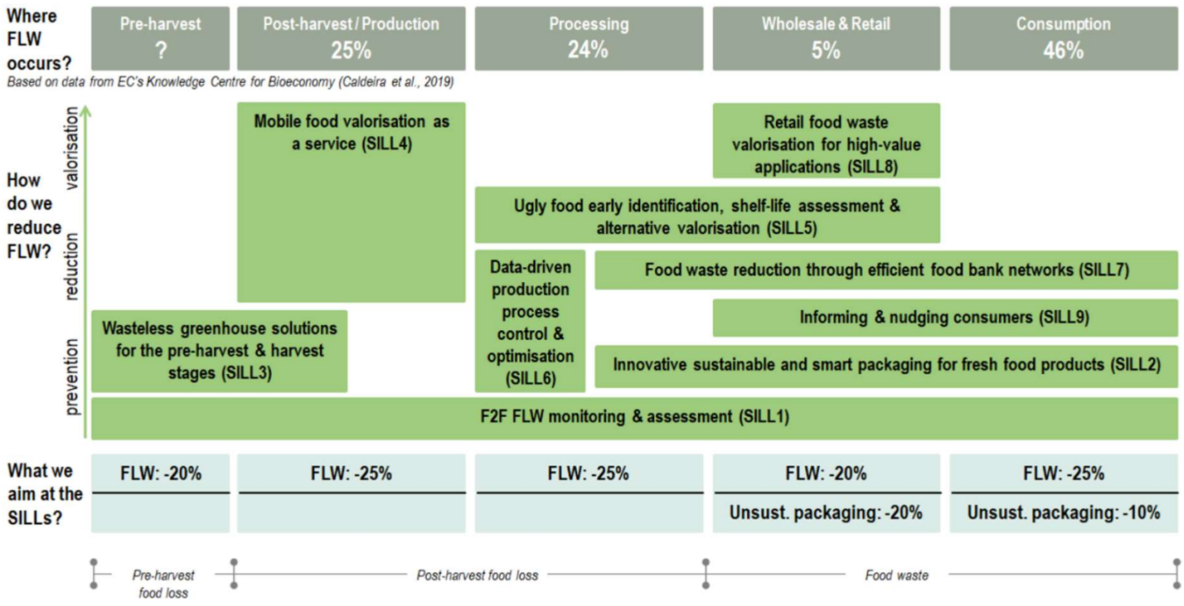
Building on Sartas et al. (2020), the SIRL tool was specifically designed to support the 9 Systemic Innovation Living Labs (SILLs) in the HE ZeroW project. Living Labs are 'spaces' that enable transdisciplinary solution building through partner-driven, open, and co-creative innovation processes (Bergvall-Kåreborn et al., 2009). The ZeroW project focuses on developing SIs to address food loss and waste (FLW) issues for a Zero FLW supply chain. As illustrated in Figure 2, each SILL targets a different part of the food chain; thereby addressing a different FLW problem. For example, SILL4 aims to valorise post-harvest food losses by developing a mobile food processing container for producing juices from edible biomass. For consistency and briefness we will use the example of SILL4 further on in this extended abstract, however, the findings formulated in the following chapters are based on observations from all nine SILLs.

Figure 1: The Scaling Readiness Barrel to illustrate how innovation(s) with the lowest readiness level limit an innovation package's capacity to achieve impact at scale. Adopted from Sartas et al. (2020).



Following Sartas et al. (2020), we pose that the SIs developed in the 9 ZeroW SILLs each consist of a set of innovations. Each of these innovations addresses a different dimension; collectively determining the success potential of the whole SI. The SIRL was then designed in such a way to support the development of as many relevant innovation dimensions as possible in each SILL to improve the readiness levels of their FLW solutions. The SIRL aims to assist SILLs in identifying necessary action for impact and monitoring progress using readiness levels. In the case of SILL4, the core innovation is developing the technology to make flexible, on-site production feasible. One crucial complementary innovation would be the development of a business model to commercially launch the mobile fruit press. In this example, it would make no sense to keep on investing in the technological solution refinement without simultaneously assessing whether a profitable business model can be developed. As long as this business model is not set up appropriately, it acts as a complementary innovation that forms the bottleneck to successful scale-up of the whole innovation package.

Figure 2: Overview of ZeroW's Systemic Innovation Living Labs (SILLs), indicating which FLW problem they target and how they envision to address it, and the corresponding KPIs pursued per sector.



The SIRL was designed based on a literature review that (1) searched for an identification and possible classification of innovation dimensions related to food loss and waste that suited the ZeroW SILLs, and (2) explored whether existing scales for assessing the progression and thus the innovation readiness, beside TRL, existed. The resulting SIRL tool is presented in chapter 3.1. The authors are currently facilitating and observing the use of the SIRL by the SILLs and performing a comprehensive assessment of the usability and applicability of the SIRL tool. Preliminary findings from this assessment are presented in chapters 3.2, 4 and 5.

Findings

3.1. The SIRL tool

The SIRL tool guides the SILLs to (1) identify complementary innovation dimensions wherein action is needed for achieving impact, and (2) monitor the progress made in those dimensions by using readiness levels. By consulting literature on scaling innovations, five generic innovation dimensions were found to be relevant for SIs to FLW problems: the technological, business, value chain, behavioural, and policy and governance dimension. They are elaborated hereafter with references to their related readiness level scales.

First, the technological dimension captures all technology aspects that play a role in either the core innovation of the FLW solution or in the side activities necessary for realisation, commercializing, or scaling of the solution. It can relate to IT equipment (hardware and software) and technologies (e.g. AI), but also the use of new machines and technical assets. The readiness of a technology innovation is assessed by the Technology readiness level (TRL) scale originally introduced by NASA and nowadays widely used by EU-funded research and innovation projects (Héder, 2017).

Second, the behavioural dimension encompasses socio-cultural and psychosocial factors influencing the development, acceptance, adoption, and scaling up of the FLW solution. Behavioural innovations involve reorganizing beliefs, norms, awareness, attitudes, behaviours, and networks, for example through education and extension programs supporting the transition to a zero FLW system. For example, a collective disapproval of previously acceptable practices, like leaving yield in the field due to unfavourable harvest-time prices. Assessing societal readiness for innovation can be facilitated using the societal readiness level ladder by Bruno et al. (2020).

Third, the policy and governance dimension involves innovations facilitating better decisions in complex, dynamic systems. Governance innovations often entail changes in power structures, institutions, or prevailing ideologies, manifested through new policies, rules, laws, legislative frameworks, or ethical considerations. This dimension can address governance paradigm shifts to resolve social conflicts fairly, such as resource sharing. Legal changes are crucial for implementing and scaling many FLW solutions, and the legal readiness level scale by Bruno et al. (2020) aids in assessing necessary compliance. Innovations challenging existing rules can influence the legal system while requiring adaptability for survival.

Fourth, the business dimension focuses on the strategic, organizational, and operational aspects of a single business. Embedding innovations in the organizational environment is crucial for permanent adoption. It involves assessing the impact on professional roles, competences and skills, functions and processes (structures); physical infrastructures (materials & equipment). The organisational readiness level scale (Bruno et al., 2020) guides to assess the preparedness level of an organisation receiving a solution. For operations, the manufacturing readiness level scale (Wu et al., 2012) enables to make the manufacturing processes in case of a new product fully ready. Regarding strategy, innovative solutions often require innovations in the marketing complex (product/service + its marketing which includes placement, promotion, and pricing strategy) (Kotler et al., 2017). For this, the Marketing Readiness Level (Muradovich, 2017) supports the assessment of the marketing maturity of the new solution. This maturity ladder can be used for evaluating innovations that encompass a new marketing method; involving significant changes in product design and/or packaging, product placement, product promotion, or pricing determination.

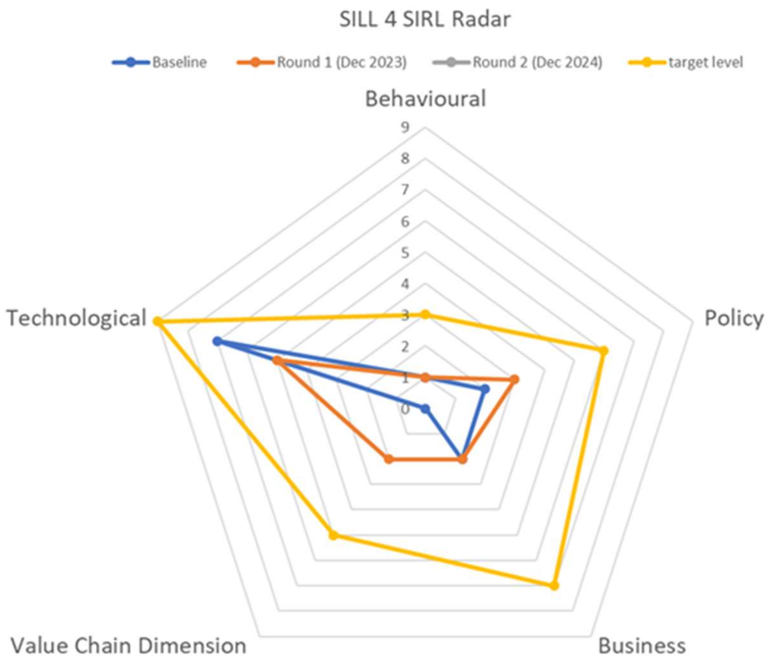
Fifth, value chain innovations are somewhat similar to business innovations, however, they transcend the level of individual businesses and instead focus more on revised collaborations between entities of the food value chain. They thereby strengthen cooperation across different sectors and among stakeholders in such a way that a more efficient use of resources through the entire value chain resulting in less waste. For example, new collaborative models that give rise to innovative cross-organisational structures, for example between sectors that were not connected before. Thus, value chain innovations affect the process of food transport and value allocation across the food supply chain. Potential scales that can be used are the same as for the business innovation dimension, but also the generic innovation scale from Sartas et al. (2020).

3.2. Usage by the SILLs

For brevity we focus here on the example of SILL4. The core innovation is the technology to make flexible production feasible. For this dimension, the team is evaluating the potential of innovative processing techniques (i.a., PEF preservation technology which uses a pulsed electric field to destroy decay-causing microorganisms). The use of this technique provides several health and economic advantages, however, it also implies that the final product may be considered a novel food and hence require long and expensive legal procedures before being allowed to enter the market. Upscaling hence demands resources and capacity for legal compliance. Another crucial complementary innovation is developing a business model to commercially launch the mobile fruit press. Without a well-established business model, refining the technological solution alone is ineffective, making the business model the bottleneck to successful scale-up. For this, the team should explore the possibilities together with key value chain stakeholders.

Within SILL 4 the 5 generic dimensions were deemed to be relevant for the further development of the project. At the start, the Technological dimension was considered to be very far developed and not many challenges where expected. However, during the first tests done with the flexible unit, technical challenges appeared. That is why the readiness level of the technological dimension dropped between the baseline and round 1. In the Value Chain and Policy dimensions progress has been made, while the behavioural and business dimensions remained stagnant. This pilot project will now need to focus on the behavioural dimension to progress. We will repeat this assessment twice more over the course of the ZeroW project.

Figure 3: SILL4 SIRL radar, indicating the Readiness Levels (RLs) for each innovation dimension that was presumed relevant for the systemic solution building at the start of the project (blue), evaluation after one (orange) and two (grey) year(s) of systemic innovation process, as well as the envisioned RLs (yellow).



Practical Implications

The SIRL tool stimulated the SILLs to explore the conditions that are required for scaling up of their FLW SIs. The main contribution domains from the SIRL tool that were detected throughout the SI processes were:

1. Fostering interaction: more in-depth discussions, collaboration, and co-creation between SILL members but also with external stakeholders
2. Creating a shared understanding of the FLW problem tackled (why) and the systemic solution (all relevant dimensions) developed in the SILL (what and how);
3. Advancing the SI process by encouraging the SILLs to include and address all relevant SI dimensions into their FLW solution building.
4. Enabling the SILLs to timely identify bottlenecks to their SI; by helping them to identify possible blind spots in their systemic solution building. For example, in SILL4, detection of the business innovation dimension that appeared to be pivotal for developing, implementing, uptake, and scaling up of their FLW solution.
5. Guide the monitoring of the SI progress, by evaluating the progression for each relevant innovation dimension at different points in time; and by visualizing the progress in each of these innovation dimensions;
6. Assessing the capacity for achieving impactful implementation and scaling of the ZeroW FLW solutions, by evaluating the innovation readiness of all relevant innovation dimensions included in the SILLs' SIs; using respective innovation readiness maturity ladders.

The above demonstrates that the SIRL tool holds promising potential for supporting SI processes. However, some challenges linked to the application of the SIRL and the current design of the tool must be discussed.

First, it is imperative for stakeholders to recognize the added value that the tool brings to the innovation process. Such inherent motivation lacked in many of the SILLs. The reasons for this varied, but the most important recurring were: (1) most SILLs' members were very technical profiles who were not so much interested and also not competent

with regards to the other innovation dimensions and (2) there was not enough capacity (in terms of budget and human resources) because the SI process required ample time and resources that were not available in all SILLs. We therefore advocate for future R&I projects to include from the beginning a diversity of profiles into the core team, and to not underestimate the resources needed to achieve systemic innovation. Incorporating a budget that creates room for feedback and learning loops and experimentation can be a good strategy. Another recommendation is to involve a facilitator to guide the evaluation moments using the SIRL tool, preferably someone who is not part of the core team as we have learned that this can bring a lot of added value for rich discussions.
Second, the first step of the SIRL covers the exploration and decision of what innovation dimensions should be considered to increase scale-up potential. However, including as many relevant dimensions as possible into the FLW solution building in practice appeared difficult. The main cause for this was that SILL members were often very specialized profiles, making it hard to think of any innovation dimension that could possibly be important for the development, uptake and diffusion of their FLW solution, and for realizing impact at scale. Consulting external stakeholders proved a good practice to avoid blind spots.
Third, a major challenge related to the use of Readiness Level Scores became evident: the tool incorporated readiness level scores, revealing a potential drawback. After the SILL members have agreed on what the key innovation dimensions of their SI are, they can start evaluating how 'ready' their FLW solution is with regard to each separate innovation dimension in their SI. In order to do so, SILL members first needed to decide what scales they will use for the corresponding innovation dimensions. This could be a scale from the literature (as the ones referred to in section 3.1) or this could be a self-made scale that is fully custom-made to their SI context. A good scale helps SILL members to precisely define and agree on what exactly should be achieved before reaching the next readiness level for an innovation dimension, making intermediary targets more concrete in a step-by-step action plan. This helped SILLs to make the right investment decisions for achieving impact with their SI. Yet, the reliance on numerical assessments to determine innovation readiness sometimes created a major drawback, as it risked overshadowing the tool's primary objective — fostering a shared understanding of readiness levels because more attention was being paid to putting the numbers rather than discussing what it means to move from one level to another. Additionally, the readiness level scales available from the literature provide descriptions of each readiness level that appeared often not directly applicable to the specific context of the SILL. Therefore, there is room for improvement when it comes to aligning the tool's objectives with its operational features, ensuring that the numerical aspect complements rather than undermines the overarching goal of creating a shared understanding among stakeholders. Alternatively, a reconsideration of the numerical scoring mechanism is proposed to align more closely with the tool's core objective of fostering collaborative understanding of the current readiness level versus what should be worked on and how to increase the respective readiness level.

Theoretical Implications

One could state that the SIRL tool formalize the participatory 'moments of reflection' that are much needed in interactive innovation processes (Brown & Duguid, 1991; Garud et al., 2013; Klerkx et al., 2010; Knickel et al., 2009; Van de Ven 2017). Ideally, team perform these 'moments of reflection' on a regular base and in a structured way. The study indicates that the SIRL tool holds inherent potential for guiding SI processes by supporting scaling of FLW solutions, and by extension other food system solutions. This is achieved by formalizing and structuring the non-linear SI process through regular implementation of reflective evaluation moments (using the SIRL tool) for monitoring progress and adjusting practices where needed. In a word, the SIRL tool can help management and coordination in SI processes because it enables to address multiple dimensions – which is key in SI development as more dimensions address more leverage points that are crucial to bring about transformative change (Fischer and Riechers, 2019; Meadows, 1999; Abson et al., 2017).

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The Network Vitality Measurement Tool

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Abstract:
Interactive innovation processes require specific tools for monitoring and evaluation. In this paper we describe a tool that has been developed by the auditors of a Provincial Government in The Netherlands, after the network approach had been introduced for complex policy issues involving a variety of actors in society. We reflect on eight years of experiences with the tool.

The need for a new generation of tools for Monitoring and Evaluation
In the past decade, awareness has grown that for complex challenges in agriculture (and beyond) investments in research alone are not enough for finding new solutions. The capacity of a system to respond to its changing environment depends on the quality of relationships between the key actors in the system (Wielinga and Burssens, 2023). Since 2014 the European commission invests heavily in programmes for 'interactive innovation'.
In The Netherlands, network approaches have gained popularity since the successful experiment "Networks in Animal Husbandry" (2004-2007) in which farmers with initiatives were invited to present themselves as a network, after which they were assisted by researchers and other technicians to develop new practices. During this experiment, a new generation of tools was developed for facilitating such co-creative processes (Wielinga et al 2007, Wielinga and Geerling-Eiff 2008).
Co-creative processes cannot be monitored and evaluated in the same way as has been common practice until now. They need to be distinguished from transfer and delivery. In transfer activities, the expert determines the desired result and the degree of success. Think of qualifications in education, or adoption rates in dissemination of innovations. In delivery activities, the clients determine the desired result and evaluate their satisfaction. Think of advisors responding to requests of farmers, or funding agencies asking for deliverables and quantifiable results as specified in detailed project agreements. The result of co-creation cannot be known beforehand, because it is the merger of contributions along the way. There is a shared ambition to start the journey, but what will happen along the way is uncertain. Nevertheless, managers wish to monitor progress and funding agencies want to see value for money. How can efforts for co-creation be monitored?
The emergence of the 'Network Vitality Measurement Tool'

The network approach has been implemented by the Provincial Government of South-Holland for over a decade now. This approach is applied for challenges which cannot be solved by the Province alone. In short, in policy areas where interactive innovation is necessary. The Province focuses on opportunities and added value, aiming for results from collective efforts that exceed what the Province could have achieved alone (Andringa et al 2013). Peer groups of policy officers underwent training using the above-mentioned tools with various partners in society.
The network approach distinguishes between 'warm processes' (ambitions, connection, energy) and 'cold processes' (targets, planning, justification). Action networks are viewed as living entities, with 'vital space' indicating a space where actors contribute, feel safe, free to make mistakes, and become creative. Ultimately, a healthy network becomes responsive, recognizing challenges and opportunities and acting effectively (Wielinga and Robijn 2020).
But: how to hold policy officers accountable for their involvement in action networks with stakeholders? Two senior auditors from the Provincial Government of South-Holland, Aad Zoeteman and Sigrid Fiering, addressed the need for more clear and measurable targets in the phase that the outcome of a network collaboration is not yet visible. They developed the Network Vitality Measurement Tool. ‘Network Vitality’ is defined by the quality of collaboration within the network and the returns it delivers. The collaboration contributes to the individual goals of the network partners. Their strategic actions are to be effective to reach their goals, which they might modify because of the process.
The core assumption is that a vital network will yield results that contribute to the ambition of the network, even if it is not yet clear beforehand what these exact results will be. If a network lacks vitality, it is advisable to continue in a different network composition, or to consider alternative approaches for making progress.
For the development of the Network Vitality Measurement Tool, three network practices within the Province of South-Holland were examined. Interviews were conducted with involved provincial employees, managers, and administrators, as well as with external network partners, experts, and leading scientists. In addition, relevant documentation on the practical cases was consulted, and a literature study was conducted to determine indicators and success factors for measuring network vitality. Subsequently, the Network Vitality Measurement Tool was tested in five network cases. Based on this, the tool was evaluated and adjusted to make it as broadly applicable as possible for different networks. After a decade of experience and various refinements, the tool still remains intact and appears to be robust. This paper is the first publication about the tool in English language.

The dimensions of the Network Vitality measurement tool

The Network Vitality Measurement Tool (Fiering and Zoeteman 2016) aims to offer objective insight in ‘network vitality’ with indicators for success on perceptions of collaboration aspects, and network returns (figure 1).
Effective collaboration indicators include ambition, interests, organization, process quality, commitment, connecting, trust, decisiveness, and network composition. Network returns are categorized into physical milestones, intermediate products, financial results, network strengthening, sustainability, innovation, reach and visibility.

Reach indicates the extent to which partners' organizational goals are achieved or approached due to network performance.

The results are presented in spiderweb diagrams (figure 2).

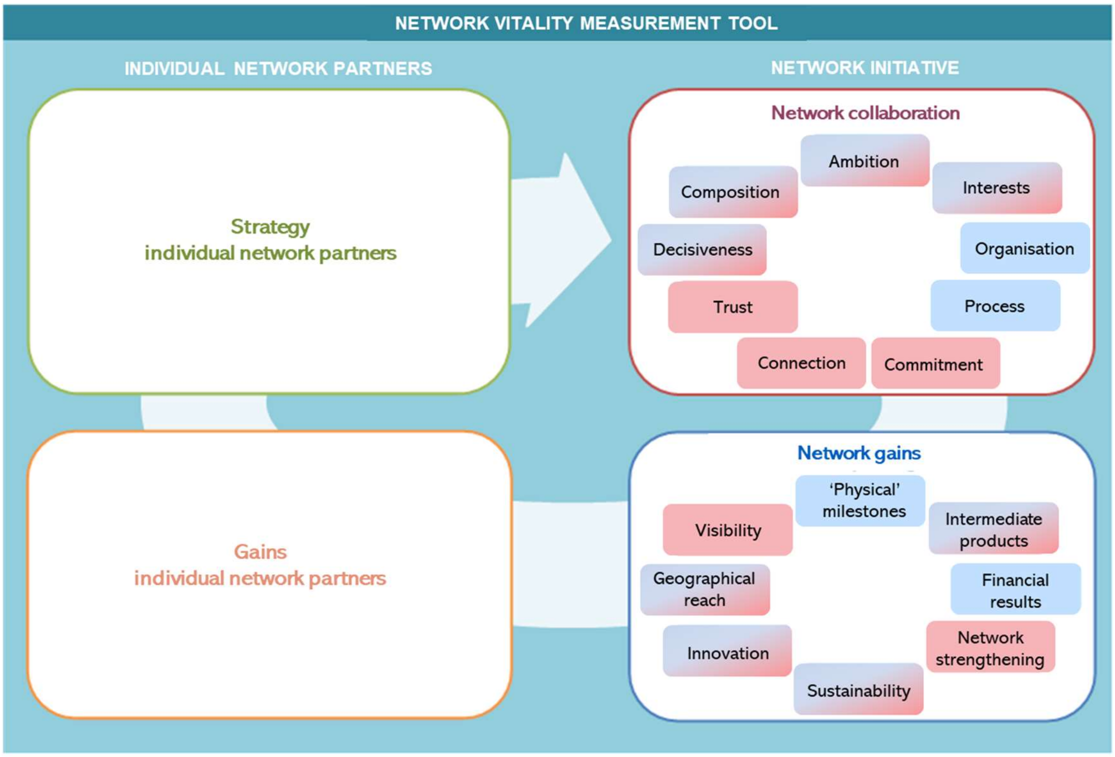

Figure 1: Indicators for network vitality

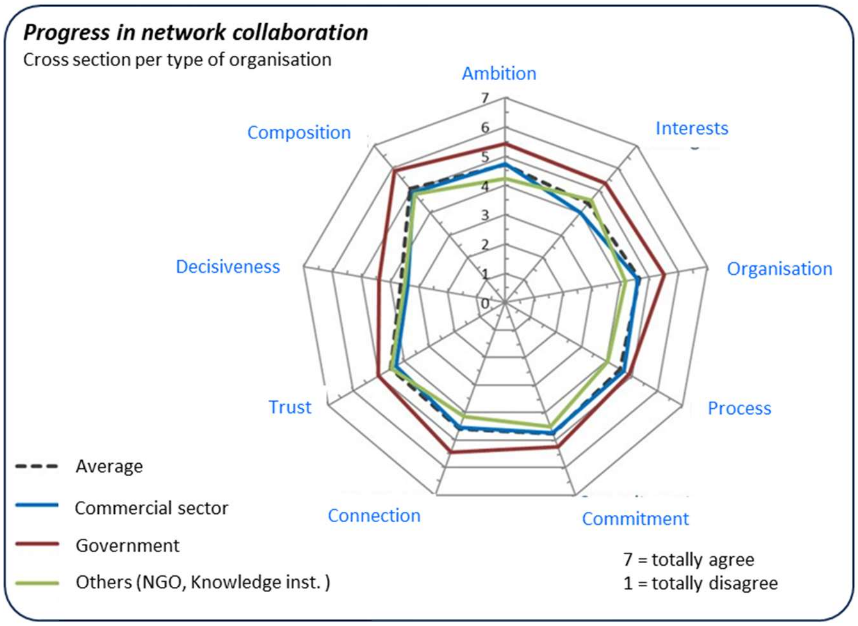

Figure 2: Spiderweb visualisation

The Network Vitality Measurement Tool can be applied in two different ways:

- *Survey and Workshop:* Network participants individually fill out survey forms with statements with a variety in response options (score from 1-7). Results are analyzed and presented in spider web diagrams, allowing for an overview of the scores of the network collaboration and its results. With this information, workshop participants actively engage in discussions about the significance of the results and collectively formulate actions for the future.

- *Serious Game:* A card game where the collaboration and outcomes of the network are evaluated and discussed in a dynamic manner. The game is played with people who are involved in the process, and contains statements to which participants can respond with 'agree', 'disagree', or 'requires further investigation'. No analyses are conducted afterwards. Such sessions lead to priorities and actions for the continuation of the network activities.

Experience with the Network Vitality measurement tool

In the period 2016 – 2023 the Network Vitality Meter has been applied around 25 times in the Province of South-Holland to measure network collaboration, returns, and goal achievement. The experience with applying this monitoring and evaluation tool shows that it opens the eyes of network participants for the relational aspect of collaboration. It raises awareness among partners that the relational aspect is crucial and creates conditions for substantive results. The scientifically supported indicators provide guidance and a structure for discussing the ‘warm side’ of collaboration and the network's outcomes. The response can indicate energy and commitment in a network, and stimulate further actions.

The Vitality Measurement Tool provides a safe method to express one’s individual opinion and gives room for individual nuances. The presentation of survey results in a spider diagram with scores that cannot be traced back to individuals ensures social safety. At the end of each evaluation process with of the tool, a final report is made, which is discussed in a workshop for dialogue with the network partners.

Managers take part in the activities using the tool, as they are partners in the co-creative process as well. If they would stand aside and wait for the results, they would take the position of the client in the market approach.

The tool provides explicit perceptions based on underlying indicators and independent analysis and reporting. As a network self-assessment tool, it catalyzes exciting and delicate discussions about progress, supporting joint management. It helps discuss next steps for board, management, network participants, and partners based on results. It has been noted by network participants, that it is important for the network vitality assessment to be facilitated by facilitators who can position themselves independently and, in addition to providing a good introduction, create an open and safe atmosphere (Fiering, Zoeteman, Van der Lans, 2016).

Improvement suggestions provided by various network partners during the survey or discussions prompt a reconsideration of the network's strategy or adjustments in direction, involvement, or other activities that enhance the commitment and effectiveness of the network.

If the measurement is conducted more frequently, objective comparison between networks becomes easier.

However, experience with this instrument also shows that the detailed inquiry into ambition, interests, degree of organization, process quality, commitment, connecting, trust, decisiveness, network composition, physical milestones, intermediate products, financial results, network strengthening, sustainability, innovation, reach, and visibility results in a survey with about 55 statements and questions. Some find it time-consuming to fill out, and the questions are sometimes so detailed that some find it hard to distinguish between them.

To perform this measurement, research experience is required to customize the vitality meter without losing the framework of underlying assumptions. The preparations, survey, analysis and workshop take time. Most people who participated in these evaluations indicate that it is worth it: it is an investment in the vitality of the network.

This investment ensures that the stimulating conversation can take place based on independent analysis using indicators grounded in scientific research. The analysis, along with the conversation, yields a great deal of insight, clarity, and fosters enthusiasm and connection within the network. It leads to a shared vision on the process and an agenda for further action.

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‘The FarmingTree’ – an integral assessment tool of the social and ecological embedding of a farm - inspired by Doughnut Economics

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Abstract:
This paper presents an integral assessment tool for the social and ecological embedding of a farm. In transitioning towards sustainable farming systems, a product-based view as well as a location-based view is needed. The location-based perspective focuses on the combined effects of farming practices on the social and ecological context of the farm. Based on a need expressed in practice, and inspired by Doughnut Economics, the FarmingTree tool was designed. Using a qualitative assessment of on-farm activities for six social and ten ecological themes, this farm assessment tool supports awareness of and communication on the situation of the farm. Testing of the tool in various contexts showed a high added value for communication between the farmer and stakeholders with an interest in the development of the farm. The tool creates a shared understanding of the farm allowing to discuss farm development options in a clear manner with stakeholders with a specific interest in the development of the farm, like local food systems or in a lessor-tenant situation and as well students in farming related studies. The tool strengthens the farmer in conveying the ‘story’ of the farm in its entirety and its complexity.

Keywords: Farming, assessment tool, Doughnut Economics, strategy, embedding

Purpose

How to assess the embedding of a farm in the local social and ecological environment? For added- value farming strategies aiming to deliver both food positive social and ecological effects, being able to assess the added value of their farm is essential. Especially when farming practices are required that lead to a higher economic cost price per unit of food produced that needs to be translated into a higher product price or payments for specific services. This requires a location-based view rather than a product-based view on sustainability and a tool that allows for an integral assessment of the effects of all farming activities on a specific location from a socio-economic and ecological viewpoint. Product-based assessment schemes are related to specific sustainability aspects of a farm like carbon or nitrate emissions or in animal welfare. These assessment schemes are often connected with a certification scheme for a specific product in the market, ensuring that the promised extra effort in the production methods is realised. A location-based view on farm development acknowledges that farming is a combined set of activities on a specific location affecting the social and ecological context. In order to support the assessment of and communication on farm development in relation to the needs and concerns of the social and ecological environment an integral tool is required. This paper describes the development of this tool and the results of the tests done with a range of stakeholders in farm development. Environmental and social pressures create an increasing need for sustainable agricultural practices and the protection of natural resources. Sustainable agriculture is of great social importance because it contributes to food security, healthy ecosystems, the protection of biodiversity and the well-being of society (FAO, 2018). Farms are essential for food production yet provide as well of public goods and services, both in the ecological and in the social context. The theory of Public Goods and Farming (Gerrard, 2012), emphasises this important effect of farming on public goods like biodiversity, soil carbon storage, water resources and quality, soil and landscape protection. Due to the primary focus on the economic aspects of food production, the importance of these goods and services is often overlooked in traditional farm economic analyses. The relation with the local social and ecological environment has over the last decades become 'footloose' (Renting and Wiskerke, 2010), the product has taken centre stage emphasising the product-based view on sustainability of agriculture.

Where a product-based view is vital for certification schemes that allow consumers to choose a product from supermarket shelves, the link with the location where the product is produced is loosened. There is however always a farm with an address where the product is produced, this address is location with a specific social and ecological context. The total of all choices made on the farm lead to a combined set of influences on this social and ecological context. Adhering to the production standards for a specific product does not necessarily mean that all effects on the local social and ecological context are positive. A more holistic approach is therefore needed that integrates the social, ecological and the economic effects of a farm to promote sustainable development (Scoones et al., 2018; Pretty et al., 2018). It is therefore important to better understand the challenges and opportunities faced by farm businesses and how these farms can develop a farm strategy that aims for sustainable agriculture. A renewed focus on the relation of the farm with the local social environment and local ecosystems needs to be part of the strategic choices in farm management (Methorst, 2017). The Farming Tree model aims to offer a tool that allows for the integral assessment of the social and ecological effects of the farm on its local context. A model that allows for an informed discussion on the development of the farm with a clear view on all relevant aspects of farm management. The model aims as well to provide farmers with a tool that allows them to take 'ownership' of the story of their farm. Where certification schemes in general 'check' whether the farm fits within the standards, the FarmingTree tool allows farmers to assess and present their farm as a complete unit, strengthening their position as owner of the farm in communication about the development of their farm.

Approach

In designing the FarmingTree model the aim was to create a system that can be used for all farms and regions and with an assessment that is based on on-farm activities and adaptations in farm management. The aim was as well to avoid the need for sophisticated ICT-systems using a range of data sources in order to avoid assessing a farm by the outcome of a calculation. In various product-based assessment schemes calculated Key Performance Indicators (KPI's) are very useful, for the FarmingTree the aim is to design an informed assessment of the sustainability of the farm based on on-farm activities and adaptions in farm management. Inspiration was derived from bio-dynamic farming where farmers need to adhere to the standards of the Demeter scheme. As part of this certification, farmers are asked to do a peer review on each other's farm development, acknowledging the knowledge and insight of a farmer being an expert in their own field. There is however the need for a common understanding on the meaning of concepts and words used. Bio-dynamic farmers operate in a specific segment of farming with a high level of shared understanding on practices that suit the standards of bio-dynamic farming, creating a common ground to discuss farm development. The FarmingTree model aims to provide this level of common understanding for farmers in general. The model provides an assessment scheme based on actual on-farm activities and adaptations that can be 'seen' and assessed while visiting and discussing the farm development. When combined with explanation for less-informed stakeholders this approach supports a level of trust in the quality, this trust is important in the communication with a broad range of stakeholders farm development.

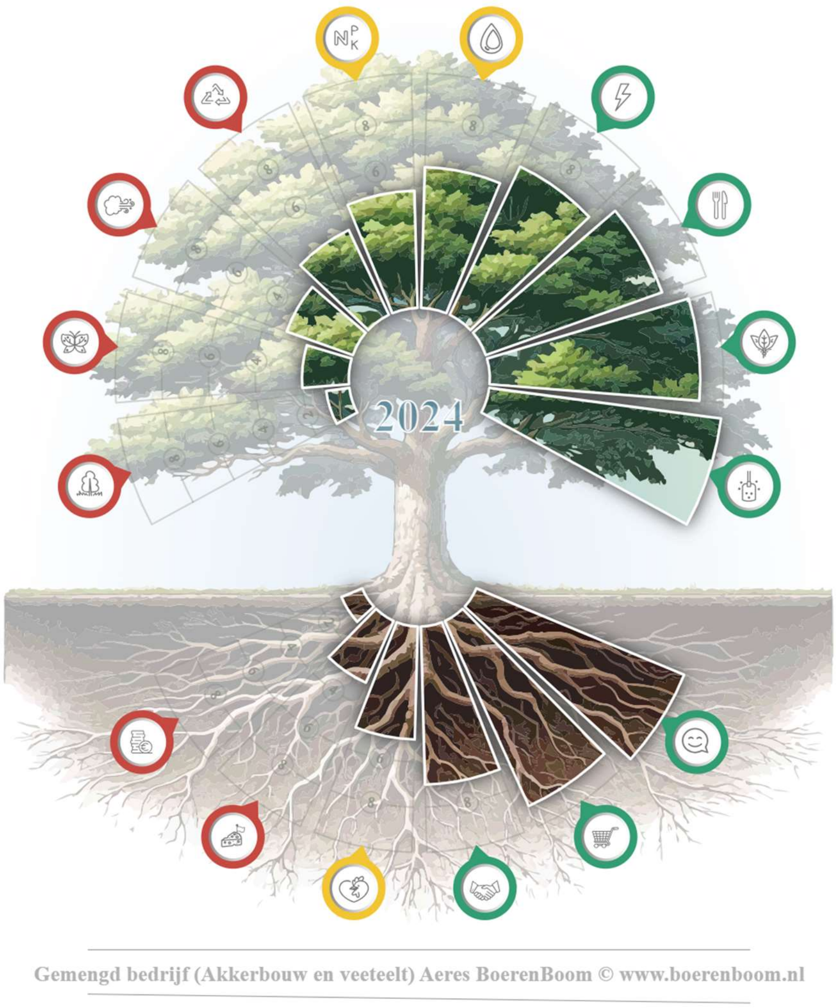
The Doughnut Economics model by Kate Raworth (2018) was as well an important inspiration as it aims to place economic activities between two circles: the social foundation and the ecological ceiling. These two circles can be seen as the inner and outer circle of a 'doughnut', hence the name of the model. The space between those lines represents the 'safe and just space for humanity' in which economic activity both brings the 'good' without creating 'harm'. This model opens a viewpoint at the sustainability in an integral manner by combining social and ecological issues. It offers as well a viewpoint of a business in a gradual development towards a more sustainable situation. The Doughnut Model has the advantage of a more abstract approach and description of the themes in which the positioning of the social foundation or the ecological ceiling can be described in more general terms. When translating to a model for a concrete activity, in our case a farm, there is however the need to link this position to real activities and adaptations in farm management. It is clear which practices are not sustainable and what practices are in sustainable, the in-between zone is however harder to describe in exact terms. In this respect the approach of developing towards more sustainable practices fits well, to see farm development as a pathway towards sustainable practices.

Starting in 2018, the FarmingTree model was step by step developed and continuously tested in practice. The farming system represents a complex web of interconnected themes creating a challenge to find a set of themes that cover the complete farm where each theme is linked to a separate aspect that can be 'measured'. This led to in total 16 themes, 6 socio-economic themes and 10 ecological themes. The visualisation of the FarmingTree model is a tree (figure 1), where the social themes are represented by the roots (the farm is rooted in the social context) and the ecological themes are represented by the branches (the farm is branched out in the ecological context).

The social themes are: *farm income*, *food with identity*, *animal welfare*, *farmer-citizen*, *farmer-value chain* and *job satisfaction*. These six themes are in many sustainability scheme not part of the assessment, yet they are inherently linked to the social embedding of a farm on its location. The themes farm income and job satisfaction explicitly focus on the farmer, farm family and people working on the farm. A farm that is sustainable in its ecological effect is not necessarily as well a farm that delivers a good farm income and/or job satisfaction.

The ecological themes are *soil*, *plant health*, *food production*, *energy*, *water*, *nutrients cycle*, *material recycling*, *air quality*, *biodiversity*, *regional landscape*. Food production needs further explanation, this theme was assed to emphasise the food production function of farming. This idee arose when visiting a farm with very high biodiversity and landscape benefits, yet the food production function was less developed due to the choice of breed and housing. For the specific farm this was a logical combination linked to its specific strategy, yet with other choices this farm could produce more food from the same resources. For this reason the theme food production became a separate theme on which a farm can be assessed.

Figure 1. Visualisation of the FarmingTree indicating 1-10 scores for social ('roots') and ecological ('branches') themes. A 'longer' root or branche represents a higher (ie better) score.



These 16 themes were selected based on both an expert judgment of the designers of the tool and the needs of farmers and stakeholders as expressed during discussions on and tests of the tool. For each theme a core sentence was made, describing the specific focus for each theme, this is essential as many themes affect each other, the farm is a system. Each theme has as well a short description of what characterises a high

sustainability situation and the on-farm activities or situations that support the development towards this high sustainability situation. The themes represent both a direct link to a level of sustainability of the farm and a link to aspects that describe relevant parts of the farm for the farmer and stakeholders of the farm. The model needs to allow a farmer to assess all relevant aspects of the farm.
For each theme a scoring system was designed in order to assess the level of sustainability for the specific theme. On a scale of 1-10 a description was made of the activities and adaptions that allow a farm to develop towards the prescribed aim. There are two main approaches possible: either a 'ladder' system where the levels are in a logical order or a 'point' system where a range of activities and adaptations is possible that are in itself not necessarily connected. In this latter situation the number of adaptations made corresponds to a score for the theme. The scoring systems is in principle a self-assessment scheme based on activities and adaptations in farm management, this means that a range of possible KPI's are not used (key performance indicators). This choice is made as the aim is to be able to discuss the development of the farm as a whole where scoring on a 1-10 level brings enough gradients to be able to distinguish between farms and to discuss farm development. For the top score in a theme, a suitable KPI may however be useful, eg in the situation where to farms have the same (maximum level of) activities and adaptions in relation to soil management, this would lead for both farms to a score of 10. Then how to allow for a different scoring between these two farms when one farm has a longer history and therefore a better developed soil quality. In this case the highest scores can only be reached when a specific KPI reaches a high enough level.

Findings

The Farming Tree model was tested in practice in 9 rounds following the development steps of the model. This involved testing with farmers in a broad range of contexts, farmers in different subsectors, different regions and with different farming strategies. The test involved as well stakeholders in farm development in farm advisory and in farm stewards (tenant-lessor situation). The model was presented in various contexts including on a conference for stewards managing estates. The latest test was done in a project where two groups of ten farmers developed their farm strategy with a localized view on social and ecological developments. The FarmingTree was used to assess the farm as it was in the past, as it is at present and for the future goals were set for the farm. The FarmingTree visualisation supported the discussion on the development and comparison with other farms.
The following remarks and recommendations were made based on the testing:

- It works well as a strategy development tool, it covers all aspects (a farmer)
- It supported a process towards clear strategic goals (an advisor)
- My view changed towards opportunity oriented (a government representative)
- It shows the complexity of a farm (a farmer in contact with local government)
- It strenghtens the knowledge position and ownerhsip of the farmer (an advisor)
- It fosters an open conversation on farm development (a steward / lessor)
- It gives insight in underlying values, opportunities and hurdles (a steward / lessor)

- It can be useful in a meeting to evaluate estate and farm development (a steward / lessor)
- It opens topics which are less discussed (a steward / lessor)
- It creates a shared language to discuss farm development (an advisor)
- It 'liberated' the farmer to tell about the farm (a steward / lessor)
- The tool works best when there is no (hidden) strategic goal for a stakeholder
- A certain level of knowledge on farming is needed to work with the tool
- The current assessment schemes focus on a production oriented farm, variants of the assessment schemes would be helpful to suit a broader range of farms
- Guard the balance between a holistic and a technical approach for a theme like energy

Practical Implications

The FarmingTree model offers a comprehensive tool that allows to assess the farm in all its social and ecological relations from a location-based perspective. The tool is useful for a farmer in strategy development, supporting (self-)reflection on the current situation of the farm and on future goals for farm development. The tool supports a clear communication between farmer and stakeholders as it creates a common language on the different themes, allowing oversight as well as insight in the themes. The farmer is supported in being able to communicate on the 'story of his farm', including the effects of changes in earliers years on the social and ecological effects oft he farm. An effect of the tool is that the (potential) positive social and ecological effects of a farm become more apparent to both the farmer and relevant stakeholders, this is as well important for a clear view on the hurdles that might limit the realisation of these positive effects.

Theoretical implication

The FarmingTree approach strenghtens the location-based view on farm development as an important viewpoint in transitioning towards sustainable farming methods. Where a product-based view is important for certification schemes in food supply, the location-based view underlines the potential benefit of farming for the social and ecological quality of the living environment. A farm is a place where products are made, the choices made in farming practices create an embedding of the farm in the social and ecological context. The FarmingTree model offers a tool to assess and compare farms in a sector and region indenpendent manner.

A second important implication is that it is a useful approach in Participatory Guarantee Systems (May, 2019), where stakeholders in farm development create their own view on the required changes and developments to suit their view on the sustainability of their food supply and the farm.

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REFLECTIONS ON THE MULTI-ACTOR APPROACH

Bridging the Knowledge Integration Gap in Multi-Actor Projects through a Reflective Dialogue Approach

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Abstract:
Multi-actor approaches are now at the core of many EU-funded projects that aim to address complex challenges and develop innovations in agriculture and rural areas. A defining characteristic of such approaches is that it brings together diverse actors from both sciences and practice in view of knowledge integration; the fundamental assumption being that the heterogeneity of the collaboration will allow for integrating existing knowledge to produce innovation solutions. However, the presence of these diverse expertise also presents a dilemma, where the task of navigating and leveraging the diversity becomes a formidable challenge to the success of a multi-actor approach. In this article, we describe our experiences in addressing such a challenge in an ongoing multi-actor project, where we used the Toolbox Dialogue method – a structured, reflective dialogue approach, aimed at increasing mutual understanding among collaborators. We present preliminary results from a workshop, where we demonstrate the potential of such a structured dialogue to support communication and collaboration among project partners. Overall, this article highlights the vital need for new reflection and communication methods that can support knowledge integration in multi-actor approaches.

Keywords: multi-actor approach, reflective dialogue approach, knowledge integration

Purpose

The agricultural sector today is faced with many serious social and environmental challenges related to climate change, environmental protection, resource scarcity, international competition, and generational change on farms and in businesses. The multi-dimensionality of these challenges has led to more interactive and participatory approaches to knowledge production (Norström et al. 2020). In the European Union (EU), such notions of knowledge co-production have entered the lexicon of diverse professional and disciplinary communities as the “Multi-Actor Approach (MAA)”, promoted by policy mainstreaming through initiatives such as EIP-Agri and Horizon 2020. A defining characteristic of a such a multi-actor approach is that it emphasizes “the collaboration between various actors to make best use of complementary types of knowledge (scientific, practical, organisational, etc.) in view of co-creation and diffusion of solutions/opportunities ready to implement in practice (EIP-AGRI Service Point, 2017, 3).

Collaborative efforts that bring diverse perspectives to tackle a problem can be rewarding. By leveraging heterogenous knowledge and perspectives, “the robust features of reality becomes salient and can be distinguished from those features that are merely a function of one particular view or model” (Van De Ven and Johnson 2006, 815). This allows for a more nuanced understanding of complex issues and the co-creation of solutions that reflects such complexity. However, the integration of this diverse knowledge can be particularly challenging as different perspectives are often so deeply ingrained that it is difficult to recognize, let alone integrate these differing perspectives. (Crowley and O’Rourke, 2021). When left unaddressed, these differences can disrupt the delicate dynamics of multi-actor collaborations, hindering progress and ultimately derailing the project.

Against this backdrop, our study aims to offer insights to those in search of communication methods that can address these complexities. Specifically, we explore the application of the Toolbox Dialogue (TD) Method- a philosophically grounded approach to enhance communication and team collaboration in multi-actor collaborations. (Hubbs, O’Rourke, and Orzack 2020). This paper is thus exploratory in nature, detailing our experiences with the method in a manner that demonstrates its potential to facilitate dialogue and collaboration in the context of multi-actor projects.

Design/Methodology/Approach

Project background

I2connect is a 4-year Multi-Actor (MA) project (2019 – 2024) funded under the Horizon 2020 program of the European Commission (EC). The project aims to empower advisors as well as their organisations to engage and support farmers and foresters in interactive innovation processes. To achieve its objective, the project brings together a broad range of actors from 42 organisations in 21 European countries, that includes farm and forestry advisory stuff and management, researchers and university lectures and public authorities. The project adopts a multi-level networking and peer-to-peer learning approach in real-world context where project partners engage in various activities such as field reviews, trainings, cross visits, workshops, etc. Together, these activities provide opportunities that enable project partners to practice and develop their skills and knowledge bases regarding interactive innovation; test different methodological and conceptual approaches; challenge their assumptions and thinking into reviewing and developing new approaches.

Toolbox Dialogue (TD) Method

The TD method uses a structured, reflective dialogue approach to facilitate knowledge sharing and coordination among team members (Hubbs, O’Rourke, and Orzack 2020). The basic assumption underlying this approach is that there are differences in perspective represented in a group that are relevant to how the group functions. These differences are rooted in different values and beliefs, often implicit that are formed as one becomes a disciplinary expert, and personal experiences that shape the practice of team members. If left unaddressed, these differences can undermine interdisciplinary collaboration. The goal of the TD method is thus to leverage these differences by systematically making them explicit and coordinating them.

The TD method is typically applied in a workshop setting. Prior to the workshop, the facilitators work with project representatives to understand and identify issues about which the project team members seem to have different opinions. These are formulated as "dialogue prompts", which are statements that express a particular point of view, typically contentious beliefs, or values. Typically, there can be several themes or "modules", each module containing six to eight dialogue prompts, together constituting what is called the "Toolbox instrument". Once this is developed, the project team members then gather for a 2 to 3 hr workshop, where they engage in a reflective dialogue on the prompts.

Implementation of the TD method

In the development of the toolbox instrument and subsequent implementation of the TD method within our project, we (the first two authors of this paper) assumed dual roles as facilitators and project partners.

(a) Toolbox Instrument development

Two aspects helped us in the design of the Toolbox Instrument. Firstly, as project partners ourselves, we knew the landscape of our project and what the contentious issues were. Secondly, our project supports a reflective monitoring approach whereby, project partners periodically submit anonymous reflections on their experiences and learnings within the project via an online reflection tool. As responsible persons for this task, we regularly compile and analyse the reflections for emergent themes and issues that are fed into the project to support collective learning. The insights collected through this task were thus instrumental in identifying the theme and crafting the prompts for the Toolbox instrument. For this workshop, we chose one theme on "Co-creation", with the core question of exploration as "How can we effectively navigate and leverage diversity in our co-creation processes?". The final dialogue instrument used can be seen in Figure 1.

Navigating and leveraging diversity in our co-creation process

Core question: How can we effectively navigate and leverage diversity in our co-creation processes?

Please rate the following prompts on a scale of 1 – 5

Disagree				Agree
1	2	3	4	5

1. In co-creation, there is a balance to strike between valuing diversity and ensuring effectiveness
2. In co-creation, it is acceptable to limit participation to partners who can contribute the most valuable insights, even if it means excluding others
3. To manage diversities effectively, co-creation requires a structured and facilitated approach
4. Conflict and disagreement arising from diversity should be minimised in co-creation processes to maintain a harmonious environment
5. Co-creation should challenge the status quo and existing knowledge in order to create something new

Figure 8 Toolbox instrument developed on the theme of "Navigating and leveraging diversity in our co-creation process"

(b) Workshop

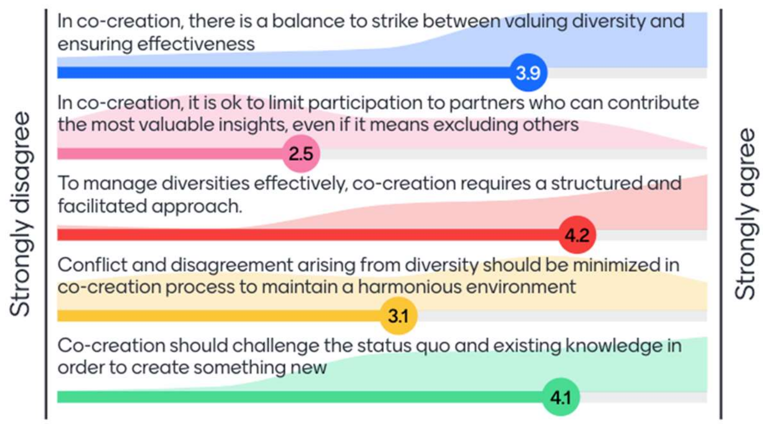
The workshop took place in the frame of the annual general assembly meeting of the project that took place in October, 2023. The meeting convened 41 project partners. The session commenced in the plenary with a concise introduction by the first author, who outlined the workshop's structure, objectives, and the underlying principles of the TD method. The primary goals of the workshop were articulated as follows (a) To collectively explore how to best navigate and leverage diversity in our co-creation processes within the project (b) To engage in and practise reflective dialogue. Following the introduction, the central theme and core question were presented, and participants were asked to individually reflect on the prompts. Responses were captured on a scale from 1 to 5 using the Mentimeter tool, facilitating real-time, anonymous collection of the results. The results were then displayed and participants were asked to discuss the results in small groups. For this, we used the 2-4-4 method: pairs discussing for 10 minutes, then two pairs merging into fours to discuss for another 20 minutes, and a final round with 4 new members discussing for another 20 minutes. After these small group discussions, participants were then convened back to the plenary where the fishbowl method[13] was used, enabling participants to share their reflections and insights with the entire assembly.

Findings

(a) Results from workshop

In this section, we present the results of the individual reaction to the reflection prompts, a description of how the dialogue ensued in the plenary session as well as implications we draw from our analysis of the dialogue. The first author reviewed the transcript of the dialogue in plenary and examined them with respect to identify whether there were differences among the participants. The dialogue in the small groups preceding the plenary dialogue was not recorded nor transcribed.

Figure 2 illustrates the spectrum of individual responses to the reflection prompts centered around the question, "How should we effectively navigate and leverage diversity in our co-creation process?" The results indicate a general agreement among participants on several prompts. As can be seen, there seemed some consensus on prompts 1,3 and 5. In contrast, the responses to Prompt 2, which considers limiting participation to partners who can contribute the most value, and Prompt 4, which relates to minimizing conflict and disagreement, display a wider range of reactions.



[13] For more on how the fishbowl method works, refer to https://en.wikipedia.org/wiki/Fishbowl_(conversation)

The plenary dialogue session began with one participant's stance that conflict, rather than being a disruptive force, can act as a constructive catalyst within the co-creation process. This was followed with the observation by another participant, on the inherent challenges of co-creation in practice, particularly because of prevailing power dynamics among actors keen on maintaining their positions. These initial observations, intriguingly, did not elicit immediate follow up reactions. Rather, the dialogue quickly turned into a deeper inquiry into the essence of what co-creation is.

One participant introduced a pivotal question of whether co-creation is already compromised from the outset if one party enters with a preconceived idea and agenda. This assertion sparked a series of responses, with some participants arguing that an initial idea does not preclude the fluid contributions from all actors involved. Still, others felt that when the initial idea is borne by only a few people, the other members only serve as a support to implement the preconceived idea. The dialogue then briefly transitioned to the practicalities of co-creation within project settings. One participant lamented on the often, insufficient allocation of space, time, and resources during the formative stages that allow for genuine collaborative ideation. This sentiment was shared by others who noted that the rigid milestones and targets set by project funders, leave little room for authentic co-creation. Still, other participants debated whether the presence of fixed milestones inherently limits co-creation or if there remains potential for collaborative innovation within these parameters. This led to contemplation on the very definition of co-creation, with some advocating for a simplified understanding centred on the integration of diverse perspectives.

In a brief interjection, one participant redirected the dialogue towards the broader contextual factors that enable co-creation, particularly the top-down educational systems prevalent in many countries. Such systems, it was argued, fail to cultivate the mindset necessary for successful co-creative efforts. Yet, the dialogue quickly returned to the pivotal question: What truly defines co-creation? This inquiry led to nuanced exploration of participant's different viewpoints and values, particularly regarding inclusivity and the role of structure and facilitation within the co-creation process.

Distinct positions soon emerged during this discourse. On one hand, some participants emphasised the principle of inclusivity from the very inception of an idea, also arguing for a co-creation process that unfolds organically, with minimal external interference or guidance. On the contrary, others posited that co-creation inherently involves varying contributions across different stages in the co-creation process, which might necessitate selective participation. For this faction, the introduction of structure and strategic navigation of group dynamics were deemed essential to the success of the co-creation process.

In the dialogue session's final moments, one participant speculated on future possibilities, questioning if the structures and designs governing project funding might evolve to better embrace co-creative methodologies. This shift, they suggested, could fundamentally alter the criteria for evaluating project success, moving beyond traditional deliverables and milestones towards a more holistic assessment of collaborative outcomes. Following this contemplative note, the facilitators summarized the key themes explored during the dialogue, effectively concluding the session. Regrettably, due to the tight schedule of the program agenda, a subsequent debriefing session was foregone.

(b) Reflections on the workshop and the TD method

In evaluating the utility of the Toolbox dialogue method, we note two important outcomes. First, TD method facilitated both individual and team reflexivity among participants. At the individual level, participants by first reflecting on the prompts, were encouraged to introspect and critically examine their own viewpoints and assumptions. This individual reflexivity is crucial, however, as highlighted by Kuhn (2015) and Gonnerman et al. (2015), it is the process of engaging in dialogue that truly sharpens this reflexive lens. Dialogue requires that one articulates one's tacit knowledge explicitly, challenging participants to justify their positions not only to themselves but to others. In our case, this process of reflexivity was particularly evident as the dialogue veered into discussions on the nature of co-creation, prompting participants to reconsider and articulate their understanding and beliefs about the co-creation process.

Another significant aspect of the TD method's utility lies in its structured approach, particularly evident through the employment of purposefully designed dialogue prompts. As Van Knippenberg et al. (2013, p.185) describe, dialogue necessitates an "effortful process" where one engages in a process of unearthing, examining and synthesizing various propositions and conclusions. Given that groups often encounter challenges in initiating and sustaining productive dialogue (Cohen 1994), the provision of structured prompts becomes a vital facilitative tool. In our application of the TD method, these structured prompts played a valuable role, particularly in the smaller group dialogues that preceded the larger plenary discussions. While the prompts may not have been the focal point of the plenary dialogue, they served as invaluable conversation starters in the more intimate small group settings. This was especially beneficial given the linguistic diversity of the participants, many of whom did not have English as their first language. The prompts provided not only a common starting point for the dialogue but also equipped participants with initial vocabulary and concepts.

Expanding on the discussion of the TD method's utility in enhancing reflexivity, encouraging perspective-taking, and providing structured engagement, it becomes essential to consider its limitations within our specific application. While the TD method was effective in bringing to light diverse viewpoints among participants, we encountered challenges in achieving common ground and laying the groundwork for joint action. Repko and Szostak (2020) highlight that reaching common ground is a process that necessitates the sharing, negotiating, and amending of concepts, theories, or issues to collaboratively construct knowledge. Although our dialogue session succeeded in articulating and sharing diverse perspectives, it fell short of facilitating co-creating knowledge based on these perspectives. This might have been attributed to several factors.

Firstly, addressing the critical issue of time allocation, our workshop incorporated 40 minutes for small group dialogues, followed by an additional 60 minutes for the plenary dialogue. This timeframe, however, was found to be insufficient for reaching the depth of dialogue we had aspired to facilitate. This shortfall reflects the common underestimation of the substantial time needed to achieve common ground, particularly in projects involving multiple stakeholders. Secondly, the effectiveness of the dialogue and its potential to lead to productive outcomes significantly depend on the participants' communication abilities. In our scenario, the depth of argumentation and dialogue was largely driven by a select few well-spoken participants. This highlights the critical importance of communicative competence, which encompasses not just the ability to articulate one's thoughts clearly but also entails active listening, understanding differing perspectives, and the capacity to constructively build upon others' ideas. These skills are indispensable for effective dialogue and should not be assumed to be universally present. Instead, they require deliberate cultivation and support within the framework of a project to ensure that all participants can engage fully and contribute meaningfully to the collective discourse. Lastly, the willingness or ability of participants to engage in substantive dialogue, as highlighted by Nagda (2006) can be inhibited by various factors, including the presence of subtle power dynamics within the group setting. Such dynamics might have created an environment that discouraged full participation from some individuals, thereby diluting the effort to navigate through complex issues towards a common ground.

Practical Implications

Our experiences with the TD method offer several valuable insights for facilitators and managers of multi-actor projects. Firstly, the critical importance of allowing sufficient time for dialogue processes suggests a need for more flexible and generous planning in project agendas, especially when aiming to achieve deep collaborative insights and common ground. Secondly, our findings highlight the need for developing communicative competence among participants, suggesting that projects could benefit from incorporating workshops focused on enhancing dialogue skills, such as active listening and constructive argumentation. Lastly, the observed impact of power dynamics on the participation and engagement of individuals points to the importance of creating safe and inclusive spaces for dialogue. Facilitators must be trained to recognise and mitigate power imbalances, which might involve adopting specific facilitation techniques or dialogue structures.

Theoretical Implications

The exploration of the TD method within our project contributes to the broader discourse on transdisciplinary collaboration. Our work underscores the complexity of achieving mutual understanding and knowledge integration among diverse stakeholders and highlights the vital need for utilising reflection and communication methods that can support knowledge integration in multi-actor collaborations.

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Insights into co-created multi-actor workshops to collect and integrate stakeholder input in a European project

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Abstract:
Stakeholder engagement is pivotal in addressing multifaceted challenges, particularly in projects striving for more sustainable agricultural practices. Multi-actor workshops have emerged as a prominent strategy to capture diverse perspectives, yet empirical evaluations of their effectiveness in integrating stakeholder input into decision-making processes remain scarce. This paper presents a qualitative cross-case analysis evaluating co-created multi-actor workshops within the H2020 RUSTICA project, focusing on the development and adoption of novel bio-based fertilisers across five regions.
The study evaluates co-created workshops on gathering and integrating stakeholder input within a European project context and provides actionable insights and recommendations. The research analyses workshop guidelines, reports, stakeholder evaluations and interviews with key project partners.
Findings include and highlight the importance of allocating time to strategize with project partners on how to cater to different stakeholders' interests and needs, devise strategies to engage missing stakeholders together with workshop participants and ensure local knowledge broker teams are trusted by stakeholders, have complementary skills and their expected role is well defined. Practical and theoretical implications underscore the complexity and challenges of implementing co-created workshops in European projects, emphasising the importance of time investment into this project pillar, thorough knowledge of the applicable legal framework and specialised expertise of knowledge brokers for successful outcomes.

Keywords: multi-actor workshops, cross-case comparison, European project, stakeholder involvement, knowledge broker

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Purpose

Stakeholder involvement is crucial for the success of projects aiming at the creation of agricultural innovation. This constructivist view on knowledge exchange and creation is reflected in the introduction of systemic thinking in agriculture (Ingram et al., 2020). This is for example reflected in agricultural knowledge and information/innovation systems (AKIS), the EIP-AGRI focus groups and operational groups (EU SCAR AKIS, 2019), and in the Learning and Innovation Networks for Sustainable Agriculture (LINSA) (Moschitz et al., 2015). The format of co-created multi-actor workshops has gained prominence to capture diverse perspectives of stakeholders, to be able to develop more locally relevant and sustainable outcomes. This is also a main goal of the regional multi-actor networks as described in the granted proposal of the EU Horizon 2020 RUSTICA project (CORDIS, 2020). Yet, the actual practical success and failure factors of such workshop designs in terms of collecting qualitative stakeholder input and incorporating this input into project decision-making requires more empirical investigation.

1.1 Project context

In this paper, we aim to evaluate co-created multi-actor workshops in the H2020 RUSTICA project (CORDIS, 2020). This project deals with the development and uptake of new types of bio-based fertiliser by applying a multi-actor approach to set up new networks, give a voice to the stakeholders and organise the value chain efficiently and sustainably.

To reach this, stakeholder workshops were organised in one non-European and four European regions: Almeria (Spain), Flanders (Belgium), Friuli-Venezia Giulia (Italy), Pays de la Loire (France), and Valle del Cauca (Colombia). Each workshop was guided by regional knowledge brokers, who were also project partners. They were responsible for guiding local stakeholders through workshops on different aspects of potential new bio-based fertilisers and communicating their input back to the project-partners. Furthermore, they were responsible to build trust and to develop a common language between the stakeholders, both necessary to build collaboration and potential value chains. They spoke the local language, knew the local conditions, and had ties with the rural community. Before the workshops started, all knowledge brokers followed two training sessions in participatory workshop methods organised by the responsible project partner.

1.2 Construction of the regional networks

A cooperative approach in multidisciplinary projects such as RUSTICA is of high relevance as it extends the benefits from individual levels to a more collective level. Therefore, a diverse group of stakeholders is needed to closely cooperate throughout the whole research project period while focusing on real problems or opportunities stakeholders are facing. Ideally, the diversity of participating stakeholders provides knowledge complementarities at both scientific and practical levels (Franco et al., 2019). The project rationale recognized from the start the importance of engaging various stakeholders on recurring moments with approximately six months intervals throughout the project duration of four years. In total, six workshops will be held in each of the five regions, resulting in 30 RUSTICA regional multi-actor workshops between

December 2021 and September 2024. This research is based on the first half (15) of these workshops.
Each RUSTICA regional network aimed to consist of about 10 to 20 experts, which could vary throughout the project. The objective was to form comprehensive discussion groups represented by universities, research organisations, technology providers, fertiliser producers, organic wastes managers, education and communication centres, advisory organisations, farmers' organisations and farmers, nature and forestry organisations, representatives of local environmental organisations, and local policymakers.

1.3 Research objectives

The primary objectives of this study are to:

1. Identify workshop design factors that contribute to or hinder collecting and integrating qualitative stakeholder input.
2. Provide actionable insights and recommendations to enhance the effective collection and integration of stakeholder input in regional development and uptake processes of innovation, in the context of a European project.

Methodology

For this qualitative case study research, we conduct a cross-case comparison of five regional series of three multi-actor workshops spread out over two years. This results in three general workshop guidelines and 15 workshop reports. To validate our analysis of the guidelines and reports, and to strengthen identification of factors that contribute to or hinder the collection and use of stakeholder input, we additionally conducted eight interviews with key partners of the RUSTICA consortium during the end of 2023 and the beginning of 2024. These included the project coordinator and the local knowledge brokers.

2.1 Co-created design of the workshop guidelines

The workshop guidelines were co-created within the RUSTICA project during several meetings with work package leaders and knowledge brokers. At least once every three months, responsible project-partners and knowledge brokers of the RUSTICA project had a meeting to ensure that knowledge from the project is transferred and co-created, questions from the regional multi-actor networks reach the project partners, and insights from the regional multi-actor networks are exchanged between these networks. This included evaluating the previous round of workshops and planning the next round of workshops while considering lessons learned.
Before the start of each workshop, a general workshop guideline was shared and discussed with the knowledge brokers. A guideline consisted of mandatory parts and adaptable parts. Mandatory parts were mostly requested and designed by a project partner who needed input for their project work around the timing of the workshop. The mandatory parts were also created to ensure consistency across the regions. Examples of mandatory parts are a stakeholder mapping exercise, brainstorming on possible new value chains, on future scenarios and defining the most important characteristics of blends of potential new bio-based fertilisers. Each workshop guideline also had suggestions for adaptable parts that gave knowledge brokers the freedom to adjust the

guidelines towards the needs of the region. Regarding the adaptable parts, knowledge brokers could use the online project toolbox for inspiration.

2.2 Workshop reports and evaluations

After each workshop, knowledge brokers wrote a workshop report in line with a template provided together with the guidelines. In this report the number and type of stakeholders attending the workshop is provided, but also the main stakeholder input and discussion points are summarised. Organisational choices are mentioned and finally, how the workshop was evaluated by the stakeholders, using mostly a set of evaluation questions provided by the guideline.

2.3 Data analysis

We evaluated each mandatory part of the three workshop guidelines and the corresponding parts of the workshop reports where stakeholder input was requested. For each part of the guidelines, we ascertained by whom and how it was constructed (for example by one partner or multiple partners discussed). Next, we checked if each part of the guidelines was explained and discussed with all knowledge brokers before the workshop took place. Finally, eight semi-structured interviews with key RUSTICA partners were conducted to validate and identify factors that contributed or hindered the collection and integration of input from stakeholders. We analysed the interview data using an inductive coding approach.

Regarding the fifteen reports, we evaluated the following questions:

Quantitative: How many stakeholders…

- attended and how many knowledge brokers were present?
- evaluated the workshop as relevant to them in general?
- felt like they could share their opinion?

Qualitative:

- What were the roles of stakeholders (policy maker, farmer organisation representative, technology developer…)?
- Was it possible to conduct the guidelines for each input requesting mandatory part: yes, partly, or no? If not, why not?
- Any notable information in the evaluation summary?

Findings

Based on the results presented in Table 1., we can conclude that the workshop guidelines combined with the performance of the knowledge brokers were overall successful in providing stakeholders with relevant workshops and the opportunity to give their input. For the second and third workshop in Valle del Cauca, evaluation data is missing, however we obtained verbal confirmation from the regional knowledge brokers that both workshops were very well received by the stakeholders.

Strikingly, almost all workshops are evaluated by almost all participants as relevant (except for the second workshop in Pays de la Loire). When participants gave suggestions, in most cases, it concerned requests to make the workshop better worth their *time investment.*

Table 1. Quantitative workshop evaluation results

	region	stakeholders + knowledge brokers	relevant workshop? *	possibility to share opinion?*
ws 1	Almeria	10+6	10/10	10/10
	Flanders	17+3	11/13	13/13
	Friuli-Venezia	16+3	12/12	12/12
	Pays de la Loire	17+3	10/11	11/11
	Valle del Cauca	15+4	15/15	15/15
ws 2	Almeria	12+5	9/10 + 1 n.a.**	8/10 + 2 n.a.
	Flanders	8+2	8/8	8/8
	Friuli-Venezia	21+6	21/21	21/21
	Pays de la Loire	15+4	7/12	12/12
	Valle del Cauca	20+5		
ws 3	Almeria	22+5	16/22 + 6 n.a.	16/22 + 5 n.a.
	Flanders	12+2	12/13	13/13
	Friuli-Venezia	19+6	19/19	19/19
	Pays de la Loire	8+3	6/6	6/6
	Valle del Cauca	12+4		

* Based on completed surveys, which could be a lower number compared to the number of attending stakeholders, due to e.g. stakeholders leaving early or other circumstances.
* * n.a. = not answered/left blank questions

Practical Implications

The workshop reports, qualitative answers of stakeholders and project partner interviews led us to formulate the following conducive or impeding factors to consider when designing and implementing co-created multi-actor workshop. Considering these factors helps when striving to create a win-win situation in terms of return of time investment for both the project partners as the stakeholders.

4.1 To consider during the project preparation phase

Legal context

(Regional) legislation and policy frameworks should be considered in-depth before the start of the workshops. In the Friuli Venezia Giulia region for example stakeholders suggested that an in-depth analysis of the regional context allows for a more precise discussion, and thus in-depth co-creation potential. Similarly, uncertainty or unclearness about legislation in fertiliser production and use led in some workshops, such as in Flanders, to inhibition.

Project flexibility, for example to allow for shareable project results

Careful thought should go to aligning shareable project results and the type of stakeholders interested in these. At the end of multiple workshops, it was mentioned that the status of what the project could share was not yet on a level where it was relevant to the stakeholder. Different stakeholders from different regions requested for example on multiple occasions for an estimation of the costs of the end products envisioned. Flexibility in the timing of the workshops could help with being able to share relevant project results. To illustrate further, after the second workshop in Pays de la Loire, evaluated as the least relevant, the results and exercises being still too vague were mentioned more than once. Reactions included: "Still too many grey areas to see the feasibility"; "We have worked a lot on the value chain without having any ideas on the size/cost of the processes". An answer to this weakness could be to specifically allocate time in the project to figure out with all project partners what the added value could be for diverse types of stakeholders to attend the project workshops and how to provide this.

Well-balanced workshop in terms of length, requested stakeholder effort and small groups

Thinking of and formulating input is tiring and demanding for stakeholders. Across the workshop reports, there were a few occasions when the knowledge brokers reported not having enough time to address all mandatory parts as requested by the guidelines. Knowledge brokers came up with solutions in these occasions such as emailing stakeholders afterwards, however these solutions were usually not ideal to foster a similar in-depth co-creation experience as could be fostered during a workshop. Therefore, a well-balanced workshop is crucial in terms of length and requested stakeholder effort. There was in general a big appreciation for the interactive nature of the workshops and the possibility to share opinions (Table 1). Several stakeholders mentioned they particularly liked a small group for discussions and sharing opinions.

Clear, discussed, reviewed, and prepared co-creation workshop exercises

There were two workshop exercises that still came across as too difficult to grasp for all stakeholders, even though the project partners specifically put time in discussing and reviewing the exercises for these parts together with the knowledge brokers. On one occasion, the exercise was developed and shared only shortly before the workshop was planned, resulting in a challenging situation for the knowledge brokers. To give knowledge brokers enough time to prepare for the workshops, guidelines designed by other partners should be ready a large amount of time in advance.

A knowledge broker team with complementary expert knowledge

Having at least two knowledge brokers taking up the role of facilitators during the workshops was strongly recommended at the beginning of the project during the training of the knowledge brokers. During the interviews, it was mentioned multiple times as crucial for a successful workshop. Not only to be able to facilitate in a qualitative way, but also because different knowledge brokers reported having complementary sets of expert knowledge and skills they could use during the workshops.

This finding adds to recent research motivating that an important factor in multi-actor partnerships to achieve their goals, is the inclusion of experienced partners with existing networks, that can facilitate internal collaboration and navigate the external environments, such as political structures and market conditions (Cronin et al., 2021). Knowledge brokers, but also participating stakeholders, can ideally take up this role.

4.2 Tailoring to specific stakeholders

Tailor to different stakeholder needs

The project sometimes lacked in creating enough incentive for stakeholders to engage. In hindsight, one specific idea of the project coordination and connected to the legal context, was to start of the workshops with what stakeholders perceive as the specific bottlenecks in policy.

There was also a struggle reported to cater to academic as well as business stakeholders needs during workshops. Some exercises were too technical, while some to conceptual. Both the workshop exercises as what the project can give back in return should be adapted to the specific participants.

Include diverse and region-specific stakeholders

The roles of the attending stakeholders seemed quite diverse, with the second workshop in Flanders reported as the least diverse. This workshop still had the representation of public academic and research institutes, private research companies, a non-profit research and advisory organisation and a regional policy representative. However, in four out of five regions, participants suggested to involve more and other stakeholders in future workshops. Notably, the roles of the requested additional stakeholders varied among the regions. To illustrate the importance of this factor, in Valle del Cauca one stakeholder said: “to meet here as stakeholders of the chain in different stages and to talk about opportunities of creating synergies and articulating ourselves are the main benefits of these spaces.”

In this first workshop, a stakeholder mapping exercise was done asking stakeholders specifically who they missed around the table. Knowledge brokers took this into consideration as much as possible. This was not enough to meet this need of the attending stakeholders. A suggestion for future workshops could be to allocate time during the workshop to put actual names on the stakeholders participants believe should take part, and brainstorm together how they could be motivated to attend the next workshop.

In-depth engagement in between workshops, in case of workshop series

Mentioned in the interviews and suggested by stakeholders, the project could have put more effort in preparing background material to send before workshops took place, for example on the results of the previously held workshop. This happened for some parts, but not for all parts. The project could have done better in general in communicating, informing, involving, and connecting with stakeholders, additional to the workshops.

Theoretical Implications

We argue that this research provides valuable additions to the current understanding of the complex design and application of effective co-creative multi-actor workshops in the context of European projects tackling the development of innovative products. We want to draw specific attention to the time investment required to successfully apply this strategy: such as addressing personal stakeholder interests and preparing co-creative workshop guidelines together with multiple project partners, among other tasks. Combining this with the specific skill set and in-depth product knowledge required from knowledge brokers in these project contexts, it is a challenging though rewarding approach.

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How to develop a successful Multi-Actor Approach project proposal: an analysis of success factors

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Abstract:

This paper discusses ways MAA is introduced in Horizon Europe Cluster 6 project proposals. More particularly, the paper focuses on the factors of MAA project proposal development that lead to a successful proposal. The paper is based on three workshops, 15 in-depth interviews with actors who have been at the core of successful MAA project proposal development, a quantitative survey focused on the relevance of factors, and longitudinal engagement with five emerging project proposals. The data has been collected in the year 2023 and year 2024 as a part of the HE Premiere project (Grant agreement ID: 101086531).

The article discusses that there are five key groups of factors that allow describe the efficiency of collaboration between the diverse actors. These groups are: Predefined factors, Contextual factors, Motivational factors, Relational factors, Skill-related factors

Keywords: multi-actor approach, Horizon Europe Cluster 6, success factors

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The urgency of challenges faced by the world and the overall speed of changes demand that stakeholders are agile and react quickly. However, from a broader perspective, this illustrates that there is a need for an optimization of the innovation process. A common response to the need to accelerate the output and adaptation of researched solutions in agriculture, forestry and related sectors is the use of a multi-actor approach (MAA). MAA is a form of interactive innovation that focuses on engaging different groups of actors potentially affected by the research results in steering the research process. The approach is gaining popularity and it is expected that in the future the approach will become even more prominent.

With the increased adoption rate of the approach, there has been also growing interest in overall reflection and academic self-reflection pinpointing the effectiveness of various ways of engaging with MAA. This reflection has illustrated, that a crucial aspect of successful implementation of MAA is ensuring that the interests of all stakeholders are captured early in the research process, i.e. during the proposal development stage.

This paper discusses ways MAA is introduced in Horizon Europe Cluster 6 project proposals. More particularly, the paper focuses on the factors of MAA project proposal development that lead to a successful proposal. The paper is based on three workshops,

15 in-depth interviews with actors who have been at the core of successful MAA project proposal development, a quantitative survey focused on the relevance of factors, and longitudinal engagement with three emerging project proposals. The data has been collected in the year 2023 and year 2024 as a part of the HE Premiere project (Grant agreement ID: 101086531).

Purpose

The urgency of challenges faced by the world and the overall speed of changes demand that stakeholders are agile and react quickly. However, from a broader perspective, this illustrates that there is a need for an optimization of the innovation process. A common response to the need to accelerate the output and adaptation of researched solutions in agriculture, forestry and related sectors is the use of a multi-actor approach (MAA). MAA is a form of interactive innovation that focuses on engaging different groups of actors potentially affected by the research results in steering the research process. The approach is gaining popularity and it is expected that in the future the approach will become even more prominent.

Methodology

The underlying methodological approach is based on the assumption that at the starting stage of the study, we have a substantial amount of unknowns and the task of the study is to capture these unknowns. Thus, the selected approach was designed to gradually move from an open approach to an ever more focused engagement with the involved actors and stakeholders. Structurally, the following consecutive steps were taken:

(1) First workshop: developing the first conceptual framework and validating it with project partners. The first workshop took place in Eberswalde, Germany in March 2023,
(2) Semi-structured interviews: designing the interview guidelines in line with this framework and carrying out 15 semi-structured interviews. Respondents included a variety of experts who have been heavily engaged with MA proposal development. The interviews were conducted between April and June of 2023.,
(3) Second workshop: verifying the results of the interviews in an interactive stakeholder session. The second workshop took place in Toulouse, France in July 2023.
(4) Online survey: designing and piloting an online survey of different stakeholders having been engaged with MA proposal development, with a focus on enhancing the overall comprehension of factors that characterise work on successful MA project proposals. Together, 120 respondents filled out the survey. The data was collected from October to December 2023.
(5) Third workshop: discussing and validating the main conclusions with the project partners in a designated online workshop. The third workshop took place online in January 2024.
(6) Coordinators of three emerging proposals were interviewed through the process of proposal development in the period between September 2023 and February 2024.

As such the methodological framework applied in the execution of this task employed a mixed-method approach (i.e. combining qualitative and quantitative research methods, as well as individual and group settings for data gathering) to allow for triangulation of results.

Findings

MA proposal preparation requires bringing together partners with different yet complementary expertise, skills and knowledge. The study discusses that there are five key groups of factors that allow describe the efficiency of collaboration between the diverse actors. These groups are:

- Predefined factors;
- Contextual factors;
- Motivational factors;
- Relational factors;
- Skill-related factors.

Predefined factors

In every project proposal, there is a space for creativity. However, next to the creativity, some aspects allow very little variation and tie the Calls to very specific needs and tasks. These are aspects that emerge from the formulations used in the call – the issues proposals are expected to react to. The consortia have to note these expectations and work with them accordingly, since not doing so will interfere with the possibility of the project receiving funding.

The cluster 'Predefined Factors' encompasses those aspects of developing an MA proposal that cannot be changed without strong justification or substantial effort. These are the factors that, for the most part, the consortium needs to recognize and react to if consortium members aim to develop a project proposal.

The so-called 'Predefined factors include the following aspects:

- Good understanding of the administrative, budgetary, reporting and evaluation criteria of the Call;
- Purposeful selection of partners focusing on the partner profiles;
- Deep understanding of the objectives, scope and expected impacts of the call;
- The skills represented by the consortium mirroring the skillset in the Call;
- Time allocated for working out which are the right partners and the right focus for the proposal already in the early stages of proposal development;
- Internal formal consortium agreements are being developed and signed already at the stage of proposal development.

Contextual factors

It is not just the diverse knowledge that partners bring to the consortium. They also embody a *diversity of capacities, experiences, professional profiles, and cultures*. Partners also represent *economic and social differences, differences in management and structure of organisations* they represent, *sectoral differences*, etc. These diverse experiences form a unique background against which the project proposal needs to be co-developed. All these aspects can have an impact on how the consortium operates and, hence, these factors need to be accounted for.

Every activity happens in a particular context. While context is unavoidable, the impact it might have on the development of a successful MA proposal is ambiguous. One should also take into consideration the diversity of contexts that can affect the success of a proposal. The geographical context might manifest itself through different economic realities and cultures, sectoral and organisational contexts that produce different organisational cultures and capacities, and political contexts that manifest in different structural support arrangements. Accordingly, partners might come with all types of local elements attached to them. Results of the interviews, the survey, and the workshops illuminate slightly different results on this matter. Respondents of the qualitative interviews present *context as a crucial element for developing a successful co-creation*. Workshop participants have also repeatedly raised concerns related to the context-related experiences of potential consortium partners. However, this sense of relevance is not shared at the same level by the respondents of the online survey.

It is not just the diverse knowledge that partners bring to the consortium. They also embody a *diversity of capacities, experiences, professional profiles, and cultures*. Partners also represent *economic and social differences, differences in management and structure of organisations* they represent, *sectoral differences*, etc. These diverse experiences form a unique background against which the project proposal needs to be co-developed. All these aspects can have an impact on how the consortium operates and, hence, these factors need to be accounted for.

The key ‘Contextual factors’ identified are:

- Consortium partners have the administrative, financial, and staff capacity to work on the proposal;
- Consortium partners have previous general experience with the preparation and implementation of international projects;
- Within the consortium, there is an understanding of and willingness to adapt to the different national contexts that partners represent;
- Within the consortium, there is an understanding of and willingness to adapt to the diverse profiles and cultures of partners' organisations;
- The project coordinator understands and engages with regional/national and organisation-specific budget setting (incl. salary rates);
- The Consortium size is kept at the level that allows for maintaining an inclusive discussion, and a timely start of partner recruitment and proposal development.

Motivational factors

In MA project proposals, motivation is crucial and cannot be taken for granted. Not all partners will be equally motivated to participate and co-create. Furthermore, their motivation can change during the proposal development. The dynamics in partners' motivations are linked to their initial expectations, former personal and institutional experiences with similar proposals, as well as transparency related to setting project goals and objectives. *Motivational factors capture aspects that shape the willingness/motivation of partners to be involved in the consortium and engage in the proposal development process***.**

Partners' as well as coordinators' motivation is something they bring along when joining the consortium. However, motivation can also grow or vanish during the proposal writing process. One should also be sensitive regarding the object of motivation. On one hand, motivation can be considered in the context of partners' general engagement with the Call topic and proposal writing. Some partners will be less engaged in discussing ideas to be advanced in the project and practically integrating those in the proposal text, while others will be more willing to allocate time for these activities. On the other hand, it could also be considered in the context of partners' willingness to engage in MAA. While some partners will be very motivated and open to engage at various stages of proposal development and explore the perspectives of various groups of stakeholders, others will appreciate the funding these projects deliver, yet might not be enthusiastic about investing the time and effort needed to work on the transdisciplinary dialogue envisioned by the MAA. The interviews with project participants illustrate that a lack of partners' motivation will not automatically disqualify proposals and render them invalid – there will always be differences between partners. There have been a lot of successful proposals with some poorly motivated partners participating in the project consortia. However, it is important that *the core team working on the proposal takes the partners' motivation seriously* and engages in overcoming the potential challenges linked to limited partner engagement. The way work in MAA will be organised can either encourage partners to engage more actively or discourage and potentially alienate them.

The key motivational factors considered are:

- Consortium partners' interest in the Call topic and project idea;
- Consortium partners' feeling of ownership over the proposal development;
- Consortium partners' interest in the project's anticipated practical output;
- Consortium partners' commitment to devote time and effort to proposal writing;
- Consortium partners' willingness to collaborate with other types of multi-actor partners in the proposal development.

Relational factors

MA project proposals can be a space for power imbalances and can employ different work strategies manifesting such imbalances. Both of the aforementioned can harm the process of developing a successful MA project proposal. Thus, the process of proposal development needs management that helps overcome power imbalances in the consortium, ensures that the interests of engaged actors are heard, and, within reason, considers and creates interlinkages between different insights and practices partners bring to the table. Relational factors refer to *aspects that cover individual and organisational levels. It focuses on the overall structure and different links between actors, which are individuals as well as partner organisations.*

Relational factors explore professional and private relations between the members of the consortium and how these relations might affect proposal development. The results of the quantitative survey illustrate that the actors applying for H2020 and HEU funding perceive this group of factors as the most impactful when it comes to the success of MA project proposals. Thus, we can suggest that the success of a proposal is largely dependent on the skilful management of relations within the consortium. The relations that need to be managed have multiple angles – for example, there is a need to ensure that partners are in the right "*place*" in the consortium (in a place that allows consortia to benefit from partners' strengths), that they know what is expected from them, and that they feel comfortable with the people that surround them. Successful management of partners is also linked to the characteristics of the project coordinator.

Good management of the consortium incorporates both good management practices as well as the use of technological innovations. For example, giving all partners access to all documents relevant to the proposal and ensuring that all of them have opportunities to comment on these materials, can ensure that all voices are heard, and stakeholders feel stronger ownership over the proposal. The same thinking can be achieved by pairing partners in smaller groups and asking smaller groups to produce parts of the documents. Several potential inclusion structures can be introduced in the process, such as ongoing and frequent communication, equality of voice, openness, and trust.

The key relational factors to consider are:

- Timely start of partner recruitment and proposal development;
- Attraction of partners with prior positive personal collaboration experience;
- Clear identification and appropriate and balanced distribution of partner roles, tasks, and responsibilities;
- Decisive leadership and advancement of the overall proposal development;
- Transparent, participatory, and mutually respectful internal communication and decision-making;
- Skilful alignment of different personalities engaged in the proposal development team.

Skill-related factors

MA proposal development requires a broad set of skills. A proposal needs to deliver the competencies that have been listed in the Call. However, it also needs to show that the consortium can execute the proposed solution and ensure that the proposal presents the idea convincingly and coherently. *This designates aspects related to experiences, knowledge, and skills that allow partners to develop a successful MA proposal.*

A successful consortium usually incorporates a variety of skills. This means that it has to have a strategy on how to make sense of and work with this resource, including scrutinising the skills that are already represented by the consortia and identifying those that are missing. Furthermore, this assessment of available skills and those still needed have to simultaneously address two questions. Firstly, *does the consortium have the skillset needed to be successful and obtain the funding*? Secondly, *does the consortium have the skills needed to later execute the proposed work plan including the delivery of promised results*?

Potential partners bring diverse sets of skills and experiences to MA projects. This is one of the key characteristics of MAA - it envisions diversity. However, most often it requires extra effort for the consortium to benefit from the diversity of skills among the partners, and this process cannot be taken for granted. For instance, partners that might be the most prominent professionals in their field might lack some other crucial experience needed to successfully engage in MA cooperation. It is also possible that a partner does not have experience with working with large groups of stakeholders representing various backgrounds or has not worked with a particular type of Call before.

Partners might also struggle with mastering some of the methods (e.g. facilitation techniques for co-creation processes) or tools (e.g. IT applications) used to collaboratively work on the proposal. It is, therefore, a task for the coordinator and consortium as a whole to *work out solutions that will allow them to make the utmost use of and benefit from all the skills represented by partners and will enable them to apply these skills efficiently*. A good example is the division of tasks among the project partners. When accomplished in a participatory manner, it can be ensured that the partners are assigned tasks that allow them to use their skills most appropriately. Consequently, it also leads to each partner benefitting the most from the involvement.

The coordinator needs to *have a clear understanding of the needs of the consortium and how well they have been addressed*. Also, the coordinator *needs to be realistic about the competencies presented in the consortium* and whether the partners jointly will be able to deliver the expected results.

The key skill-related factors to consider are:

- Strong leadership skills of the coordinator;
- Good professional skills of consortium partners;
- Consortium partners' mastery of technical and digital co-working solutions used during the proposal development process;
- Good transversal skills (such as communication, problem-solving, and time management skills) of consortium partners;
- Purposeful matching of tasks with partners' skills and competencies.

Practical implications

The practical solutions that will initiate transition in the food system require MA engagement. The study illustrates the key factors that need to be considered to successfully develop a multi-actor proposal thus allowing to develop more impactful project proposals.

Theoretical implications

The research illustrates the complexity of factors that need to be taken into account to facilitate MA co-creation. Due to the limitations in the allowed length for this paper, it is not possible to discuss here all of the nuances of this complexity. However, the full set of results illustrates that different groups of factors have to be engaged in different ways and while some of the factors can be engaged in a purely technical way, some require in-depth negotiations. Also, the significance of some factors is overestimated while other relevant factors remain almost unnoticed.

We hope that the results of this study will allow us to develop pathways laying out the key turning points in the development of successful MA project proposals.

Moving Targets in Multi-Actor Processes and Tracing Effectual Reasoning: A Critical Reflection

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Abstract:

The integration of multi-actor (MA) processes in European Horizon projects is gaining momentum, aiding in data collection, co-creation, and policy development with stakeholders. However, current research tends to overlook the dynamic nature of project objectives, focusing more on process improvement than understanding project objectives themselves. This paper investigates the dynamic nature of MA project objectives and their interplay with system-level factors. Effectuation theory is used to comprehend non-linearity within MA projects, emphasizing stakeholder engagement and solution-oriented approaches. Through qualitative case studies, we analyze the H2020RUSTICA project, revealing diverse mindsets and the importance of flexibility in meeting stakeholder needs. Our findings emphasize the necessity of an entrepreneurial mindset and a social entrepreneurship approach in MA processes to ensure inclusivity and societal relevance, challenging prevailing managerial perspectives.

Keywords: Multi-actor EU projects, Effectuation, Entrepreneurship, Unanticipated outcomes

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Purpose

There has been a growing interest in integrating multi-actor (MA) processes into European Horizon projects. MA approaches are beneficial in various ways, such as serving as a data collection platform for research, acting as co-creation points between project consortia and external stakeholders, and facilitating (bottom-up) policy and scenario developments by involving multiple stakeholders, speeding up innovation processes (DG AGRI, 2018; Cronin et al., 2022). Hence, the introduction of MA approaches aims to ensure that EU projects follow a specific approach to connect with stakeholders, while delivering results for both stakeholders' needs and society. To implement this approach, various funding instruments are assigned to different programs within the Horizon Europe program. In many calls, it is explicitly mentioned that projects should follow a MA approach to research processes, bringing the MA approach alongside multi-inter-intra disciplinarity research to the forefront of European-funded research projects (European Commission, 2023). This signals that, in order to address grand challenges, research and solutions should be derived from, accepted by, and taken up by a variety of stakeholders, from different disciplines and levels, inducing change.

However, while MA processes are seemingly perceived as an ideal approach, they face a number of challenges that are not fully realized before the plannings. The success of MA processes depends not only on implementation and planning but also on the stakeholders involved at various levels. Scholars highlight various functional areas where MA processes may fail, including knowledge development, networking, and support for market developments. Failures can be traced to both project-level issues (e.g., communication, budgets) and system-level factors (e.g., infrastructure, institutions) (Cronin et al., 2022).

In this regard, while there is a rich literature on MA processes, the current literature is mostly dedicated on diagnosing issues during the conceptualization and implementation of MA projects, improving MA processes, identifying and attracting stakeholders, and enhancing trust and interactions (Feo et al., 2022). Even though largely mentioned in the literature, this diagnostic view on MA processes may undermine the nature of innovation as non-linear processes (Frow et al., 2015), which could potentially result in unanticipated outcomes through entrepreneurial processes (Read & Sarasvathy, 2005; Sarasvathy, 2001, 2009). Arguably, even though the dynamic nature of MA processes is well recognized in the literature, the current mainstream view on the non-linearity of MA processes mostly focuses on the process itself and explicitly does not address the potential changes in the main goals of the MA project as planned during the conceptualization phases. Against this backdrop, in this paper, we aim to (1) investigate the dynamic nature of MA objectives and goals with respect to innovation and entrepreneurship, (2) explore the complex interplay between MA processes and system-level factors given the evolving MA objectives.

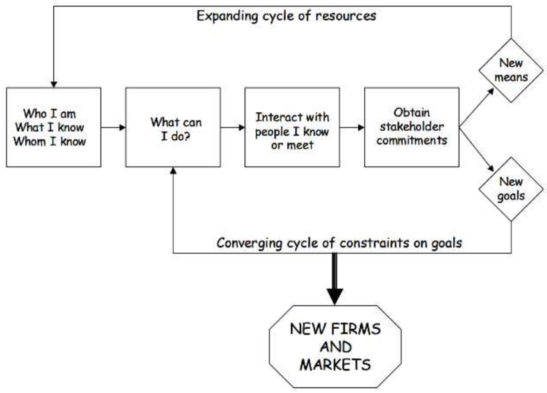
Methodology

Framing. To explore how objectives evolve in MA process, we adopt an entrepreneurial approach. This approach is based upon the Effectuation Theory (Sarasvathy, 2001, 2004; Townsend et al., 2018), which proposes an original approach to deal with uncertainty that entrepreneurs face in novel situations, where means and goals are underspecified. The theory emphasizes decision-making logic based on creating new goals from existing means (Sarasvathy, 2001). Furthermore, it appraise creativity in identifying connections between means and ends (see Figure 1). This approach offers insights into how entrepreneurs navigate uncertainty and innovate in MA projects, where outcomes are often unpredictable. Effectuation Theory is well-suited for understanding innovation in MA processes due to its emphasis on multidisciplinarity and stakeholder engagement, which can shape and be shaped by project outcomes. Many researchers in MA projects adopt a stakeholder-driven approach (Feo et al., 2022), potentially leading to unforeseen results. Effectual reasoning is guided by three key principles: affordable loss, strategic partnerships, and leveraging contingencies (Sarasvathy, 2001). These principles encourage experimentation with limited resources, collaboration with partners, and adaptation to unexpected opportunities, aligning with the dynamic nature of MA processes and fostering innovative outcomes.

Method and Research Design. We rely on a qualitative case study approach (Stake, 2000; Yin, 2009), to explore the dynamics and interactions that underpin effectual and entrepreneurial reasoning while focusing on specific cases (i.e., MA projects) with traceable outcomes. This qualitative approach allows us to unravel the mindset of coordinators, partners, and stakeholders involved in these MA projects, shaping co-creation and open innovation in non-linear dynamics.

Case Setting. We apply effectual reasoning and thinking to the H2020RUSTICA project. The project aims to develop waste-valorization technology producing bio-based fertilizers and study its market across five regions: Almeria (Spain), Flanders (Belgium), Friuli-Venezia Giulia (Italy), Pays de la Loire (France), and Valle del Cauca (Colombia). The project is a MA project conceptualized to involve different stakeholders in the aforementioned areas at various stages. More precisely, 30 workshops are designed (six workshops per region), and the aim of each workshop is not highly specified during the conceptualization phase of the project. Instead, it is co-created during the project's research activities with project partners and stakeholders, providing ample room for exploration, albeit within the structure imposed by the project scope and technology. Specifically, the technology, in the initial phases of the project, was at a low Technology Readiness Level (TRL) (European Commission, 2017) of approximately 4, and aimed to reach a pilot level (TRL approximately 6) by the project's conclusion. As the technology improves during project research activities, market development research in an MA setting is organized, facing great uncertainty in terms of economic and social assessments. Although workshops may vary in enactment across different regions, one could argue that the technology in the project was perceived more as an idea by stakeholders rather than a final scalable technology, thus allowing a great room for their imaginations and influencing their commitments.

Figure 1. - Effectual process described and made by Read & Sarasvathy (2005).



Data collection and analysis. The analysis relies on three main sources of data: (1) Observational data (gathered from participation in project meetings, stakeholder workshops, one-to-one interactions, etc.), (2) (semi-structured) Interview data (12 have been conducted; eight internally within the project and four externally for external validity reasons), and (3) Secondary data (EU Commission documents, reports, etc.). Regarding data analysis we use open coding to broader aggregated dimensions (Glaser & Strauss, 2017). Our aim is to capture the complexity of the project and its environment, which could influence effectual reasoning, as well as other factors such as individual partners' interests (i.e., mindsets and goals), roles (power dynamics), project structural complexity, regional specificity, technological innovation status, and the constellation of stakeholders (e.g., experts, researchers, advisers, firms, etc.).

Findings

Results indicate that two mindsets coexist within the project consortium: entrepreneurial thinking (effectual reasoning), and managerial thinking (causal reasoning; i.e. sticking to the grant agreement). Furthermore, we observed that involving stakeholders in co-creative processes had a significant impact on promoting effectual thinking, leading to unanticipated outcomes. This was visible especially in the case of two regions in Colombia and France in the case of H2020RUSTICA project. More precisely, the French region stakeholders saw a great interest in the by-product (i.e. liquid bio-based fertilizer), which was beyond the focus of H2020RUSTICA, and the Colombian region showed a great interest in the pre-step of the technology (i.e. focus on compost), therefore not in the scope of the project. Both needs were accommodated. However, for such needs to be addresses and arguably unanticipated outcomes being resulted, the project consortia and structure played an important role. Below we elaborate on the dynamics and role of different entities.

Project coordination role and predominant mindset. Arguably, the project coordinator team played a significant role in H2020RUSTICA. With their experience in European MA projects, the coordination team believed in a market-driven approach and engaging with stakeholders. If a need arose, they made efforts to accommodate it to the best of their ability. One of the members of the coordination team even criticized the lack of market orientation in the EU policy and the way EU policy and project officers see the project implementation and how they are disconnected from the day-to-day implementation of EU projects.

[...] It was once believed that universities remained isolated in their ivory towers, disconnected from practical realities. However, I would challenge this. Nowadays, it seems that those in Brussels are the ones residing in ivory towers, lacking insight into on-the-ground realities and the needs of stakeholders, as well as what they can do [interview with a member project coordination team].

We argue that the project coordination team, while being cautious about what the project can offer, followed effectual reasoning. They conducted a series of dialogues with project partners, who were able to carry out additional assessments and processes, and, where necessary and possible, reallocated budgets and made amendments to the project's grant agreement.

Uncertainties, stakeholder involvement changes. We identified both positive and negative effects of uncertainties on stakeholder involvement. On one hand, the project solution, being at a low TRL, framed it more as an idea than a feasible solution. This was evident as, many times during workshops, project partners were unable to fully address questions regarding costs, efficiencies, and viabilities.

[...] Our workshops were successful, but at times, it felt challenging to keep stakeholders engaged. The project outcomes and what we could actually deliver were unclear. There was limited knowledge about the technology. [interview with the responsible researcher for Friuli-Venezia Giulia, Italy]

On the other hand, in some cases, uncertainties enhanced stakeholder involvement. More precisely, the project solution not being fixed allowed some stakeholders to flexibly position themselves within the project and discern potential benefits. In some instances, while attempting to understand the research process, stakeholders realized that their needs could be connected, albeit beyond the main focus of the project, leading them to raise their voices.

[...] During the workshop, we presented that our focus is solid fertilizer. However, during the process, we ended up producing some liquids as well. There was a stakeholder, [name mentioned], who pointed out that this liquid is nutritional and could be utilized. And now they are extremely engaged and we should not lose this opportunity

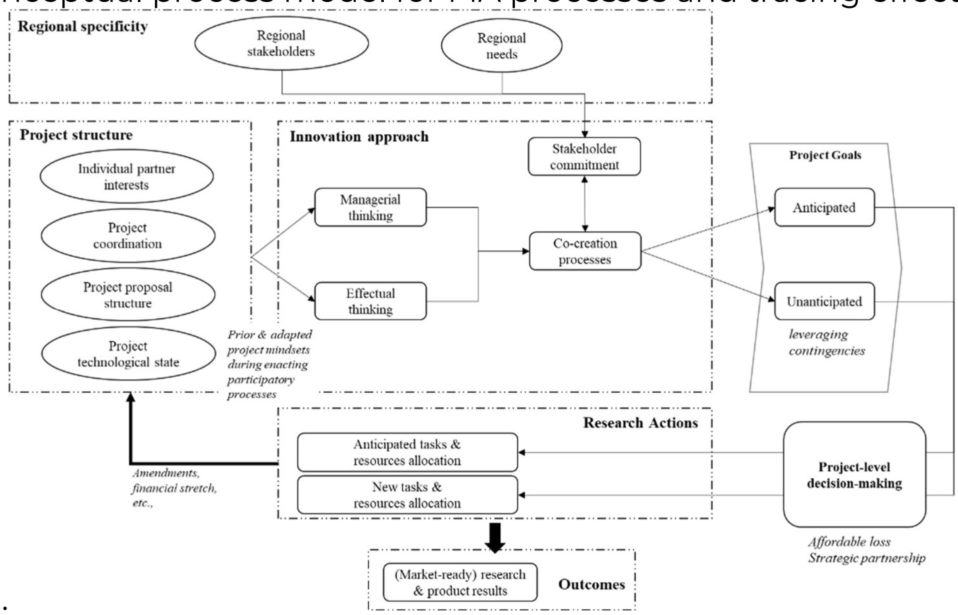
[reconstructed from the meeting notes with the responsible research for Pays de la Loire, France]

Project consortium predominant structure and mindsets. We observed that the predominant mindset of individuals involved in the project also played a significant role in how project solutions evolve. Some individuals possess a stakeholder-driven (i.e., client-oriented) mindset, while others lean towards academic-oriented mindsets.

[...] What I see now is two groups, almost like researchers versus businesses. What is our ultimate goal here? Do we aim to develop tangible solutions with viable business models that can be quickly implemented by the market? Or is our focus more on producing a proof of concept and signaling a future where circularity can be achieved in our way? [reconstructed from a work package meeting related to market developments]

Given such diversity and competing mindsets, the project coordination team found itself in a challenging position. They needed to balance and align the views of the consortium, dedicating a number of meetings to specific sessions on project expectations. Thanks to the structure of the project, which spans multiple regions, the competing mindsets appear to be accommodated in different areas. For example, in the Belgian, Italian, and Spanish regions, a more proof-of-concept approach (arguably based on managerial planning according to the grant agreement) was adopted, whereas in the French and Colombian regions, a more effectual approach and market orientation were embraced. This approach mitigated the risk of the project being seen as out of its scope while also allowing for the development of market-ready solutions. Altogether, Figure 2 summarizes the conceptual model addressing effectual reasoning within MA projects.

Figure 2. Conceptual process model for MA processes and tracing effectual thinking.



Practical Implications

Through this case, beside the managerial approaches, our preliminary results emphasize the importance of adopting an entrepreneurial mindset in MA processes. Such approaches should be considered during the project proposal stage or even when initially drafting the call for proposals to ensure a quick adoption of project solutions in the market, while also adding nuanced insights into their potential benefits.

Furthermore, we showed that if the project's objective is to also deliver solutions, which might be unanticipated and can be readily embraced by stakeholders, active engagement with a group of regional stakeholders becomes essential, following an effectual reasoning approach. This engagement serves not only to identify their needs but also to offer them solutions leveraging the project's available resources. This, in turn, requires flexibility within the project, encompassing mindsets, budgets, and resource allocation. As pointed out by our external interviewees, we also acknowledge that there might be some risks of "deviation from social missions", "becoming less inclusive", and "serving only those seeking profits". Therefore, we emphasize the importance of incorporating a social entrepreneurship approach alongside effectual reasoning rather than solely focusing on market-ready results.

Theoretical Implications

Even though non-linearity is acknowledged in the literature as central to co-creative innovative processes (Frow et al., 2015), the change in target objectives appears to be overlooked, with most literature focused on improving this non-linear process. In other words, it seems that MA project assumptions assume fixed initial and final points, with the process itself deemed non-linear, reflecting a managerial and fixed-planning mindset. This research challenges this perspective by advancing the theorization of changes in project targets through effectual reasoning and stakeholder engagement.

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The reflective learning methodology: lessons learned from the MIXED project

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Abstract:
Scholars agree that evaluation of participatory action research is inherently valuable; however there have been few attempts at evaluating across methods and across interventions because the perceived success of a method is affected by context, researcher skills and the participants' aims. This paper describes the systematic evaluation of the application of Moschitz and Home's (2014) reflective learning methodology to a Horizon Europe project titled MIXED: Multi-actor and transdisciplinary development of efficient and resilient MIXED farming and agroforestry systems. A list of questions was distributed to project partners to gather their experiences with the methodology. The responses were analysed according to their content. The results indicated that the usefulness of the methodology was hindered by the heterogeneity of the cases in the project that led to them having few challenges in common so that solutions were not easily transferrable. Faced with this barrier, the participants in the MIXED project formed subgroups that consisted of cases that did have thematic overlaps. These results suggest that researchers intending to apply the reflective learning methodology should carefully consider whether the cases they want to include are sufficiently similar for the methodology to produce useful interactions that lead to co-learning and co-creation of knowledge.
Keywords: Mixed farms; Reflective learning methodology:

Purpose

The application of the reflective learning methodology that is the focus of this study was in the context of the Horizon Europe project: MIXED- Multi-actor and transdisciplinary development of efficient and resilient MIXED farming and agroforestry systems. MIXED has to goal of finding ways to support the development of European mixed farming and agroforestry systems that optimize efficiency and resource use, reduce GHG emissions, and show greater resilience to climate change by considering agronomic, technical, environmental, economic, institutional, infrastructure and social advantages and constraints. Systems such as different forms of organic and non-organic agroforestry, land/manure/nutrients as well as grazing exchange between arable and livestock farmers, (re)wetting of arable land in livestock arable land exchange, and agri-tourism are all represented in the MIXED networks.
In a pan-European project such as MIXED, a transdisciplinary approach challenges researchers with the need to upscale the research experiences from different local

contexts (in our case, experiences from mixed farming system case studies) and integrate them into an overall understanding of mixed farming processes at the European level. The reflective learning methodology was developed during the FP7 research project SOLINSA and proved to be an effective way of organising multi-actor transdisciplinary research within the confines of externally funded research (Moschitz and Home, 2014). The methodology provided a way of assuring project funders that it would produce useful results, while allowing the freedom to co-develop both research questions and choose specific methods, which are inherent to the co-creation of knowledge in transdisciplinary research. However, following the success of the methodology in SOLINSA, it has not been sufficiently evaluated in other multi-actor transdisciplinary research projects. The aim of this contribution is to reflect on the application of the reflective learning methodology in other transdisciplinary research contexts.

The Reflective Learning Methodology includes two spaces where learning takes place. On the local level, learning took place in the field, where knowledge is co-produced between (innovator) stakeholders (in this case, the members of the participating mixed farming networks) and the MIXED researchers. On the project level, the MIXED researchers met in reflection workshops to develop the approach and to reflect on the outcomes of its application. These processes are interlinked: The outcomes of the reflection workshops fed into the field work in the form of suggested methods, and an initial set of research questions. Reports on the results of the field work contained a reflection on the methods that were applied, responses to the research questions, and feedback to adapt the research agenda according to the needs of the participating networks. The recurring reflective processes that flowed through the research project thus made the learning and research agendas profoundly dynamic and included ongoing monitoring. The iterative process of the application of the multi actor reflective learning methodology is shown graphically in Figure 1, to illustrate the procedure. Field workshops (FW) at the regional/country/network level address specific challenges (including technical, environmental, labour and gender issues), which provide the material for reflection workshops (RW) at the theme level which allows sharing of innovative solutions across networks within the theme.

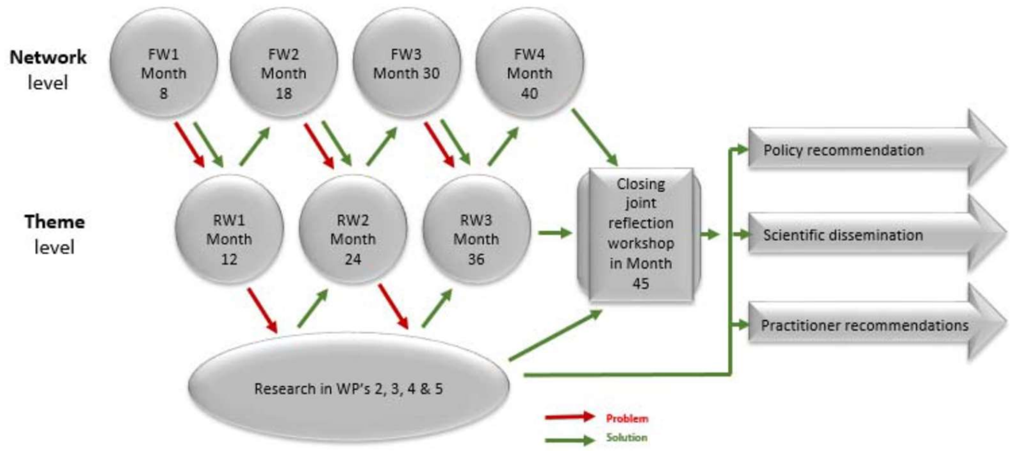

Figure 1: MIXED co-learning process. Alternating field workshops (FW) and reflection workshops (RW), along with the further project work, lead to the development of recommendations to practitioners and policy makers as well as the scientific dissemination.

Design/Methodology/Approach

To address the aim of this contribution: namely to evaluate the usefulness and applicability of the reflective learning methodology, a learning-oriented evaluation (Horton et al. 2010) was adapted to the MIXED project. Included in the concept of an action research project, all partners, including non-scientific participants should be involved in the formulation of research questions along with design of the methodology used to answer them. In practice, this means that the researchers and participants had freedom to co-design their interactions, which we describe under the umbrella term as 'field workshops'. The heterogeneity of the co-designed methodology is inherently problematic for evaluation because of the need to compare the different processes. The solution to enable comparability while providing sufficient scope to maintain relevance to the responding networks was to provide a selection of questions to be answered. In line with the principles of transdisciplinary research (Home & Rump, 2015), the researchers and participants negotiated and co-created the methods for answering these questions.

A concept was developed using the theory presented by Midgley et al. (2007), which was used to create an evaluation instrument with a list of questions that were applicable to the evaluation of the interactions between academic and practice partners and the outcomes of these interactions. To this end, Home and Rump's (2015) interpretation of Midgley et al.'s (2007) quantitative questions were collaboratively adapted by the researchers to reduce them to their base concepts so that each researcher could conduct a qualitative but structured self-evaluation of their action research. The researchers had the task of providing responses in written text form, which were then analysed according to their content. The final evaluation instrument consisted of the following questions:

1. Please outline your understanding of the logic behind the reflective learning methodology (the alternating field workshops and reflection workshops)?
2. Did you benefit from participation in the reflective learning methodology? If 'Yes', how did you benefit? If 'No', can you please elaborate on why you did not.
3. How has the network changed since the beginning of the project? Which changes/effects were only possible because of the interactive approach of the collaboration with MIXED?
4. How do you feel that the interactions with your farmer network were going? What were the conditions that supported, or hindered, successful participatory research in your network?
5. Did the field workshops give you enough freedom to express your needs?
6. Do you feel that the farmer network had ownership of the process, the results and the outcomes of the project?
7. Do you feel that you actively co-created knowledge in the project? Do you have the impression that the scientific work in the project was matched with the practical, real-world needs of the farmers?

8. Did your network receive inputs from other networks? Were these inputs interesting for your networks?
9. Did your network receive inputs from the science part of the project? Were these inputs interesting for your networks?
10. What advice would you give to researchers or innovation brokers who would engage in future research projects involving participatory processes?

Findings

While it appears that the methodology is useful for encouraging reflection about the research process, three main challenges were identified:

The usefulness of the methodology in cross case study comparison is challenged if cases are sufficiently different that the problems that they face also too different for any useful sharing of knowledge. The outcome of this, in MIXED, is that similar projects tended to cluster into spontaneously formed thematic groups during reflection workshops and share their co-created knowledge, but with little exchange between clusters.

A further challenge was related to the importance of gaining early momentum in the collaboration with the case networks and maintaining that throughout the process. Although at least part of this challenge can be traced to the COVID pandemic (the project started in 2020), there were still expressions of frustration that network members did not feel engaged in the project. Several partners reported that engagement only become strong when co-designed experiments had been implemented and participants could see evidence of concrete and useful results. This affected the cross-network learning, as many of those at the network level could not see the broader picture.

A broad geographical distribution of case study initiatives can cause logistical challenges. In the MIXED project, farming system network clusters were widely dispersed across Europe, which meant, despite significant effort, it was difficult to arrange exchange visit opportunities. Some farmers would have needed to spend four to five days off the farm to attend an exchange visit, which is simply not feasible for many farmers.

On the positive side, where reciprocal field visits were able to take place, participants placed great value on them and they were perceived as useful: even when the networks were engaging in quite different farming practices. Furthermore, participating farmers appreciated the opportunity to participate in the design of on-field experiments, and occasionally insisted on trials that researchers were reluctant to conduct.

In summary, the reflective learning methodology appears to be suitable for application when the units of study are likely to share many problems or challenges, so that solutions to a particular challenge in a particular context are relevant to other participants. As this was not the case in the MIXED project, participants in the reflection workshops struggled to find common ground and tended to form subgroups that did have overlaps in the challenges they faced

Implications

In cases in which an overlap of challenges faced by the participating networks was found, the reflective learning methodology proved to be a powerful tool for knowledge co-creation. The lessons learned from the MIXED experience of the reflective learning methodology do not challenge the value of the methodology, but rather identify some limitations. Researchers intending to apply the methodology in multi-actor projects should carefully consider whether their units of study are sufficiently homogenous for the methodology to produce useful interactions. The sufficiency of homogeneity is, however, subjective, so it will depend upon a judgement call of the research team designing a project whether Moschitz and Home's (2014) reflective learning methodology is an appropriate instrument to encourage co-learning and co-creation of knowledge.

The results suggest the value of efforts by researchers applying this methodology to take steps to actively motivate engagement by the researchers to overcome other limitations of the methodology. Indeed, even when the network case studies were apparently heterogeneous, researchers and participants from individual networks were still able to find common ground, and thereby co-create knowledge. One of the barriers to engagement at the beginning of the project was unfamiliarity of the researchers with the methodology and inexperience with facilitation. For this reason, a useful early step is to conduct training in facilitation, which can be supplemented by applying participatory methodologies during the reflection workshops: thereby giving researchers direct experience of using methods similar to those they will apply in the field workshops.

In any case, for projects in which the methodology is applied, we recommend building exchange visits into the project design (and budget), including on farm experimentation at the network level, and establishing exchanges towards real and practical challenges as early as possible. With these activities in place, the methodology has the potential to encourage co-creation of knowledge: even in multi-stakeholder projects with very different cases.

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Capitalizing on farmers' experiences of integrated crop-livestock systems: insights from the sociology of translation

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Abstract:
Conceiving a complementary relationship between crops and livestock is an agroecological challenge in the French department of Aude. Deploying this practice involves capitalizing on and disseminating what works. Drawing on actor-network theory and the concept of translation developed by Callon and Latour, we show how capitalizing on farmers' experiences helps establish a multi-actor network (farmers, advisors, government officials, researchers, etc.) and contributes to the construction of new and more sustainable agricultural models.

Keywords: actor-network theory, agroecology, facilitation, innovation support services, local knowledge

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Purpose

In France, agroecology is now institutionalized (Wezel et al, 2020). Putting the notion of agroecology on the political agenda contributes to the recognition of bottom-up innovation (Compagnone et al, 2018). This recognition of the ability of local actors to innovate is reflected in a financial support scheme dedicated to groups of farmers. Support to bottom-up innovation initiatives also contributes to recognizing the ability of local stakeholders to generate new knowledge that could be useful to others (Salembier et al, 2021). The problem is to make this local knowledge available to others in different contexts (Girard, 2014). Thus, agricultural development organizations are being reorganized to stimulate local innovation networks and make the knowledge they produce accessible.

In France, Chambers of Agriculture are responsible for coordinating the capitalization of experience gained by farmer groups and more broadly, innovative projects supported by public funding. New innovation support services have been created for this purpose. The stated aim of capitalization is to ensure that the knowledge generated within situated innovation networks is exported to other places, so that agroecological practices can be deployed more widely. In other words, the idea is to accelerate the scaling out of agroecological practices based on the farmer's innovations and to encourage as many farmers as possible to adopt agroecological practices that have proven successful under real production conditions (MAAF, 2016).

For agricultural advisors, this involves relying on farmers' practices to support others. While this entails complex tasks in examining these practices (Doré et al, 2011; Salembier et al, 2021), little is known about the role that capitalization processes and associated outputs (cognitive resources) play in driving change (Girard, 2014; Quinio, 2022). In this paper, we explore the links between capitalization of experiential knowledge, the structuring of stakeholder networks and the development of innovative integrated crop-livestock systems in the department of Aude, Occitanie, France.

Design/Methodology/Approach

A research-intervention that examines the link between knowledge based on practice, networking and the scaling-out of agro-ecological practices

Our approach is based on the empirical analysis of a group of agricultural advisors from a Chamber of agriculture dedicated to working together on integrated crop-livestock systems, bringing together specialized advisors (livestock advisors, crop advisors, viticulture advisors) and generalist ones (territory facilitators, innovation broker/researcher). This is a collective where experiences of farmers and breeders experimenting with the integration of animals and plants into their production systems are exchanged and capitalized. For the members of this group, it represents a resource space aimed at exploring the possibilities for integrated crop-livestock initiatives in the Aude territory. By participating in the design of this group from its inception, we have built a research-action framework conducive to the analysis of actor networks in the deployment of integrated crop-livestock systems in Aude, Occitanie, France.

Integrated crop-livestock systems in the department of Aude, Occitanie, France

Located between two mountain ranges, the Black Mountain to the North and the Pyrenees to the South, and subject to Mediterranean and Atlantic influences, the department of Aude is often considered a "small France" with the same diversity of agricultural productions. However, this diversity in the territory does not necessarily produce synergies between productions, and furthermore, territories are identified as each having their flagship production: arable crops to the West (Lauragais), livestock farming to the North and South (Montagne noire, Pyrénées), viticulture in the central plains and East of the department (Carcassonnais, Narbonnais). With the deployment of agro-ecological agriculture, the lever of coupling between animal and plant productions is gaining momentum. With numerous agronomic, social, economic, and environmental benefits, integrated crop-livestock systems oppose this trend towards territorial specialization and intervene in a context where the diversification of production systems is a real challenge to succeed in agro-ecological transition. While the reintroduction of livestock into specialized crop systems can occur at the scale of the farm or at the territorial scale, the sustainability of complementarities between animal and plant relies, albeit not exhaustively, on new work organizations, the structuring of adapted sectors, or the implementation of partnerships between breeders and farmers (Asai et al., 2018).

Interpretative framework

In situations of innovation, the notion of socio-technical network (Callon, 1986; Latour, 1992) emerges as central to explain the production and diffusion of new objects (knowledge, innovative practices…). According to this approach, human actors bring non-human actors such as instruments enabling the structuration of the network through different stages of translations (problematization, engagement, mobilization, enrollment). Through these processes, adjustments between actors are required to define their role in the broader innovation process. Our study applies this actor-network theory to analyze the role of processes of capitalization of farmers' experience in the development of an innovation network around new systems and practices integrating crop-livestock interactions. We aim to describe the processes by which farmers' situated experiences are capitalized by advisors and analyze the role of capitalization products in strengthening the innovation network. By focusing on the "spaces" and the various "objects" mobilized by advisors (Thèvenot, 1986; Callon & Law, 1988; Star & Griesemer, 1989), we seek to identify the different translations that contribute to the structuring of the network (Callon, 1986).

Research approach

Our research work has thus consisted of conducting ethnographic observations of the working group meetings to analyze the objects mobilized and exchanged by advisors to account for field experiences and support them. The group meets every three months, allowing us to follow the evolution of experiences at regular intervals and keep track of what happens outside the group. As facilitators of the group, we adopt a research-intervention posture combined with a position of observation of encounters happening outside the group between development agents, farmers, and breeders. This allows us to collect data from their origin and appreciate their evolution as soon as they are shared within the group. This study is still ongoing and is based on an inductive analysis of various documents produced by the group and material from our participant observations, similar to analytical frameworks of grounded theory (Blais & Martineau, 2006; Langley, 1999).

Findings

Objectifying practices

Problematization and background information

In the Aude department, the working group on crop-livestock interactions was formed from an initial problem formulated and taken on by a small number of local actors: cooperative wineries, local authorities, sheep farmers, agricultural and rural development organizations such as the local Chamber of Agriculture. On the one hand, wine cooperatives are going through a crisis in viticulture, and are looking for new ways to produce and promote their products. By integrating animals into vineyards, wine makers seek to reduce chemical weeding and enhance the marketing of their bottles. On the other hand, livestock farmers are facing yield losses due to climate change and are looking for fodder to feed their herds. In this context, some winegrowers and livestock breeders have launched initiatives to integrate animals into vineyards. Since then, the Chamber of Agriculture has been increasingly questioned by local actors who are also seeking to create synergies between animal and plant production. The working group was formed in response to these numerous requests from stakeholders on the field. Within the group, the central object involved in problematization and networking therefore focuses on the possibility of integrating animals into specialized cropping systems. Initially, the questioning from advisors within the group is posed in this manner: *under what conditions should the practices of crop-livestock integration be promoted and supported?*

Devices to promote crop-livestock integration

These devices enable different forms of translations. Within this group, the ongoing initiatives are described and debated in light of other experiences and knowledge from external sources (scientific and grey literature, testimonies from colleagues and R&D projects from other areas in France…). Feedback from experiences are formalized. Reports of discussions and farm portraits are made and archived internally. Most of the experiences involve grazing in vineyards in the central and eastern parts of Aude. While the advantages and drawbacks for grape growers are discussed, the ability of vineyard spaces to provide quality and sufficient fodder is questioned by livestock advisors. Livestock advisors mention the possibility of creating partnerships between livestock breeders and cereal producers of the western part of the department. This new option directs the reflection towards integrating animals within specialized cropping systems: the crop-livestock interactions no longer only involve grazing in vineyards but also grazing in arable crop fields. Within the group, new issues and inquiries emerge regarding the possibility of integrating animals into specialized cropping systems. Alongside the initial issue of feasibility, the problem of the ability of livestock breeders and cereal producers to establish connections and form partnerships is added. Therefore, the central question for the group becomes: *how to structure sustainable partnerships between livestock breeders and cereal producers*?

Recruiting new stakeholders

Proving it is possible

The question of partnerships brings operational sub-questions with legal and regulatory implications to the forefront: to what extent is it possible to move animals? How to declare the request for CAP subsidies? What commitments must be made and what needs to be compensated? Should agreements be written or oral? Recruiting a new actor into the network seems inevitable to address these questions. The departmental services of the State are invited in the fall of 2023 to the premises of the Chamber of Agriculture. The request is clear: what can be done to ensure that these synergies are allowed without fear of breaching current regulations? An item is proposed to formalize the request and keep track of the response provided by the State services. A "regulatory note" is thus drafted following this meeting by the Chamber of Agriculture. While the content of the note may not entirely satisfy agricultural advisors, the item at least has the merit of engaging the stakeholders in a formal search for common information that secures their support activity for actors wishing to deploy crop-livestock interactions on a territorial scale.

The search for evidence that it is possible to establish crop-livestock interactions is carried out both in regulatory texts and in practice on the field. When livestock breeders in serious difficulty contact the Chamber of Agriculture to find forage areas, agricultural advisors see the opportunity to run a large-scale experiment. This is an opportunity for agricultural advisors to prove that grazing in specialized arable crops is possible. The challenge then lies in facilitating exchanges between livestock breeders and cereal producers to ensure that the mutual experience goes smoothly. Within the working group, the experience is shared and formalized. However, an outdoor laboratory is indeed located in the countryside of the western Aude region. The arrival of sheep on the plain has given rise to a number of problems, including the need to find new grazing land every day.

From practice-based evidence to evidence-based practice

The first organic cereal farmers to commit to hosting sheep flocks does not necessarily have enough land to offer breeders. So it is vital to find new organic pastureland and convince new cereal farmers to let ewes onto their plains. Recruitment works both ways. The sight of ewes on some neighboring plots has prompted new cereal growers to come and offer theirs. In addition, the breeders went door-to-door every day with the help of a local cereal grower. In the end, recruiting new cereal growers is not a problem. The running experiment is a kind of life-size demonstration that it is possible to graze on arable land. From an experiment to produce proof that it works, the initiative has become a piece of evidence in the service of promoting this practice, which the agricultural advisors quickly understood, and which they will use to extend the network and promote grazing in specialized cereal-growing areas.

Implications

The experiences of farmers integrating animals into specialized cropping systems act as incentive schemes. These schemes contribute to the creation of an internal working group at the Chamber of Agriculture, which can also be seen as a “translation center”. This first device is based on the negotiation of items regarded as essential to the progress of the working group, but more broadly to the innovation in question. The need for regulatory approval and agronomic objectification helped to attract the support of actors who did not necessarily work together (field crop advisors, livestock advisors, vineyard advisors, etc.) and to make contact with new stakeholders (government officials) to form a real network around innovative crop-livestock interactions. In this network, certain stakeholders play a key role, such as livestock advisors, constituting the essential nodes of the network. As soon as a new event hits the network, these actors become essential to driving innovation forward. While the working group was initially designed to objectify practices integrating animals into specialized cropping systems (what can be called a capitalization device), it simultaneously becomes an incentive device when breeders start grazing cereal fields. Alongside producing evidence that grazing in arable crops works, it promotes the practice and helps recruit new actors, both cereal producers and breeders, into the network.

In this case, farmers and their experiences play a central role in building and extending the network. These scattered experiences stimulate the formalization of a working group where new translations can easily be made, essential for advancing the network. The functioning of this group, based on the sharing of farmers’ experiences, facilitates back-and-forth between real-world events and reflection when discussed within the group. Local knowledge, derived from farmers' experiences in the area, is hybridized with exogenous knowledge from farmers outside the Aude region as well as scientific knowledge.

The initial translation, which involves objectifying practices, constitutes a test of ongoing experiences. This need for objectification leads to negotiation phases, aiming to test new objects requiring network expansion. Each phase of network expansion is a source of validation but also a threat to its relevance and sustainability. Indeed, the different phases we have identified bring about significant changes in the number of actors involved, their languages and belonging logic, and the links that unite them. It shifts negotiation locations and establishes new objects and power dynamics to manage. If not sufficiently gradual and respectful of the balance between openness and closure, this network complexification can threaten it. Proximity ties, which are essential for the trust necessary for network operation, can be broken by a scale change implemented too quickly.

In the current network, the question arises regarding network extension to new farmers, allowing for the deployment of integrated crop-livestock systems on one hand but potentially creating competition for land allocation, among other issues. This clearly demonstrates the essential role of agricultural advisors who must "deal with" potential new controversies to manage.

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CAPACITY DEVELOPMENT

Educating future researchers and rural advisors to support interactive innovations

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Abstract: This work discusses the results of two summer schools carried out in the framework of the I2CONNECT Horizon project[14] intended to enhance the capacity of future advisors (and researchers) to support interactive innovations. Trainees were involved in participatory learning regarding key concepts pertaining advisory work and interactive exercises using methodological tools aiming at the analysis and running of innovation networks. The analysis of evaluation data showed that the trainees enjoyed a dynamic and inspiring environment from which they benefited significantly; thus, they positively evaluated both summer schools, which in most cases exceeded their expectations. Such findings provide support for interactive training as a means of building capacity and encouraging positive attitudes towards interactive innovations. This further implies that the introduction of such professional capacity development courses into the university curricula of future advisors and researchers would enhance the design and implementation of interactive innovation projects.

Keywords: participatory training, methodological knowledge, advisor upskilling

Purpose

Interactive approaches of innovation are key elements of important EU policy interventions and initiatives, such as the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI), the Strategic Working Group on Agricultural Knowledge and Innovation Systems of the Standing Committee on Agricultural Research of the EU (SWG SCAR-AKIS) and Horizon 2020 projects. These approaches, which derive from the Agricultural Knowledge and Innovation Systems (AKIS) thinking, recognize that the actors involved in innovations are valuable sources of complementary knowledge, skills, and experiences; thus, their engagement in innovation networks throughout the entire innovation process is an essential condition for reaching sustainable solutions to complex problems. This implies the need to enrich the conventional advisory services with a new set of functions that enable them to act as Innovation Support Services coordinating social learning within innovation networks. Social learning is understood as "*a simultaneous*

[14] https://i2connect-h2020.eu/

process of both individual learning and interactive learning in a process of social change" (Knierim et al., 2020: 35). Respectively, capacity building is no longer perceived as a "*vehicle for results*" but as "*involving collective learning*" and facilitated "*adaptation to numerous opportunities and challenges*" enabling actors "*to build trust and take joint action*" (TAP, 2016). This further implies the need for upskilling advisors to meet the role of the co-learning facilitator, i.e. individuals who support actors involved in innovation networks in following and reflecting on innovation processes and building trust and consensus that enables learning. Neutrality, ensuring clarity of roles and communication skills are among the most important qualities of facilitators (ibid.), enabling them to effectively intermediate between "*the stakeholders along the value chains and at different territorial levels*" (Knierim et al., op. cit.).

Within this context, the i2connect project identified crucial concepts and modes of learning related to the qualification of advisors-as-facilitators engaged in interactive innovation (Hoffman et al, 2011; Hoffman et al, 2009), which, in turn, were utilized to design three summer schools over the period 2022-2024. A non-directive, participant and problem-solving-oriented training approach was adopted to support trainees in their own learning about concepts and methodological tools for interactive innovation. The purpose of this work is to present how the participants in the first two summer schools experienced and evaluated their training, with the aim of facilitating similar future efforts.

Design/Methodology /Approach

The two summer schools this work deals with were organized by the Agricultural University of Athens (AUA) and the University of Hohenheim (UHOH). Responding to open calls published in early 2022 and 2023, 26 MSc and PhD students from all over Europe attended each of the summer schools; each school was facilitated by a team of four trainers/facilitators (different in each summer school). Each summer school was carried out in 3 stages: a two-hour introductory online meeting, a four or five full days course with physical presence and a two -hour follow-up online meeting. The kick-off online meetings aimed at familiarizing participants with each other as well as the objectives, the structure, and the basic concepts of the training; students were assigned with the task to study an interactive project from their country (Zarokosta & Koutsouris, 2024).

The face-to-face courses took place from the afternoon of the 23rd till the noon of the 29th of July 2022 at the Mediterranean Agronomic Institute of Chania (MAICH) and from the 11th till the 15th of September 2023 at the University of Hohenheim (UHOH). The duration of the second course was extended to five full days, following the recommendation of the trainees who participated in first course to dedicate more time to the training activities - without changing the syllabus (Table 1). The courses covered basic concepts and a variety of interactive exercises and methodological tools to sensitize trainees about the roles undertaken and the competencies needed for successfully delivering interactive advisory services (Wielinga and Sjoerd, 2020).

Table 1: Overview of the structure and topics covered in the 2nd Summer School in UHOH

	Monday	Tuesday	Wednesday	Thursday	Friday
Morning sessions	• Introduction Overview • Rules • Exercises	• Practical case • Tasks & competencies of advisors • Communication exercises	• The role of advisors in innovation process	• Debriefing of field visit & conclusion • Introduction to facilitation	• Facilitation - feedback • Networking
After-noon Sessions	• Types of advisory approaches • The AKIS concept & exercise	• Spiral of innovation • Analysis of participants' cases	• Farm visits -Preparation -Field trip	• Facilitation exercise -Preparation -Conducting a facilitation event	• My own role as an advisor • Energy timeline • Evaluation • Next steps

At the end of the courses the trainees filled in a questionnaire comprising 34 Likert-type questions (which were analysed using descriptive statistics) and 4 open questions, regarding the best and the most difficult aspects of the training as well as their feedback and suggestions for improvements. In the follow-up online meetings (carried out on November the 2nd, 2022 and November the 30th, 2023) the trainees had the opportunity to reflect on their learnings and the tools they had put in practice after the course as well as to further strengthened their networks.

Findings

The quantitative analysis of the questionnaires shows that the answers provided by the trainees in Chania were in general more homogenous than those of their colleagues in UHOH (nine questions with coefficient of variation cv ≤10 in Chania against five questions in UHOH) (Table 2). The answers of trainees in both schools almost coincide as regards their peer-to-peer cooperation along with the knowledge and the ability of trainers/facilitators to support them and create conducive working environment during the training. On the other hand, the most heterogenous findings concern participants' views about the length of the training and their fatigue during farm visits.

According to the quantitative evaluation, both summer schools were found to be well planned and organized, exceeding most trainees' expectations, and thus rated ('overall impression') them 'very high'. The trainees agreed on the usefulness of the training, claiming that the schools motivated them to pursue further learning. Particularly enthusiastic were the trainees in UHOH with the cross visits in comparison to the trainees in Chania (Means Difference: 0.76). Nevertheless, UHOH trainees appeared less confident than their colleagues in Chania about their own ability to support interactive innovations using the methodological tools they were taught (MD: 0.54). Moreover, UHOH trainees appeared more reluctant than their colleagues in Chania to agree on the extent to which the objectives of the training were met (MD: 0.59) and the adaptation of the training to their own knowledge and skills (MD: 0.88). In addition, the trainees in UHOH were less persuaded about the ability of their trainers/ facilitators to explain concepts and tools.

The answers provided by the trainees in UHOH to the qualitative questions confirmed their overall satisfaction, adding on the enthusiastic feedback of the trainees in Chania, particularly regarding the group activities and the dynamic and inspiring environment they enjoyed (Zarokosta and Koutsouris 2024). More specifically, among the elements that satisfied the trainees in UHOH the most was the opportunity of "*meeting new people*" and "*working with people from different countries and backgrounds"* as well as the interesting topics, the farm visit and *"the variety of methods"* and specific tools, such as "*the circle of coherence*", helping them "*...to understand others and communicate more efficiently*". Other trainees underlined the *"team work" and "interactivity"*, with one trainee pointing out that: "*I loved how interactive and diverse it was, that we always did something physical too. It made it more colourful*".

The feedback provided by the UHOH trainees reflects the same willingness to "learn more" that was expressed by the trainees in Chania (ibid.). Their comments focus on their "learning [experience, which was] beyond expectation about participatory processes" since "everything stimulated me to grow and reflect", providing them with "much room to grow both professionally and personally". Some participants felt particularly aware of the concept of co-creation and "the importance of making sure that the [meaning of a] message [is] well transmitted" to interlocutors. As one trainee pointed out, the course helped them "clarifying theoretical concepts....to see my weaknesses and what to do to overcome them", while others felt inspired "to improve the skills that are important for life", recognized "big improvement [of] my knowledge and ...skills" and felt "very motivated to take next steps". This was particularly true for trainees who were not professionally oriented to advisory services, with one of them saying: "Having no background about the advising subject, it was all new for me and really want to find a chance to apply them". However, the feedback was not always positive as regards the working environment and the support provided by the trainers, with one trainee noting that: "I felt not ideally supported in my respective learning process" during the course.

Table 2: Main features of the trainee questionnaire and evaluation results

Evaluation (1: totally unsatisfied to 5: totally satisfied)	**No of Answers MAICH / UHOH**	**Average score**		**Standard Deviation**		**Coefficient of variation**	
		MAICH	**UHOH**	**MAICH**	**UHOH**	**MAICH**	**UHOH**
The training was well planned and organized	23/24	4.70	4.58	0.5	0.6	10	12
The objectives were clearly defined from the beginning	24/24	4.08	4.04	0.9	1.0	22	25
The objectives of the training were met	24/24	4.63	4.04	0.6	0.7	12	18
The length of training was sufficient	24/24	4.00	3.75	0.9	1.1	22	30

The length of training was too long	24/24	1.54	1.88	0.8	1.0	53	54
The training met my expectations	24/24	4.33	4.04	0.8	0.8	18	20
The training exceeded my expectation	23/23	4.22	3.35	1.1	1.0	26	31
The training was useful to my professional growth	24/24	4.42	4.33	0.8	0.7	18	17
The training was adjusted to my current capabilities	23/24	4.09	3.21	0.9	1.2	22	36
The teaching aids used during the training were helpful	23/24	4.74	4.58	0.5	0.5	11	11
The content of the training was problem-oriented	24/23	3.63	3.35	1.1	0.9	32	27
The method of training made it easy for me to understand the use of tools	24/24	4.46	4.21	0.7	0.7	16	17
I feel more confident to use various tools to support interactive innovation	24/24	4.54	4.00	0.6	0.9	14	22
The content of the training was quite comprehensive	23/24	4.17	4.13	1.0	0.7	25	18
The webinar was useful to me	23/24	3.61	3.50	1.2	1.0	32	29
The interaction with peers & facilitators increased my collaborative attitude	23/24	4.83	4.58	0.4	0.5	8	11
The training increased my motivation to pursue further learning	23/24	4.65	4.58	0.6	0.5	12	11
The farm visit was useful	23/24	3.87	4.63	1.2	0.6	30	12
The training facilities were adequate and comfortable	23/24	4.65	4.42	0.6	0.9	12	20
Access to the webinar was easy	23/24	4.61	4.79	0.9	0.4	20	8

Travel to Chania/Stuttgart was rather easy	23/22	4.17	4.27	0.8	1.1	20	26
Accommodation was OK with me	23/21	4.61	4.52	0.6	0.7	12	14
The infrastructure / facilities in MAICH/UHOH were fine	23/24	4.57	4.58	0.7	0.6	16	14
The farm visit was tiresome	22/22	2.23	2.32	1.2	1.6	54	68
The facilitators were knowledgeable about the training topic.	23/24	4.65	4.71	0.5	0.5	10	10
The facilitators encouraged participation and interaction	23/24	4.91	4.75	0.3	0.5	6	11
The facilitators had the ability to explain concepts and tools clearly	23/24	4.35	3.79	0.7	0.8	16	20
The facilitators were supportive and eager to help me when needed	23/24	4.91	4.79	0.3	0.4	6	8
The facilitators created a constructive working atmosphere	23/24	4.91	4.83	0.3	0.4	6	8
I have had a good cooperation with the facilitators	23/24	4.78	4.79	0.4	0.6	9	12
Adequate knowledge and experience were shared with my peers	24/24	4.46	4.38	0.6	0.6	14	13
I had good cooperation with my peers	24/24	4.75	4.75	0.4	0.4	9	9
Involving people with different backgrounds was key for the training effectiveness	24/23	4.67	4.42	0.6	1.0	12	23
OVERALL IMPRESSION (1= poor. 2= satisfactory. 3=good. 4=very good)	24/24	3.83	3.52	0.4	0.7	10	18

In line with the recommendations of their colleagues in the previous summer school, the trainees in UHOH underscored the time limitations, suggesting to the trainers in the next Summer School in Ireland to "be less ambitious with time", adding that "we would have learned more if we would have done less activities but devoting more time to each of them". Their recommendations mainly point to the need to spend more time on "real examples" of advisory work, on explaining concepts and theory and providing "designed presentation[s] about the topics" as well as on more feedback after the completion of tasks since, as one said: "I do not know if what I did in the tasks [was] right or wrong". Furthermore, one trainee wondered if "facilitation is the best way to conduct… [training] where new ideas are so important", given that "in facilitation not a lot of info[rmation] comes from the facilitator, only the attending members' ideas are shared".

The first follow up online meeting after the summer school course in Chania demonstrated the sustained feelings of happiness and excitement among the trainees, who referred to communication skills, particularly active listening, better understanding of networking and exercising patience and self-confidence among their most prominent 'learnings/gains', which they had also put into practice. In the same vein, the trainees in UHOH, apart from their improved "overview about advising and mediation", reported a better "understanding of other people" and the "social dynamics" and improved awareness of the communication skills that together with "a lot of patience and practice" are required "in a complex process". Trainees noted that co-creation is more effective than the transfer of knowledge, that the training improved their presentation skills and that some of them had started exercising facilitation techniques in class and offering tutorial to fellow students. Indicative of their feelings are their comments that they felt "less scared of *asking questions*" and "*more comfortable in facilitating meetings*".

Practical Implications

This work shows the effectiveness of interactive training in fostering skills and attitudes enabling interactive innovation. The available empirical evidence from the two i2connect summer schools shows that even a short but intense training course can broaden the horizons of future advisors and researchers and enhance their awareness, understandings and capability of being actively engaged in and facilitating multi-actor processes. The findings highlight the need for changes in the traditional Higher agronomic education; they indicate the potential benefits when integrating communication and facilitation – networking exercises/practice as well as methodological knowledge about developing and facilitating interactive processes into university curricula. This type of knowledge and skills is useful to researchers as well, especially those involved in interactive projects (such as EIP-AGRI).

Theoretical Implications

This article adds empirical evidence on the value of interactive learning/methods vs. ex-cathedra instruction, especially with regard to future rural advisors and researchers and the need to develop new roles, knowledge and competencies to foster sustainable innovation within multi-actor settings.

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The Italian Education Project Rural4University: Development and Evaluation of a Service-Learning Model

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Abstract:

Despite the first step toward institutionalization of Service Learning (SL) in European Higher education, more attention needs to be placed on feedback process, by assessing the experience of students and other actors that participate in SL education programs. To fill this gap, the current paper explores the Rural for University (R4U) experiential learning to evaluate if the project is successful in providing both learning opportunity for students and benefits for the community. The findings are presented according to two macro-areas: the first explores the reasons for universities to support SL in the development of students' soft skills (social, methodological, and digital skills), by analysing the theoretical frameworks and the key words used; the second area investigates the SL governance and application model and its capacity to understand the main challenges for the actors involved and to develop innovative solutions, through positive interactions on the field. In conclusion, taking into consideration the current state of the art of the research (e.g. strengths to be enhanced and critical issues to overcome), the study provides insights on how to set-up a structured Monitoring and Evaluation (M&E) system, to ensure that the R4U SL goals are pursued.

Keywords: Service learning, Evaluation, Capacity building, Public engagement, Team working, Transformative learning

Purpose

The Service Learning (SL) is an educational and training approach that combines service to the community (solidarity actions, volunteering, troubleshooting, etc.) with the acquisition of didactic knowledge by developing students' skills in a more articulated and complete way as well as the ability to interact in the field with local actors, learning their craft and developing a certain sensitivity towards the society needs (Raciti and Saija, 2018). Experiential learning is acquiring ever greater importance in both schools, starting from the primary one, and universities study programs (OECD, 2018), so much so that, in Italy, an academic network has been created for the diffusion of this approach, the Network of Italian Universities for SL (*Rete delle Università Italiane per il SL*), functionally to the development of the third mission (Albanesi et al., 2023; Ribeiro et al., 2021). In this context, the present paper, illustrates the SL pilot experience in the implementation of the project R4U[15] (https://www.reterurale.it/rural4universita) and describes first evaluation activities carried out with the aim to: i) verify the compliance of the R4U SL approach with the specific criteria established for SL projects; ii) identify what are the

[15] R4U is a project developed within the Italian National Rural Network. Currently, the partnership consists of 14 Italian Regions and 27 Universities. It is connecting different subjects, specifically university students and teachers, food system operators, regional representatives, and no-profit organizations.

main strengths and weaknesses of the adopted SL approach in the two previous editions of R4U.

Our research questions are the following: What are the key elements to achieve the SL goals of R4U project? Which are the policy pointers to overcome the critical issues emerged from the results of the first evaluation activities?

Design/Methodology/Approach

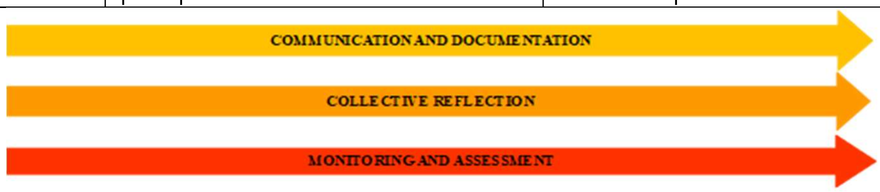
The R4U project promotes: I. Virtual learning (in-depth e-learning course integrating university curricular subjects, public engagements, scientific dissemination, research, and evaluation); II. In person experiential learning (field experience focused on concrete projects and real-life challenges). SL evaluation makes the learning process visible. The SL itinerary includes: (a) observation of real case history and problem framing (thematic cafes & field visit); (b) research, strategic analysis and critical reflection to generate new ideas and innovative solutions (mentorship sessions & team working); (c) grounding of the network vision, adoption of innovative solutions and dissemination of results (final event, digital publication, social media disclosure). Therefore, SL evaluation has a training function towards the recipients. The assessment is accompanied by project documentation (photographic video documentation, storytelling, professional report) and critical reflection, the factor which drives the transformation of students' learning into service for farms. The multi-level evaluation focuses on one side, on students' skills assessment (learning verification tests, portfolio of multimedia works); on the other side, on project path and the impact of activities (semi-structured interviews). An in-depth evaluation, conducted by external experts, is foreseen within the Italian National Rural Network (NRN) program. The compliance of R4U SL pilot project with the specific criteria established for SL projects is verified on the basis of the glossary defined in the "Manifesto of Italian Universities Network for Service-Learning" (UNiSL) (Albanesi et al., 2023). This glossary consists of nine key words: Transformative learning, Skills, Interconnection, Active participation, Reciprocity, Research and evaluation, Reflexivity, Relevance, Respect.

In line with the scientific and grey literature (D'Anna, 2023; SMA, 2020), the SL project develops along five phases (Table 1) Motivation, Diagnosis, Ideation and planning, Execution, and Closure; and the three processes (transversal to the five phases) Reflection, Documentation and Communication, and M&E important for ensuring the quality and effectiveness of the SL project (D'Anna, 2023). Communication and collective reflection are instrumental to Evaluation activities. The monitoring process, involving all phases, is systematic, requiring the collection of primary data and the use of the most suitable tools (interviews, questionnaires, logbooks, focus groups, etc.) for each SL phase. Evaluation is focused on SL results, processes, and impact[16] and can take the form of an activity carried out by a third party or as a self-evaluation process.

[16] https://www.iccannizzarogalatti.edu.it/wp-content/uploads/2021/07/9-Primaria-VALUTAZIONE-e-SL.pdf

Table 1. Five phases of a SL Project with reference to the R4U SL one

PHASE	DESCRIPTION	ACTION/OUTPUT
MOTIVATION	There is the need to increase the university students' knowledge of common agriculture policy, testing the opportunities seized by farms in the territory, and pursue a change in academic education system by promoting more connection between this one and the farming system.	Partners' briefing, contracts, project proposal and background analysis consisting of two steps: 1. Exploring students' learning needs; 2. Identification of innovative experiences, relevant for students.
DIAGNOSIS	Identification of farmers' needs and main challenges in the area selected for the field experience	Call to action; farmers' dinner to activate social relations among farmers and explore their needs.
IDEATION & PIANIFICATION	Planning and design of main activities	Didactic project, training program, briefing with partners (Universities, regional authorities, stakeholders, and no profit associations).
IMPLEMENTATION	Project implementation in collaboration with partners and local community	Brainstorming, thematic talks, labs, study visits, including development of techniques (scenario-based learning, role plays, focus group, audition and group projects, assessment of performance tracking, feedback sessions) and tools for soft skills development (i.e. starting tool kits, the sustainable business canvas model, and swot analysis matrix, e-learning tools, and interactive resources).
CLOSURE	Results dissemination, reflection about future perspectives	Focus group, surveys, mission report, portfolio case histories, databases, workshops.



*__3-Step Evaluation__:

- *Ex ante* evaluation: Evaluation of the quality of the SL project, definition of indicators, analysis of previous results, consistency with the expectations of the subjects involved (brainstorming, questionnaire, focus group)
- *In itinere* evaluation: Knowledge creation to ensure the effectiveness of the SL project (random interviews, questionnaire, feedback)
- *Ex post* evaluation: Evaluation of processes and impacts (Brainstorming, questionnaire)

To investigate the effectiveness of the intervention we provided preliminary elements for a self-evaluation. An in-depth evaluation, conducted by external experts, is foreseen within the Italian National Rural Network (NRN) programme.

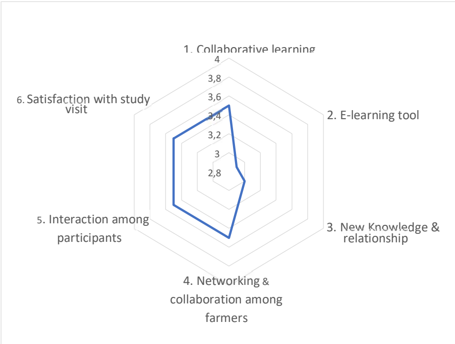
Although a step-by-step monitoring and evaluation process has not yet been defined, in the last two editions of the project, at the end of the last two Summer Camps (2021 and 2022), a questionnaire has been addressed to the main stakeholders involved (i.e. regional authorities, university teachers and students, farmers) to analyse SL effectiveness and verify the compliance of the R4U SL Pilot experience with some elements defined in the UNiSL Manifesto (Albanesi et al., 2023). A total of 62 actors participated in the survey and students' feedback were measured with a Likert-type scale and then compared with the results of previous edition. Besides that, we randomly selected a few participants among different actors to the field experience for targeted interviews. Furthermore, with the same aim, a first evaluation of the SL effectiveness has been carried out in January 2024 adopting a qualitative approach. Specifically, a CAWI (Computer Assisted Web Interviewing) survey was carried out in which all the same categories of actors involved in the last two Summer Camps were invited to fill out an online questionnaire shared via WhatsApp/e-mail. The questionnaire, consisting of five close-ended questions, concerns the achievement of specific objectives, process improvement, and the first impacts of the R4U SL. Clearly, the five questions vary depending on the category of interviewed and the responses were anonymous. The 55 respondents include 27 students (28% of participant students), 4 farmers (36,4%), 13 University professors (100%) and 11 Regions representatives (85%). Participants' feedback and questionnaires within each group involved in the R4U SL project allows collection of useful data and information about the project compliance with the set objectives. These tools could be combined with other ones like self-evaluation forms, logbooks, observation forms. Although very synthetic, the questionnaires filled out online in early 2024 result useful because they were very streamlined and able to detect some impacts, given that a suitable period of time has passed since the last camp, providing initial elements of an *ex post* evaluation. However, during the next rural camp it would be better to match critical Reflection with Evaluation by involving students and farmers, the main beneficiaries of the SL project, in collective brainstorming to identify and develop key elements to improve future editions of R4U.

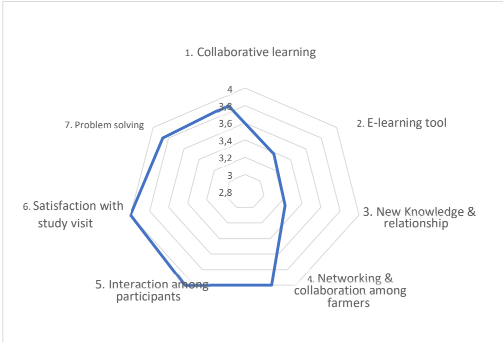
Findings

The findings from the first survey (after the last two Summer Camp) reveal that the R4U SL carry out a transformative influence on the community. Specifically, in compliance with the UNiSL Manifesto (Albanesi et al., 2023), SL promotes new skills (social, methodological, and digital skills), farmers' interconnections, active participation of young people (protagonism of students, farmers, experts), and relies on the 4 Rs pillars: reciprocity (exchange of ideas, knowledge, experience and good practices), respect (recognition of the role played by each actor), relevance (especially for universities) and reflexivity (partnership between theory and practice). Research & evaluation are still at an embryonic stage, but participants' feedback helps to track progress and performance. Specifically, from the agree/disagree responses to the questions of the questionnaires aimed to university students, improvements emerge for all the elements considered in the latest edition compared to the previous one.

Figure 1. R4U '20-'21: students' feedback

Figure 2. R4U '21-'22: students' feedback





Similarly, in the community interviews the following strengths were highlighted: 1) Collaborative learning: team building, team working, peer-to-peer training; 2) Tools to increase competency based on responsible change; 3) New knowledge; new relationships; 4) Networking and collaboration among farmers to tackle main issues; 5) Interaction among participants, knowledge exchange and dialogue; 6) Satisfaction with study visits: acquisition of technical, soft and transversal skills (communication, marketing, data analysis); 7) Problem-solving: ideas and innovative solutions to meet the needs of current and future agri-food workers. However, the too short times relating both to visits to the farms and to the development, by the students, of solutions to the farms' problems constitute the greatest criticality. Instead, the results of the CAWI survey are shown in the following graphs. From the analysis of results of the two surveys a substantial coherence emerges, allowing the identification of different strengths and some critical issues. With reference to transformative learning and skills, a good portion of the students' express preference for problem solving and collaborative learning, several other students believe they have valorised their curricular (question C) and their professors agree. Professors, farmers, and Regions confirm the existence of interconnection between the different actors of the project and on the possibility of developing forms of collaboration and participatory research paths between universities and farms (question E). In general, the different categories interviewed agree on R4U's ability to make different actors, especially students and farmers, understand the strategic importance of collaboration between universities, the productive world, and the Regions for the valorisation of the territory's endogenous resources and the development of growth and innovation strategies (question B). On this subject, the incidence of indifferent respondents is greater among farmers and professors. The results of the CAWI survey confirm that reciprocity is a critical issue for farmers as two out of four are indifferent regarding the ability of the solutions proposed by the students to solve the major issues related to agriculture (question A) and to allow a more objective assessment of the farm's problems (question C).

Figure 3. The distribution of responses by score, question, and respondent category

Legend: Score 1: Totally disagree; 2: Partially disagree; 3: Indifferent; 4: Partially agree; 5: Totally agree

With reference to what to improve, the most respondents indicate the need to spend more time discussing farms' case studies and processing the results (question D). Six students would also increase the duration of visits to farms, confirming what emerged from the random interviews. Finally, two farmers would like to ensure privileged relationships with the universities after the conclusion of the activities while the other two would like to prepare the visit with preliminary meetings with students and teachers, thus strengthening the "active participation" and "interconnection" components.

Practical Implications

R4U SL has a positive impact on its participants, especially in terms of development of skills and interconnection of the R4U community. The assessment has been effective in showing some critical issues in the two last edition of R4U, as the poor correspondence with respect to the key words (a) "active participation", (b) "reciprocity" and (c) "relevance", because (a) students can't choose the community problem to solve or mitigate and the type of subject to whom to provide the service with reference to a specific territorial area; (b) the selected case history had already been identified as top (best practice), consequently there were limited benefits for both students team working and farms' improvement; (c) the maximum number of participants was about 55 students per year with a limited number of farms involved, although the relevance of the project for universities was undoubted and SL has been included in the academic learning plans. The effort of this new edition 2024 is to move in the direction of SL model development (students' involvement from the diagnosis phase; choosing farms less structured with respect to production, organization, innovation, and marketing strategies) beyond the pilot experience, by replicating it at both regional and European level through the European Cap Network ; integrating the qualitative with the quantitative assessment tools, so as to improve the analysis and therefore the long-term sustainability of the learning process, that include the young people and local community voice in the design and implementation of the model. In addition, internal and external recognition is important, both for teachers, through promotion mechanisms and accreditation systems, and for students, who must obtain wider recognition of their participation in these experiences in terms of ECTS credits.

Theoretical Implications

Implication in the study refers to the application of the model and the outcomes of the findings, showing a good compliance with the key words defined in the UNiSL Manifesto, also confirmed by the feedback from the students who participated in the last two summer camps. The results of the CAWI survey highlight the achievement of main objectives, even if there are a few process aspects to be improved. Next step concerns the construction of a structured M&E system that develops along all the phases of the SL project (see Table 1) and ensures involvement of a third-party evaluator while now it is still a partial self-evaluation. This involves identifying the appropriate tools needed from time to time to monitor the individual phases of the SL project and a set of indicators so as to allow assessing their effects on the environment and on the various actors. Moreover, a stable governance structure, that support the planning, execution, and monitoring of SL projects and allows overcoming lack of compliance with the key words "research and evaluation", must be created. Specifically, research must be developed, being functional to strengthening the participatory approach in the dynamic construction of the R4U SL project and to sharing knowledge between all the actors involved also regarding its impact on students, teachers, universities, and community.

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Capacity development through new advisory practices: Insights from a better-regulations project

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Abstract

Purpose: Extant research on the changing role of farm advisors has hitherto given advisors' work with legal compliance sparse attention. This paper investigates the changing practices of advisors and their capacity building.

Design/methodology/approach: A project was run by advisory organisations in south Sweden, aiming to develop a method for identifying, processing, and submitting candidates for better regulations to regulating authorities. The dataset comprises interviews with 21 project participants, participatory observations and working group notes, analysed using structural coding and analytical memo-writing.

Findings: The findings show why and how the advisors decided to tackle the issue of better regulations in terms of facilitation, cooperation, and social learning.

Practical implications: The expanding role of advisors as facilitators of farmers' experiences of regulating authorities is highlighted, and how the facilitation process develops the advisors' work practices.

Theoretical implications: The advisors renegotiate their relationship with the authorities, by learning new practices and building new capacities. Thus, a change in practices can lead to a repositioning of a professional group in relation to governing authorities and society at large.

Originality/Value: The paper studies a previously little discussed dimension of advisory practices and describes a recent change in advisory practices in Sweden.

Keywords: advisory practice; agricultural extension; communities of practice; bureaucracy; regulatory compliance

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Purpose

This paper studies a group of farm advisors who started a "better-regulations project" aimed towards a reduced regulatory burden for farmers. The paper investigates the changing practices and capacity building of the advisors by asking the following questions:

(1) How does the project participation develop the advisors' practices?

(2) How do the advisors develop their capacity to deal with issues of better regulations, in general and in relation to other stakeholders?

We draw on the established definition of “a farm advisor’s *practice*” which “is their routine activities and behaviours when working in an advisory relationship with farmers” (Cerf et al. in Nettle et al., 2018: 21, emphasis added). Relying on this definition, *capacity development* refers to learning processes and activities which foster the development or enhancement of skills and knowledge (i.e., capacities) to support said practice. In this paper, we focus on capacities that concern advisory practices related to agricultural regulation and regulatory compliance.

The last decades have seen a change in the conception of the working practices of farm advisors; from linear technology and knowledge transfer towards interactive and participatory practices. This change includes a broadening of the advisors’ commitment, from production-related advice to one encompassing a broader set of issues (cf. Nettle et al., 2018). One such issue is on-farm legal compliance, which has become a topic for diverse types of advisors, both public and private advisors. Some advisors have specialised in legal compliance, including supporting farmers in legal licencing and other legal processes.

Reports show that the total amount of regulations related to farming increased by 134% over the past 25 years (1996-2021) in Sweden, despite politicians and authorities claiming to be working for simplifications, i.e., less and more precise legislation (see, Lans Strömblad and Bergström Nilsson, 2022). Today, farmers with dairy, meat and crop production face 480 rules related to their farm operations, excluding regulations for bookkeeping, taxes, employment and other areas applicable to all private firms (Lans Strömblad and Bergström Nilsson, 2022).

Previous research on the changing vocational role of advisors have engaged with issues of e.g. environmental concerns (cf. Ingram, 2008), workplace and employment (Nettle et al. 2018), and farmer health and safety (Mohammadrezaei et al., 2022). Landini (2021) emphasises the meaning of developing communities of practice for advisors’ peer learning, co-creation and life-long learning. The changing conditions for advisors and advisory organisations have also been described in terms of a shift from public toward private and farmer-based advisory service organisations (Knierim et al., 2017). However, extant studies do not grant vocational change in relation to advisors’ work with legal compliance and other legal processes much attention. This paper sets out to bridge said research gap.

Design/methodology/approach

The paper draws on qualitative data from a qualitative case study of a project for better regulations. The project spanned 2020-2024 being run by four advisors from three farmer-owned advisory organisations in south Sweden, and a representative of the Federation of Swedish Farmers. In parallel with the project, all five worked at least part time with on-farm legal compliance and licencing processes. The study focuses on a part of the project that aimed to develop a method for identifying, processing, and submitting candidates for better regulations to regulating authorities. The advisors applied for, and were granted, funding for the project by the Rural Development Program. Studying this project enabled us to study their capacity building in terms of *facilitation* of multi-stakeholder relations and, inter-advisory *cooperation* and *social learning*.

The dataset comprises transcripts from 21 semi-structured interviews with participants in the project, including 6 advisors from multiple advisory organisations, and 15 stakeholders including regulatory authorities and farmers' organisations. In addition, the dataset includes participatory observations and notes from project working group meetings; and presentations and evaluation surveys from multi-stakeholder dialogue meetings. The analysis involved structural coding and extensive analytical memo-writing (Saldaña 2021).

The paper draws on the communities of practice theory of learning (Wenger 1998; Blackmore 2010), and theories on facilitation of multi-actor dialogues (Daniels and Walker 2001; Leeuwis 2004). By utilizing these theories, the analysis engages with whether and how participation allowed the advisors to develop new vocational practices as a community, and how such learning allowed for capacity development among the advisors and the involved stakeholders. A key issue regards whether and how the advisors and other stakeholders formed a community of practice and how said community fostered new or developed capacities.

Findings

3.1 Why the advisors decided to tackle the issue of regulatory improvement

The advisors' motivation to tackle the issue originated in frustration over the increasing regulatory burden and bureaucracy for Swedish farmers, as experienced in these advisors' line of work. In a previous project, running 2016-2020, the advisors collected 80 suggestions for better regulations, which were presented to the responsible authorities at a concluding seminar. The advisors felt that the presentation resulted in resignation and excuses from the authorities. This experience provoked the advisors' ambition to find a better method – a formalised structure – to capture and seriously regard proposals of better regulations. The representative of the Federation of Swedish Farmers underlined that adequate regulations are an essential part of a well-functioning democracy.

3.2 How the advisors chose to tackle the issue of regulatory improvement

The advisors realised that they had to cooperate to draw upon their different areas of expertise to foster a holistic approach to regulatory improvement. Consequently, they developed a project plan that involved developing and testing a coherent method for collecting candidates of better regulations, investigating, and comprehensively assessing their impact, before presenting them at dialogue meetings with representatives from relevant authorities and industry organisations. This meant that the advisors tried to share the perspective of regulating authorities and suggest concrete solutions to the authorities' issues; in a sense trying to make the different perspectives of farmers and legislators meet. The focus of the test was finding ways of how to handle these perspectives in a working four-step model.

3.2.1 Identifying candidates for better regulations

The advisors identified a total of 151 candidates of better regulations, whereof 91 from interviews with 20 farmers, and 40 through a web page submission function, and another 20 suggestions which were identical in both sources. The identification resulted in a report with 150 suggestions for better regulations (Bergström Nilsson and Lans

Strömblad 2021). While the in-depth interviews provided a more comprehensive picture of the regulatory landscape, the website allowed anyone to submit suggestions. One of the advisors commented:

> We learned from what was submitted via the website that you don't always understand what people mean. They hardly write which regulation and paragraph, but more like, for example, to simplify labour immigration or scrap certain documentation. So, we had to interpret the suggestions and turn them into a specific request.

3.2.2 Sorting and prioritizing the candidates

The advisors interpreted and sorted the incoming suggestions according to the following criteria: to which government ministry and national authority it belonged, whether it had an influence on the competitiveness and degree of self-sufficiency of Swedish agricultural produce, and farmers' willingness to invest in their farms. In addition, they sorted the suggestions according to their impact on the farms' social, economic and ecological sustainability. Finally, the suggestions were sorted according to whether the regulations were deemed unnecessary, difficult to comply with, or to create unnecessary worry/anxiety (Bergström Nilsson and Lans Strömblad 2021). From the report of 150 candidates for better regulations, 60 were prioritised and provided with a problem description and an impact assessment.

3.2.3 Providing a problem description and impact assessment of each candidate

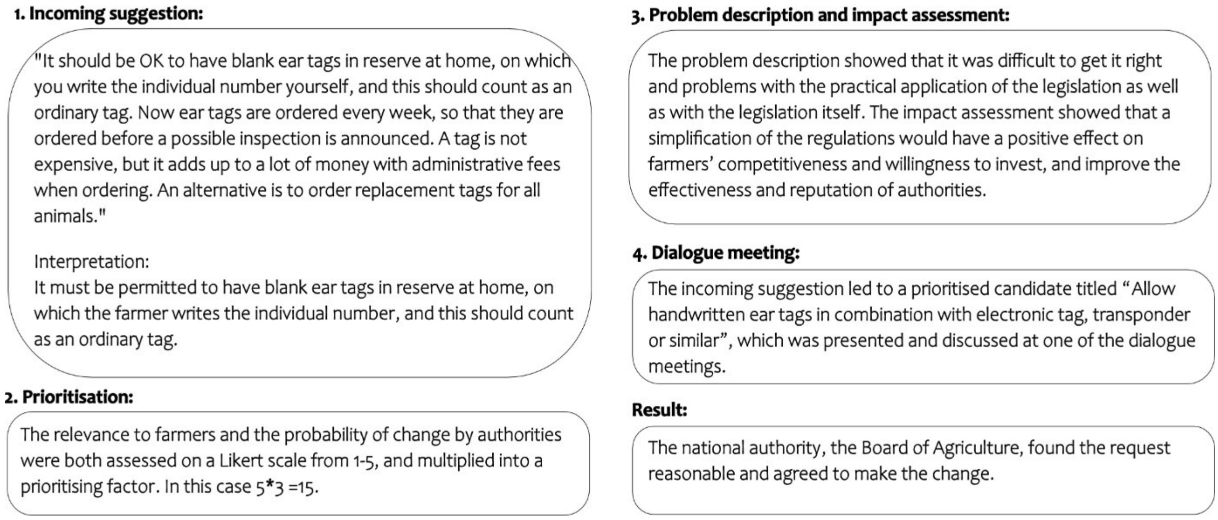
This step required in-depth expertise. Thus, the advisors opted to involve several colleagues of plural expertises in writing the problem descriptions and impact assessments. These investigations showed the degree of difficulty to change the regulation, if it affected few or many farms, and how serious it was perceived by the farmers. Thus, the investigations clarified whether an issue was "merely" administrative or if it prevented farm growth and development. Based on these assessments, five sub-areas were defined and five to six candidates per sub-area chosen to be presented in the dialogue meetings.

3.2.4 Setting up dialogue meetings with regulating authorities and other stakeholders

The purposes of the dialogue meetings were to present the prioritised candidates, foster a shared understanding of the associated problems among the authorities and stakeholders, discuss possible solutions thereto, and decide on further steps towards simplification. Previous work for improved regulations, and whether the authority's regulation letter mentions a mission to reduce or simplify regulations over-all, coloured the different authorities' representatives' engagement. The Swedish Agency for Economic and Regional Growth assisted in arranging the meetings.

To conclude this section, we present an example of an incoming suggestion and how it was processed through the steps 1-4, see figure 1. The incoming suggestion is related to the obligatory ear tags on cattle, and the administration effort and cost of ordering new tags when they fall off. The figure summarises how the suggestion was processed according to the steps described above.

Figure 1. An example of an incoming simplification suggestion, related to the obligatory ear tags on cattle, and how it was processed through the steps 1-4.



Practical Implications

The practical implications highlight the evolving role of advisors as central actors in identifying issues close to practical farming, related to public governance. This is relevant for several types of farm advisors, who must deal with legal compliance and other legal matters within their area of expertise. We identify three cases of capacity development in the advisory role's evolution. First, the group of advisors' attempt to *facilitate* the process between the perspectives of farmers and of regulating authorities, and how this process develops the advisors' work practices (as shown in 3.2). Second, they *cooperate* to share knowledge and develop their vocational practices. Third, by cooperating, they develop a community of practice that promotes *social learning* throughout the group of advisors (cf. Landini 2021; Nettle 2018). These capacities all promoted the creation of new practices as the advisors had to learn the perspective of the legislator and how to associate it with that of the farmer.

Before the project, the advisors' work had been directed solely at farmers. However, during the project, the advisors came to direct their work also towards authorities. In this way, besides developing the advisors' work practices, the project also contributed to developing other stakeholders' capacity to work with simplifications and better regulations. The facilitated process, including all the steps described above, helped the stakeholders see other actors' perspectives. Facilitation constitutes a capacity that realizes this kind of learning.

Furthermore, the aforementioned process fostered a broader awareness of the necessary procedures to proceed towards better regulations; moving from the level of detail to engage with the entire ecosystem of regulations. Sometimes, the phrase "it is EU regulations" was used as an argument for passivity, while some participants reasoned that the EU is also interested in better regulations. In any case, there seems to be a need for a platform for scrutinising EU regulations and comparing their interpretations between EU member states.

Theoretical Implications

This paper's results contrast the findings of extant literature, insofar as portraying advisors as at least partly reluctant to take on new practices and services (cf. Mohammadrezaei et al. 2022). In this case, however, the project was initiated by the advisors. The results thus highlight the need to acknowledge advisors' engagement and their institutional support for developing new practices, as also noted by Nettle et al. (2018) and Mohammadrezaei et al. (2022). These results nuance the implicit laissez-fair assumption that privatisation will automatically lead to advisors being more responsive to farmers' needs on a commercial basis (see e.g. Knierim et al. 2017).

The study's results exemplify the bridging and facilitating role of advisors regarding farmers' legal compliance and, their capacity building to promote better regulations. Hence, the results show that the role of advisors has expanded to include bridging to expert legislators on the regional, national and EU level, also including politicians and authority officials. The implications emphasise the importance of advisors' ability to cooperate and form communities of practices with advisors and other stakeholders to develop their capacities for regulatory advice (Wenger 1998; Blackmore 2010). To some extent, the role of a facilitator presupposes an ability to take such a comprehensive approach. This implicates new and widened demands on advisors in terms of bridging and facilitating between different perspectives (Daniels and Walker 2001; Leeuwis 2004).

The theoretical implications highlight the connection between practice and structure, i.e., how the development of new practices by the advisors lead to their ability to renegotiate their relationship with the authorities. This illustrates how a change in practices, with the help of a community of practice, can lead to a repositioning of a professional group in relation to governing authorities and thus to society at large. The project does not question the authorities' legitimacy *per se*. Rather, it challenges the authorities to review the quality of their governance. The project thus suggests that advisors and farmers find current governance practices to be below par, and thus can and must be improved. The results of this study do not only suggest a change within the advisory service organisations, but also to the societal role of advisory services and their relationship with authorities and society at large.

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A group learning E-VSM approach for improved environmental, economic and social performance of small suckler cow beef farms in Sweden.

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Abstract:

This paper reports on the evaluation of a new advisory concept applied on small suckler cow beef farms in Sweden, where group-based learning was combined with an environmental value stream mapping (E-VSM) approach including environmental, economic and social aspects of sustainability. The E-VSM was carried out by presenting the farmers to blended learning comprising on-line material and assignments in combination with group workshops and meetings on the farms. By the end of the project, farmers were satisfied with the advisory concept and experienced that the E-VSM helped them to identify wasteful activities and implement continuous process improvements.

Keywords: sustainability transition, value-stream mapping, process improvement, lean production

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Purpose

The importance of suckler cows for beef production has increased due to the declining number of dairy cattle in Sweden. For the same reason, the suckler cow beef production has become increasingly important in the preservation of semi-natural grasslands in agricultural landscapes. However, beef production contributes to climate change, mainly because of the production of methane released during feed digestion, and this emission is difficult to control. But increased efficiency can decrease the negative environmental impact of cattle production and reduce costs to the farmer (Hessle et al. 2017). Therefore, it is crucial to support farmers in identifying and implementing process improvements.

Value stream mapping is a method for visualizing the flow of material and information in processes, identifying wasteful activities, and supporting process improvements in various types of operations. A recent development of this method is the integration of sustainability concepts also known as Environmental Value Stream

Mapping (E-VSM). The method has its origins in Lean production and the manufacturing industry but has also been introduced in other sectors, such as the service sector (Abdi, Shavarini, and Hoseini 2006; Piercy and Rich 2009; Swank 2003), administrative processes (Atkinson 2004), healthcare (Brandao de Souza 2009; LaGanga 2011) and public administration (Arlbjørn, Freytag, and de Haas 2011; Pedersen and Huniche 2011). At its core, Lean production consists of a set of management principles that aims at increased productivity and efficiency by eliminating the non-value-added activities or 'waste' in the production processes of a business (Womack and Jones, 1996).

Although previous research showed that VSM may improve the performance of dairy farms, studies on the application of VSM in agriculture are limited (Melin and Barth, 2020). This paper reports on the co-development with farmers and evaluation by an action research-based study of the Environmental Value Stream Mapping (E-VSM) tool customized to the needs of small suckler cow beef farms in Sweden. The aim is to support elimination of waste and to improve sustainability outcomes at farm level, as well as implementing a new approach of reflecting upon farm processes by the farmer.

Design/Methodology/Approach

The VSM technique developed in this study builds on the visual mapping approach (Rother and Shook, 1998) and Value Stream Management (Hines et al., 1998), which are tools that help the business manager to use the lean principles and build knowledge on the Lean concept. The methodological approach was action-oriented research, which in this case address problem-solving based on recurring cycles of action and reflection. The role of the researchers was to facilitate meetings and provide farmers with coaching and support as well as to evaluate the project outcomes. Data was collected at workshops with farmers and farm advisers and by making observations at the farms. A total of 3 meetings online and 5 on farms were performed from May 2021 to December 2023 with two groups each consisting of 5-6 farmers. The results of the workshops and the farm visits were documented which gave a good idea on how the farmers improved their processes during the course of the project. By the end of the project, six of the participating farmers answered a questionnaire about their experience of participating in the project. The questionnaire comprised of several statements that was valued on a Likert scale 1 to 7. How the farmers answered to some of the statements in the questionnaire is shown in Table 1 as means and min and max values. Only seven of the statements are presented here due to limitation in space.

Findings

3.1 Co-development of E-VSM

The project started with a few modules including tools and learning materials developed by the researchers drawing on their previous experience from working with Lean production in different areas and with farm extension. The modules were tested by the farmers in the project and was then further developed by farmers and researchers in collaboration. By the end of the project there were six modules comprising of recorded online webinars, tools, workshop guides and other learning materials (figure 1).

Module 1: Introduction to the modules.

In this module the project was introduced to the farmers at an online webinar, where the purpose of the project, the overall concept and what could be expected from participating in the project were communicated.

Module 2 and 3: Introduction to Lean and VMS.

The principles of lean production were presented in a webinar on-line and farmers were introduced to the concept of value adding and non-value adding activities. The farmers were given a home assignment to do before next meeting, which was to identify and document wastes on their farm by performing a “waste walk” at the production site and to contemplate about the root causes of the identified wastes. The findings were then presented and discussed with the other group members at a follow-up meeting.

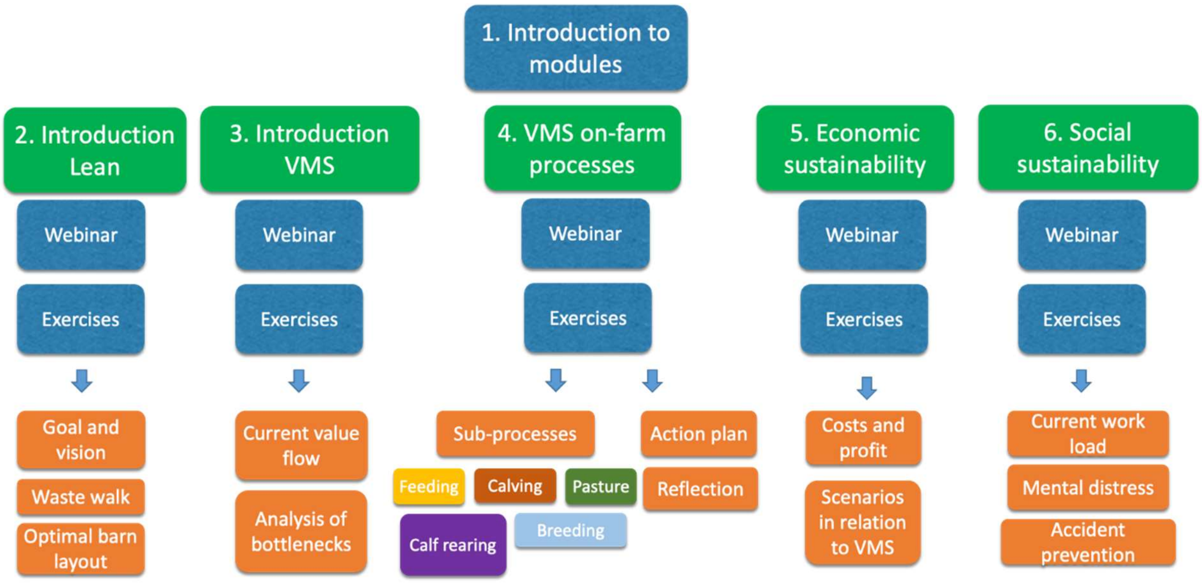

Figure 1. The different modules (green boxes), educational content and workshop guides (blue boxes) and tools (orange boxes) of the learning approach.

In a second webinar, farmers were shown how to map the total value flow of the beef production process of their farms. Identification of sub-processes and useful key performance indicators were done by the researchers and farmers together. The idea with this mapping activity was to facilitate the identification of waste and other factors that creates problems in the value flow. The maps were printed and discussed at a follow-up meeting. This activity resulted in a tool that guides the user in describing the value stream, identify wasteful activities and document the improvement work, which can be used by other farmers and advisors who would like to engage in the same exercise. When it comes to the feeding process, farmers discussed the most optimal place to store silage bales and other feedstuffs to minimize the distance that machines had to be used for transport. In the calf rearing module, discussions concerned for example, improved management routines such as new regimes for feeding, weighing, and marking of the young calves. At some farm visits, the farmers wanted to discuss their plans on building a new barn or enlarging the current one and received feedback and suggestions from the other farmers in the group.

Module 4: Value stream mapping in farm sub-processes

In this module, the value streams of the most critical sub-process were mapped. This activity was done at three subsequent workshops on the farms where the farmers were guided through the mapping of one sub-process at a time (calf rearing, grazing management and feeding). There were plans to also map the calving and breeding process but it was not done due to lack of time in the project. The researchers' role was to present an unbiased, external perspective on the production processes and to support the farmers in picturing the value flows, identify its problems, and to help come up with improvements.

Module 5: Assessment of the economic sustainability of suckler cow beef production

In this part of the project, an agricultural economist analysed the final accounts of the suckler cow beef production of each farm. The purpose was to give the farmers an opportunity to reflect on profit and costs in relation to the outcomes of the value stream mapping and the improvement work. The analysis was done for each individual farm and the compiled results were discussed at the group meetings.

Module 6: Social sustainability, lean and the working environment

The purpose of this module is to make sure that the focus on Lean and efficiency don't have negative effects on the farmers working environment. A tool was tested and further developed to support the group discussion on the farmers' psychosocial work environment. The result showed that farmers experienced heavy workload and mental distress at different times of the year. Also mapping of risks and hazards in the work environment is included in this module but was not brought up due to time limitations in the project.

Table 1. Results from a questionnaire on how farmers (n=6) experienced their participation in the E-VSM program presented as mean, min and max values of a likert scale (1=do not agree at all, 7=fully agree).

Module - question	**Mean likert value**	**Min-Max likert value**
Introduction to Lean – I would recommend my farmer colleagues to do waste walks on their farms	6.5	5-7
Value stream analyses – Value stream mapping helped me to see my production process in a new light	5.8	4-7
VSM feeding – VSM helped me to identify wastes in the feeding process that I hadn't noticed before	5.4	4-7
VSM calving and calf rearing – VSM helped me to identify wastes in calf rearing that I hadn't noticed before	5.6	4-7
VSM grazing – VSM helped me to identify wastes in the grazing management that I hadn't noticed before	5.3	4-7
Farm economy - To analyse the final accounts gave me new insights in my business	6.5	5-7
Social sustainability - The workshop where we discussed workload and mental distress in different parts of life (the farm, private, outside the farm) was useful for me	6.3	4-7

3.2 Evaluation of the advisory concept

Overall, the farmers were satisfied with the project and in the questionnaire the separate modules were rated between 5.6 to 6.5 on average out of maximum seven. The waste walk exercise in module 2 helped them to identify wastes in the processes, and one of the farmers said: "We had observed them (the wastes) before but now they became very clear to us. Clear enough we actually did something about them." Examples on wasteful activities identified by the farmers were weak calves due to suboptimal routines in management of the newborn calf and bad on-farm logistics by placing silage bales far away from the barn. The Value stream mapping exercise in module 2 made the farmers see their farm in a new perspective. One farmer said: "This is a totally new way to look at my production. It makes you realise that every little part can have a big influence. Everything from the choice of grass variety to harvest and weaning of calves."

To break down the daily work into sub-processes and activities was new to the farmers and made them reflect on what they did on their farms and why and if they could do it in another way. The farmers thought it was worthwhile to engage in this exercise and it resulted in that all farmers who answered the questionnaire identified wasteful activities, and by the end of the project most of them had set new goals for the production and had implemented improved routines.

All farmers thought the economic analysis was valuable and gave them new insights in their business. For some of them it led to changes in business strategies and investment decisions. Because Swedish suckler beef farms are rather small and are often run part time the economic analysis is often neglected, which makes this kind of analysis valuable for this kind of farmers.

The farmers said it was difficult to discuss social issues like mental stress and workload and that this was something they usually don't talk about with others. To get the opportunity to share their thoughts with other farmers in a similar situation was new to them but it was meaningful, and they realized that they were not alone in sometimes feeling a lot of distress. They thought the exercise where they mapped the workload in relation to different work processes was valuable and it resulted in ideas on how they could improve the situation, e.g by hiring a co-worker, prioritizing among assignments and planning their duties better.

Practical Implications

The project resulted in five modules comprising workshop guides, learning materials and tools that can be used by other farmers and advisers who would like to apply E-VSM. The content in these modules will be published on-line and is available for anyone to use. After more than two years in the project, the farmers were satisfied with the method and thought the learning materials and the E-VSM supported them to become better at identifying wasteful activities and finding out where improvements could be implemented.

Theoretical Implications

Previous research on implementation of Lean principles and value stream mapping in agricultural firms has until now focused on bigger farm operations where the farmer and the employees have formed an improvement group that received external lean coaching. This is similar to how implementation of lean usually is organised in the manufacturing industry. With support from a national Lean program, several Swedish farmers have begun to implement Lean principles and methods on their farms to become more efficient (Melin and Barth, 2018). The farms that participated in this program were all large operations, which contrasted with the typical Swedish suckler cow beef farm that is family owned and managed by the farmer, sometimes as a part-time occupation. This paper is to our knowledge the first to report on a concept customized to the needs of small agricultural firms where five to six farmers have supported each other in the improvement of production processes. This paper also shows how all three aspects of sustainability (i.e. the environmental, economic and social) can be included in the mapping of value streams of a farm. More research could be done to further develop E-VSM to a process improvement tool for small farms with other types of production as well as quantifying the effects of implemented improvements. The implementation of Lean in agriculture is not a straightforward process and barriers to change may be encountered on several levels in a firm (Barth and Melin, 2018)

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Knowledge exchange and peer learning in Participatory Guarantee Systems (PGS): insights from a Costa Rican case study

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Abstract:

Participatory Guarantee Systems (PGS) are said to combine control and advice in farm inspections and foster learning processes that can support the improvement of production practices and facilitate the conversion to organic farming. Empiric research on knowledge exchange and peer learning in PGS is scarce, PGS farm inspections are hardly studied. This contribution applies a mixed-methods approach to investigate learning processes in two Costa Rican PGS initiatives. The results indicated that advice and exchange were important aspects of PGS farm inspections. Most PGS members received advice during farm inspections and reported an increase in their knowledge about organic farming following PGS participation. Access to information and knowledge exchange and learning were perceived as a benefit of PGS participation, and served as a reason for joining the PGS, as a benefit of participating, and as a disadvantage of not participating in PGS bodies and activities. Overall, the findings offer new insights into knowledge exchange and peer learning in PGS and demonstrate that PGS farm inspections can serve as a valuable platform for peer learning and that PGS can play an important role in facilitating knowledge exchange and capacity development.

Keywords: Participatory Guarantee Systems, organic certification, participation, peer learning, capacity development, Latin America

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Background and Purpose

Participatory Guarantee Systems (PGS) are organic conformity assessment systems that are based on broad stakeholder participation (e.g., farmers, consumers, NGOs, universities). Organic conformity assessment in PGS is typically based on a peer review process, whereby organic producers inspect and certify other farms and farmers, often with additional engagement of consumers and other stakeholders (IFOAM-Organics International, 2019). PGS have the potential to facilitate social learning processes, including as part of organic inspection and certification. Consequently, PGS are not only understood as alternative organic certification mechanism, but also as a tool for capacity development (Home and Nelson, 2015). Knowledge exchange and peer learning among the participating producers are key elements of PGS that purportedly contribute to promoting the adoption of more sustainable agricultural practices, the wider spread of organic farming, the diversification of production systems, and the transformation of food systems (Moura e Castro et al., 2019). The combination of control and advice in farm inspections is a key element particularly differentiating PGS from external impartial (no advice allowed) third-party certification (IFOAM-Organics International, 2019; Moura e Castro et al., 2019), which is mandatory for making organic product claims in accordance with the EU organic regulation (EU) 2018/848. PGS have proliferated particularly in countries of the Global South, yet they are increasingly receiving attention, including in the European context, and are also being adopted in countries such as Italy (Sacchi, 2019) and Spain (Cuéllar-Padilla et al., 2022). Studies that empirically address knowledge exchange and peer learning in PGS are rare, and there is very limited research on PGS farm inspections (Cuéllar-Padilla et al., 2022; Hirata et al., 2021). The aim of this contribution is to portray the type and scope of knowledge exchange and peer learning in PGS.

Methodology

The contribution is based on a case study conducted in the Costa Rican PGS initiatives „ *Asociación de productores orgánicos Las Brumas*" (PGS1) and „*Coopeorgánicos R.L.*" (PGS2). The methodology used was based on the framework for assessing actor participation in PGS as outlined by Kaufmann et al. (2020) and an operationalization of chapter 6 ("conducting an audit") of the norm EN ISO 19011:2018 Guidelines for auditing management systems (Austrian Standards International, 2018). Data was collected between May and July 2022 using semi-structured interviews (n=18, PGS1+PGS2) and informal interviews (n=8, PGS1+PGS2), participant observation of PGS farm inspections (n=11, PGS1), and PGS producer surveys (n=32, PGS1+PGS2). All semi-structured interviews and surveys were voice-recorded after obtaining prior informed consent, and then transcribed. Participant observations were documented on paper, and the data was digitalized after the observed events. Qualitative data was analyzed using inductive and deductive coding techniques (Friese, 2012; Saldaña, 2013). Inductive coding resulted in the following main categories of information and knowledge exchange: i) advice given to inspected PGS members, ii) exchange between the inspected and the inspecting PGS members, and iii) references, i.e. exchange involving a reference to another PGS member and/or PGS farm inspection. To identify the main topics across these categories, descriptive codes on the content of information and knowledge exchange where additionally grouped further (see Kaufmann et al., 2023). Qualitative content analysis, and inductive category formation followed Mayring (2015). For the quantitative data, descriptive statistics were calculated (IBM SPSS Statistics, Version 24) (Bühl, 2016).

Findings

In both PGS, the farm inspections were carried out by PGS members, who were all producers. During the PGS farm inspections, *advice* was given (f=10) and there was mutual *exchange* between inspecting and inspected PGS producers (f=6) on a diversity of topics. On various occasions, exchange between the inspecting and the inspected PGS producers included *references* to other PGS producers and/or farms (Table 1). For example, positive experiences from other PGS producers were shared with the inspected PGS producers (f=8) (n=11). The advice observed primarily focused on the continuous improvement of production techniques, rather than on compliance with the organic standard. PGS farm inspections were carried out by two PGS producers in charge, other PGS producers did not usually participate (see Kaufmann et al., 2023).

In addition to having received advice during farm inspections, meetings of all PGS producers were an important source for advice and exchange related to organic farming practices, particularly in PGS1. About one-third of the respondents mentioned "access to knowledge and information, and learning processes" as a motivation for PGS membership, making it the most frequently indicated reason for PGS participation among survey respondents. Similarly, "access to knowledge and information, and learning processes" was indicated as a benefit from PGS participation by approximately one-third of the survey respondents. Learning processes were not only a frequently mentioned benefit of PGS participation, but also a prominent missed opportunity for those not participating in organizational bodies and activities of the PGS (e.g., PGS farm inspections, PGS certification committee). The majority of respondents reported an increase in knowledge about organic farming after joining the PGS and had received training through the PGS.

Table 1. Topics observed most frequently during farm inspections in PGS1 (n=11). f = frequency, f total=total occurrence frequency (multiple occurrences in one farm inspection possible; total of all occurrences across all observed farm inspections), f inspections=number of farm inspections in which the topics arose (adapted from Kaufmann et al., 2023).

	Advice		**Exchange**		**Reference**	
	f total	f inspections	f total	f inspections	f total	f inspections
Total	50	10	29	6	17	8
Topics						
Soil	14	6	1	1	1	1
Crop management & fertilization	9	5	0	0	4	3
Pest & disease management	9	4	3	3	4	3
Certification & compliance	6	4	1	1	0	0
Access to equipment & inputs	3	3	0	0	2	2
Crop quality & yield	0	0	4	4	3	2

Theoretical Implications

Advice was an important aspect of PGS farm inspections, confirming the findings on PGS in Spain (Cuéllar Padilla and Ganuza-Fernandez, 2018; Cuéllar-Padilla et al., 2022) and supporting common theoretical propositions on PGS functionality and advantages over other conformity assessment systems (Bouagnimbeck, 2014; IFOAM-Organics International, 2019). Our findings highlight the importance of learning processes as a benefit of participating in the PGS and as a lost benefit of not participating in PGS bodies and activities, similar to findings from PGS research in Chile (Hruschka et al., 2021). In both studied PGS initiatives farm inspections were carried out by producers inspecting their peers. Thus, the findings overall indicate that PGS farm inspections can serve as a valuable platform for peer learning and that PGS can play a crucial role in facilitating knowledge exchange and learning. Consequently, PGS have the potential to contribute to farmer capacity development, to promote the adoption of more sustainable agricultural practices and the further proliferation of organic farming (Lemeilleur and Sermage, 2020; Moura e Castro et al., 2019).

Practical Implications

The findings suggest two main implications for practitioners of the studied PGS initiatives. Firstly, learning opportunities emerged as important reward of and incentive for PGS participation. Consequently, it would be important to continue creating or expanding these spaces for shared learning during PGS activities, not only for fostering capacity development of PGS producers, but also for *stimulating PGS producer participation in PGS bodies and activities*. This is particularly relevant because both PGS initiatives were exclusively managed by these PGS producers, and were thus fundamentally based on the voluntary work of PGS producers. Secondly, considering the limited opportunities for PGS producers to participate in key PGS bodies and activities vital for learning processes (PGS farm inspections, PGS certification committee), and the limited practice of PGS producer participation, it may be beneficial to *create additional opportunities for knowledge exchange and peer learning*, to further support learning processes and capacity development among PGS producers. For instance, organizing extra visits to PGS member farms that are not related to the certification process and involve more producers could promote exchange and knowledge sharing instead of just offering advice.

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Impact of Certification Schemes on Farmer Livelihoods in Ghana's Cocoa Sector: The role of Cooperative and farmers capacities along the impact pathways[17]

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Abstract:
Capacity building is one of the interventions that come with the certification process. Capacity building is recognised as a significant means by which certification schemes can enhance smallholders' livelihoods. Nevertheless, there is still little work questioning the role of farmers' capacities along these complex pathways that contribute to livelihood impacts. This study closes this gap by providing a new perspective on how certification affects smallholders' livelihoods through an explicit causal chain connecting inputs, outputs, outcomes, and impacts; an impact pathway approach, with an emphasis on the role of cooperatives and farmers' capacities. Our analysis is based on five case studies of cooperatives in certification schemes (Rainforest Alliance, Organic, and Fairtrade) in Ghana's cocoa sector. We employed a participatory process of data collection and conducted Focus Group Discussions (FGDs) with 60 participants, 12 key informants' interviews, and desktop reviews. This study highlights the interconnection of technical, cognitive, relational, and organizational capacities that individual farmers and the cooperative mobilized along the pathways that drive inputs, outputs, and outcomes, contribute to impact. This could prove useful to certified value chain actors to determine which combinations of capacities to pursue and develop initiatives aimed at enhancing and strengthening these capacities to enhance farmer livelihoods.
Keywords: Capacities; Impact pathways; Certification schemes; Cooperatives, Livelihoods, Cocoa

Purpose

This study brings a new perspective on smallholder participation in certification schemes based on capacities using the impact pathways approach. Adopting such a perspective allows for an explanation that does not only focus on causal behaviours

[17]Codjoe, impact pathways and Capacity development to support systemic change: approaches, methods, and tools

(effects such as outputs and impacts) but rather on deconstructing the mechanisms with a focus on the role of farmers' capacities that contribute to impacts.
In this study, we utilise, technical, cognitive, relational, and organizational capacities that individual farmers and the cooperative collectively mobilised and utilised along the certification process that contributes to achieving impacts. Table 1 is introduced to define and explain the many key constructs that are used in the following capacities utilised in this study. Capacity building is one of the interventions that come with the certification process. In certification, capacity building through training and other forms of support to producers and their organizations helps to improve the sustainability, competitiveness, and inclusivity of their production systems (Oya et al., 2018a). Thus, cooperatives and farmers develop and apply their unique capacities dynamically and adaptively to raise their yields or quality, improve bargaining power, and increase income to enhance their livelihoods**.**

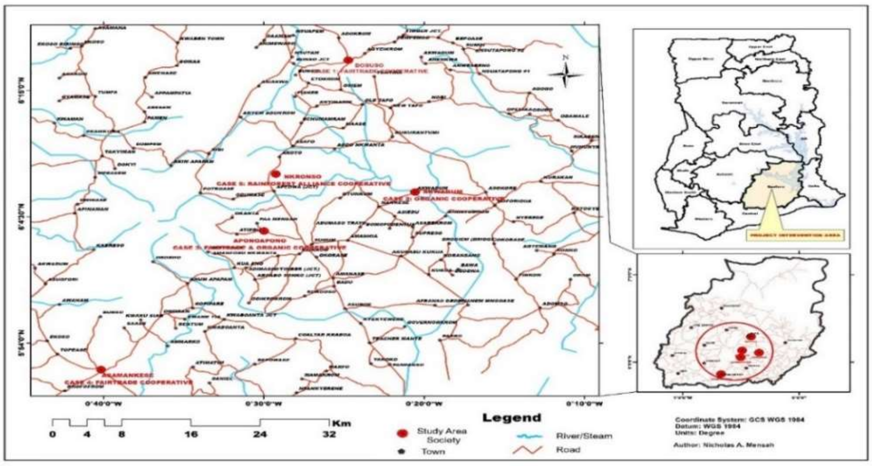
Table 1: Description of capacities mobilised or utilised

Capacities Utilised	**Description**
Cognitive	It encompasses a farmer's mental abilities, including decision-making, problem-solving, and adaptability, which are crucial for optimizing agricultural practices.
Technical	It refers to the knowledge, skills, and resources that farmers possess to effectively manage their agricultural practices.
Organisational	It pertains to the ability of farmers or cooperatives to manage their farming operations efficiently, including planning, resource allocation, and coordination of activities
Relational	It involves the ability of farmers or cooperatives to establish and maintain relationships with stakeholders, such as buyers, suppliers, government agencies, and other community members.

Design/Methodology/Approach

We chose to implement a case study approach (Yin, 2009) as seen in the ImpresS approach (Faure et al., 2020). Our analysis is based on five case studies of certification schemes (Rainforest Alliance RA, Organic (Org), and Fairtrade (FT) located in the Eastern Region. The region was purposively chosen for the study due to its historical significance in sustainable cocoa production. The cooperatives labeled as cases include Case 1 (Bosuso) and Case 4 (Asamankese) both of which began operations in 2012 and are involved in marketing Fairtrade-certified cocoa beans. Case 5 (Nkronso), RA certified, Case 2 (Akwadum), Organic certified, being the first to receive Organic certification in Ghana, and Case 3 (Aponoapono) a certified cooperative combining Fairtrade (FT) and Organic (Org), the first (FT & Org) cooperative in West Africa.

Figure 2: Map of study area showing the location of the cooperatives under study



We employed a processual approach to reveal capacities mobilised and utilised by using the Impact pathway approach (Faure et al., 2020). We aimed to reconstruct trajectories of certification stories and develop impact pathways. The impact pathway outlines the process leading from inputs to outputs to outcomes to impacts, explaining the causal mechanisms. We employed a qualitative survey, which involved a series of interviews using an interview guide. Our data collection process followed a participatory approach, which included key informant interviews, focus groups, and desk reviews to analyse impact pathways. The initial step of the process involved gathering secondary data through a review of scientific literature, documentary analysis, and key informant interviews. We conducted 12 key informant interviews including 2 certification standard owners, 3 certified cooperative managers, 3 traders, 2 focal farmers, 1 Technical Manager (CHED-COCOBOD), and 1 Research Scientist (CRIG). Key informant was purposefully selected according to the role (major, influential and impacted) they play in the certification process. This phase contributed to the development of materials such as trajectory templates with timelines and impact pathways for each case. In the second step, through focus group discussions, farmers actively involved in the certification process characterized the impact pathway and the causal mechanisms. They updated the information gathered from scientific literature, documentary analysis, and key informant interviews. They described the causal mechanisms that enabled the certification process to move from producing outputs to being adopted by actors who changed their behaviors, practices, or interactions, ultimately leading to the attributed impacts. This process of reconstructing the certification story provided both a historical perspective and insights into understanding the causal mechanisms and capacities mobilised and utilised that contribute to impact. In step three, we consolidated data from the key informant interviews and focus group discussions. The fourth step consists of employing focus groups and interviews with purposefully selected participants involved in the second step to validate the certification stories and impact pathways. Data obtained using the participatory approach was processed using Canva (a graphic designing tool) to develop, map, and visualize the impact pathways. The diagram (Fig 2) demonstrates the linkage between the inputs to their impacts, emphasizing the capacities that were mobilized and unitized during certification processes. This diagram typically consists of coloured boxes and arrows with numbers (i.e., the capacities) linking the impact pathways (e.g., input, output, outcome and impacts). Data collection lasted between June and August 2023.

3. Findings

We structured our results based on: 1) the analysis of the collective and individual capacities mobilised during the trajectory of the certification processes within the five cases and 2) capacities as key drivers of the impact of the certification process.

3.1 Analysis of the collective and individual capacities mobilised

Developing the trajectories of the certification schemes within the five cooperatives reveals the historical perspective crucial for understanding causal mechanisms and capacities mobilised and utilised during the certification process. As a dynamic process, smallholder participation in certification schemes is not an event but a long process characterised by individual and collective capacities. Results indicate that, at the individual level, there are variations in the capacities used and mobilized on a cognitive and technical, but not significantly different on the organizational and relational level across the cooperatives (Table 2). These findings suggest that the cooperatives are in varying stages of development concerning capacities mobilized and utilised during the certification process. It shows that cooperatives can serve their members in a variety of capacities and that those who actively mobilize and use these capacities can offer more benefits to their members. Furthermore, the collective utilisation of these capacities can help reduce transaction costs, improve quality standards, and increases bargaining power by connecting members and cooperatives to the market. This has the potential for these cooperatives to stay in certification schemes, contribute to impacts, and enhance members' livelihoods.

Table 2: Collective and Individual capacities mobilised and utilised during the trajectory of the certification processes within the five cooperatives

Capacities Utilised	**Individual**	**Collective**
Cognitive (Klerkx & Leeuwis, 2008)	Knowledge in the investment, purchase, and use of approved inputs and conformity to standards and good agronomic practices (cases 1, 4, 5) and adaptation to farming practices with no intensive use of inputs (cases 2 and 3) and re-investment of income into cocoa farming activities (labour and new establishments). Capacity mobilised at the start and utilised during the certification process	Common knowledge on cocoa cultivation and decision for producing with no intensive use of inputs (cases 2, 3) and producing respecting fair labour practices such as child labour and sustainable practices such as cocoa agroforestry systems (shade tree planting) (cases 1,4, 5). Capacity mobilised at the start and utilised during the certification process

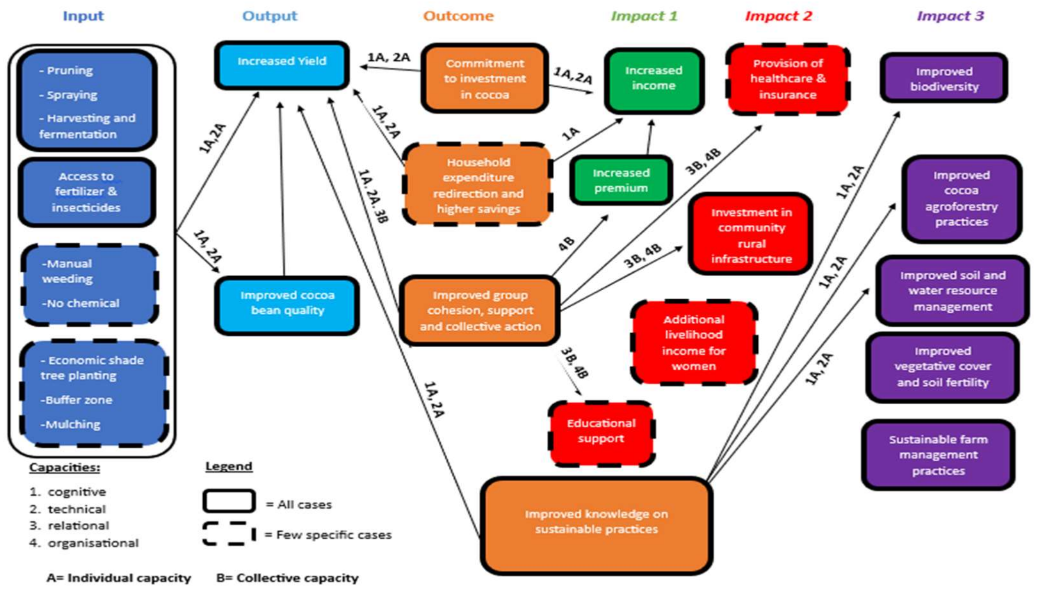
Technical (Feder et. Al, 1985)	Knowledge of the use of inputs and skills for application e.g application of fertilizer and fungicides (cases 1, 4 5), the manual weed control measures (2, 3), and good agricultural practices such as pruning, spraying, harvesting, mulching (All cases). Capacity mobilised during the certification process	Common knowledge on standards of their respective schemes e.g., child labour issues, cocoa agroforestry practices, buffer zone creation, farm sanitation practices by group training support services using own internal field technical team (2,3,5) or reliance of government service providers (case 1 and 4). Capacity mobilised at the start and utilised during the certification process
Organisational (Dillon & Hardaker, 1993)	Knowledge of proper input combination. The management of cash or income, family, and hired labour allocation to farm activities to optimize yield (All cases). Capacity mobilised at the start and utilised during the certification process	Cooperative knowledge in the recruitment of members, criteria for membership selection to be able to plan, and coordinate production (pruning and spraying services for members), and sales activities to meet the demand of buyers (cases 3). Capacity mobilised at the start and utilised during the certification process
Relational (Hashemi et, al, 2022)	Knowledge of group support and cohesion. Member-to-member support on production activities as well as diverse actor collaborations (NGOs, development partners, Government Ministries, and state extension providers) supporting individual farmers with training support services (spraying and pruning services, input credit supply services (access to fertilizers, insecticides). e.g., communal labour and knowledge exchange on standards (cases 1,2,3,4 5). Capacity mobilised and utilised during the certification process	Knowledge and skills in progressively establishing, maintaining, and bargaining with external buyers (cases 3 and 5) and relationship diverse support actors for training (cases 1, 2,3 4,5) Diverse actor collaborations (NGOs, development partners, Government Ministries, and state extension providers) supporting the cooperative with training support services (spraying and pruning services, input credit supply services (access to fertilizers, insecticides). Capacity mobilised and utilised during the certification process

Source: Author's construct deductively derived based on literature

3.2 Capacities as Drivers of Impact

Based on capacities as drivers to impact, we bring out the interconnection between individual farmers and collective capacities mobilised and utilised along the pathways of certification that contribute to impact (Figure 2). Figure 2 displayed a truncated impact pathway for all the cases showing areas of capacities mobilisation and utilisation along the pathways. Along the pathways to impact, we categorise impacts into three: 1) Impact 1-as first-level impacts on the directly on farmers, potentially improving their personal livelihood and well-being 2) Impact 2: Second-level impacts extend to the cooperatives or societies to which the farmers belong and 3) Impact 3 third-level impacts, positively influencing the environment surrounding the farmer, as sustainable agricultural practices benefit biodiversity, soil health, and ecosystem resilience.

Figure 2: A generic truncated impact pathway of the certification process showing areas of capacities mobilisation and development



3.2.1 Our findings highlight the significance of relational and organisational capacities along the Impact 2 (outcome to impact at the cooperative levels) pathways of certification (Figure 2). Organisational capability seems to be crucial to the long-term viability of these certification programmes. This is because it sustains the cooperative through membership drive, the management of production activities to remain standard complaint, and group sale of certified cocoa to buyers for expected premium. Though cooperatives are at different levels, our findings underscore the ability of farmers to manage their farming operations efficiently, including planning, resource allocation, and coordination. Case 5 over the years registered 29% in membership due to the restricted membership selection strategy, while cases 1, 2, 3, and 4 recorded significant membership enrolment (86% -668%) based on the membership recruitment process. In terms of planning and proper coordination of production activities, case 3 has demonstrated the capacity of providing spraying and pruning services to members at a reduced fee of GHC 120 through its spraying (45) and pruning (25) gangs and procurement of seedlings through support actors such as Cocoa Health and Extension Division (CHED) and Seed Production Division (SPD).

3.2.2 Our results emphasize the significance of cognitive and technical abilities along the pathways leading from input to output, output to inputs, and output to impact the farmer's environment (impact 3). Through individual cognitive capacities, farmers decide to access government and cooperative support programmes for agriculture inputs such as fertilizers and insecticides. They also participate in training and skill development through meetings, and workshops to enhance knowledge of good agricultural practices and standards (cases 1 and 4.

Practical Implications

This study stresses the role of cooperative and farmers' capacities along the impact pathways and highlights the interconnection of technical, cognitive, relational, and organizational capacities that individual farmers and the cooperative collectively mobilized along the pathways that drive inputs, towards outputs, outcomes, contribute to impacts and enhance their livelihoods. This could prove useful for buyers, manufacturers, retailers, and other value chains to determine which combinations of capacities to pursue to achieve impacts as well as to develop initiatives not only aimed at enhancing but also building and strengthening these capacities to achieve improved farmer livelihoods.

Theoretical Implications

Through capacity building and the Impact Pathway approach, we bring new perspectives to how capacities mobilised and utilised during the certification process can contribute to achieving impacts, hence livelihoods in agricultural commodity certification schemes.

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Developing farmers' autonomy to move towards more sustainable systems

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Abstract:
Farmer autonomy has become a research issue and a key factor for the farming systems transition. However, there is no consensual definition of what farmer autonomy at work is, nor any way of describing it to promote it. To contribute to this challenge, the aim of this paper is to identify the underlying dimensions of farmers' work autonomy processes, as well as the conditions that have favored or prevented it. We approach it as a process of renormalization and learning at work. To this end, we have combined two methods of data collection: individual interviews of farmers and the confrontation of an individual trajectory with the collective. In this way, we identified how important it is for these farmers to choose their own system and finding meaning, in spite of being confronted with the norms of the local environment. Participating in collectives that set new professional norms is a way of promoting transition.We have shown that their posture is a condition conducive to experimentation and renormalization. Finally, articulating renormalization theories and valuation is essential to understanding autonomy at work. These results open up avenues for reflection on designing collective training settings that mobilize individual trajectories to achieve collective and individual learning.
Keywords: farmers' work autonomy, renormalization, learning conditions, training systems.

Purpose

Farmer autonomy has become a central research object for understanding farming systems transition (FST) (Milestad et al., 2012). This actor autonomy is an intrinsic property of the resilience of organic farmers (Perrin, 2021) and a means of achieving a sustainable professional transition (Coquil, 2023). Although the aforementioned work shows that farmer's autonomy is an issue for research and a key factor for FST. Exploring the diversity of learning configurations, including the forms of temporary dependence on which they are based, that enable people to take the path towards empowerment (Dewey, 2011), is a challenge for education and training research (Mayen, 2017). Within this context, this research aims to understand farmers' work autonomy and identify the learning conditions that foster it.

To do this, from a developmental approach rooted in the spirit of activity theories, we approach the autonomy at work of livestock farmers as a process of reconception and

debate of norms (called "renormalization" by Schwartz and Durrive, 2003)[18] emerging in confrontation with work situations and in interaction with their work environments. On the other hand, by acknowledging the close links between competence and autonomy, defined by (Zarifian, 2002), for whom autonomy is an essential condition for the deployment of competence, we have also chosen to study autonomy as a learning process at work, at the crossroads between collective and individual dynamics. It is thus a dual experiential process: the conception of norms 1) through farmers' singular confrontation with work, on the one hand, and 2) through their participation in collectives in which these norms and individual experiences are exchanged and discussed, on the other. Our theoretical perspective sees these interdependent processes as potential factors in the development of skills and the empowerment of farmers in the exercise of their profession.
To date, there is no consensual definition in the literature regarding farmer's autonomy at work and its specific role in the FST. Furthermore, there is no stable method to understand and foster it through training systems. To contribute to these issues, the aim of the paper is to identify the dimensions underlying farmers' work autonomy processes, as well as the conditions that fostered or hindered them, with two perspectives: 1) to contribute to the theorization of autonomy at work 2) to translate our findings in terms of learning and coaching issues for farmers to promote it.

Methodology

We collected data in two stages. In the first stage, we carried out eight individual semi-directive interviews with farmers, involving the feeding of their herds from semi wild vegetation, to increase the forage autonomy of livestock farms. These practices guide farmers to adopt a dynamic and adaptive management philosophy between the processes of animal feeding, the dynamics of plants and the farmer's management practices. Farmers are located in different mid-mountain regions in France and selected based on two criteria, the implementation of agroecological practices and their participation in collectives that share these “non-standard” practices, which allows us to examine the dynamics between farmers' groups and individuals. To conduct these in-depth surveys, between March and December 2023, we drew on the "chronicle of change" (Chizallet et al., 2019), a tool based on a chronological timeline that helps understand the transformations of work on the farm by examining the difficulties, objectives and resources involved in these changes. Our aim in using this tool was to understand the process of autonomy at work and then to reconstruct it through narrative activity (Bruner, 2002), based on the premise that renormalization takes place over time. The narrative approach enables us to integrate this diachronic perspective.
Secondly, we led a workshop divided into two parts: in the first, a farmer - in interview - recounted to fifty farmers of the network "Pâtur'Ajuste"[19], his path to autonomy at work. In the second part, we split into two groups and led discussions on how this storytelling

[18] Drawing on Canguilhem's theory of "*normativity*", which affirms, "*the effort by which the individual attempts to anticipate subjection to the norm*", Schwartz and Durrive (2003) propose renormalization as a means of enabling individuals to become "*subjects of the norm*". This process is the result of a "*debate and arbitration*", between "*antecedent norms*" and "*reworked norms*", which takes place in the course of activity.

[19] The Pâtur'Ajuste network is a group of breeders from all over France who meet twice a year to exchange experience and knowledge on how to make the most of semi-natural environments. The network is run by Scopela, a Scop for consulting and training, which promotes independent decision-making by farmers.

resonated with each farmer. The aim was to raise awareness of renormalization through language and discussion in a mediating social context (Vygotsky, 1985) and create a debate of norms. These two types of methods - individual interviews on the one hand, and the autonomy story on the other - provide complementary data for targeted study of dual experiential processes of renormalization. These two corpora were structured into a database using NVIVO software, then analyzed inductively using a "grounded theory" approach (Bryant et al., 2019), by going back and forth between data, coding (descriptive then analytical) and bibliographical readings, and then expanding and generalizing our theoretical findings on farmer's autonomy (Yin, 2018).

Findings

1.1 Choosing one's system and finding meaning despite confrontation with the norms of the local environment

All the farmers interviewed affirm their desire to be in control of their choices and the changes they implement, as expressed by farmer E6: "*I like to change, but when it's me who decides to change*". For breeder E2, it is also important to understand the reasons behind her choices, as this translates into a form of "*mastery*" that gives her the confidence to "*take the plunge*" and accept the consequences of her choices. All the farmers stressed the importance of making decisions that make sense to them, and that correspond to their professional and personal objectives, and to their vision of economically frugal, environmentally friendly farming. Among their motivations, the search for pleasure at work and a balance between professional and personal life emerged as elements shared by all breeders.

Most of the breeders surveyed come from a farming background. In only two cases (E1, E5) did the breeders say that their fathers had left them "*free to make their own choices*" when they took over their farms. For farmer E5, this went against the "*patriarchal system*" on farms, where the immediate family does not let the next generation make choices. For farmer E1, the choice to move towards economically frugal, ecological farming was a continuation of his father's commitment.

Their desire to choose their own system is reflected in the implementation of practices that go against what they have learned at school (E1, E4) or from their family environment (E2, E3, E6), or from an alternative view of dominant agriculture (E5). Nonetheless, at certain points in their careers, the majority of farmers have followed norms that they now see as external, for example by adopting "*system security*" practices modelled on those of their neighbors (E3), or by applying ammonium nitrate to their plots on the advice of their father-in-law (E5): "*I was led to believe that (ammonium nitrate) was a necessity. As a result, it took me 10 years of installation to say to myself, Bah no, in fact, I don't think we need it*". In contrast, farmer E7, who set out on his own path right from the start of his installation, claims to have drawn on his past professional experience to identify the system that suited him: "*I knew that putting ewes outside all year round, for me, in my head, was sure to work*".

The farmers who took part in the "autonomy story" workshop testified to the weight of the "*gaze of others*", mainly their close circle of family, neighbors and/or the owners of the land they rent. In some cases, breeders follow the norms of these social circles, which are "*generally accepted*", in a logic of compromise and social cohesion. Other breeders, who do not come from farming backgrounds, said they were also subject to this pressure, and felt the constant need to prove their skills to their neighbors. One breeder said she suffered from "*impostor syndrome*" due to a "*lack of confidence*" in herself. These results suggest that breeders work under the gaze and influence of others' norms, which they may see as a brake on change and experimentation.

1.2 Participating in informal groups or networks that promote new professional standards

The adoption of "non-standard" practices can dissuade breeders from talking about their technical choices, because of their presumed distance, or even their presumed incompatibility with conventional practices. However, breeders E5 and E3 do express a need to break out of their isolation and, to do so, to establish links with other types of social circles that are similar to their own: "*I was trying to break out of my isolation, and I was trying to tell myself that maybe I'm not alone, that I need to find people who think like me and try to do what I do*" (E5). However, each breeder has his or her own way of creating their milieu, either through a formal collective, or by creating their own more informal networks.

Breeders E1, E2, E3 and E5, who belong to existing breeder collectives in their territories[20], emphasize the positive effects of belonging to these collectives:

- Taking a step back to "*get your head out of the game*" (E3) and get a constructive, non-judgmental outside view, which encourages breeders to ask questions.
- Exchange of experiences with other breeders: "*It's the exchange of practices, experiences and feedback from others that reinforces our decisions. Yes, it worked for him, why wouldn't it work for me?*" (E1).
- Feeling legitimate about what they do, in order to communicate with those around them "*and that allows me to put into words, to theorize these practices too, to put words to them and be able to explain them, and not feel all alone*" (E3).
- Collectively, through exchanges between peers, they build new points of references on the effects of their actions and thus find a guiding thread, which helps them overcome the discomfort caused by a lack of vision on their actions: "*You have no hindsight, you don't know where you're going. Somewhere you're going down a tunnel, but you don't know where the exit is. You don't know if there is one, and you don't know if you're going to come out on the right side or the wrong side. You have no reference, you have no one who can help you*" (E6).

In addition, three farmers (E5, E6, E7) have built up their own informal support network, with neighbors or farmer friends, i.e. by "*selecting the people we want to talk to*" (E6). The help they received from this "*network of trust*" enabled them to make progress in solving technical problems by drawing on the experience of other farmers, such as ewe's foot rot incidents in the case of farmer E6, or the identification of a toxic plant that was causing the loss of lambs in the case of farmer E7.

[20] Collectives organized and run by leaders of ecological agriculture development structures (Patur'en Pilat, Cant'ADEAR, ADDEAR 48). The main aim of these groups is to organize training courses and peer-to-peer exchanges of experience.

1.3 Develop a posture that encourages experimentation and the construction of one's own thought process

According to the farmers interviewed, the agro-ecological transition is accompanied by many doubts, uncertainties and a lack of references. Experimenting, observing and evaluating the results of their actions is a way for them to build references and redesign new standards. For farmer E1, testing the cessation of shredding enabled him to redefine indicators of success ("*It saved me time, diesel and danger*"). When they consider the results of their experiments to be positive in technical or work terms, these farmers express satisfaction at being able to challenge the external norms by those around them: "*People used to say 'he starves his animals to death' or that sort of thing. And now, it's quite the opposite when I see old farmers walking among my cows, saying that your heifers are in good condition, even though they're still grazing in winter*" (E1). However, it is not just a matter of experimenting on a one-off, isolated basis, but also of prioritizing experiments to maintain continuity in the work: "*We're in a work with so many cursors that you have to master some of them before agreeing to move others*" (E3).
For farmers, undertaking trials also means overcoming certain apprehensions, whether they relate to objective conditions (e.g. for E1, the availability and quality of the resource for winter grazing), or subjective ones (e.g. for E2, who expresses the fear of facing "*uncertainty*" and the feeling of not being ready to do so). In all cases, we have identified that their posture to cope with a transition to the unknown is a condition conducive to renormalization. For example, E1, E3, E5, E6 and E7 emphasize their ability to question their practices ("*get out of the rut*"). Indeed, they affirm their appetite for reflection, questioning and ongoing experimentation, which enable them to learn for themselves, to feed off their successes and mistakes: "*Yeah, I need that, I need to think, I need to ask myself questions and . … and you see, I'm telling you that I've got a system that's been in place for a few years now, but in fact, it's true without being true, because… the day I stop questioning myself, I'll stop*" (E5). Finally, they tend to approach problems from a different angle, putting the risks into perspective: "*There wasn't a risk … it's not like when you make an investment and say 'I'm going to build a building, there's a risk. So to say 'I'm going to make them eat bramble, …, but if they don't eat it, it doesn't really matter'*" (E1). These postures foster the reassurance that was recognized during the workshop as a lever for "*mapping out one's own path*" and daring to experiment by going beyond external views and standards.
The construction of their own scheme of thought led the majority of the breeders surveyed, on the one hand, to deconstruct their own habits and those of their animals, and on the other, to redesign their system while dealing with their parcels of land, their animals and the farm's soil and climate conditions: "*From 2008, my reasoning was a little different, … There are big disadvantages because it's fragmented, because it's very difficult to mechanize, because it's very constrained. And that's when I said to myself, it's like that anyway, so I might as well try to turn these constraints into assets*" (E5). Breeders constantly adjust and rebuild their ideas according to the singularities of the work situations they encounter, which can be particularly demanding: "*So, I don't have any major ideas to deconstruct, but on the other hand, I have everything to build. That's more like it. And that's very, very energy-consuming*" (E8).

Practical Implications

Our results show that farmers' decisions are part of a chronology integrating both professional and personal events, which we have identified using our methodology inspired by the chronicle of change (Chizallet et al., 2019). As research continues to evolve in its understanding of agricultural systems (Milestad et al., 2012), it seems important to us to extend this understanding with regard to their personal and professional experiences, as articulated by the individual and the collective. To this end, we find it is promising to be able to design collective training programs that mobilize individual trajectories to achieve collective and individual learning. This is one of the perspectives of this project, to co-design and experiment with individual coaching systems mediated by peer's collective.

Our results suggest that moving towards a FST requires a particular posture enabling action in the face of uncertainty (Dedieu et al., 2013), a posture that is constructed and could become an object of learning. Moreover, they allow us to assert that it is not just a question of redesigning individual norms, but also the professional norms of the farming profession. Creating spaces for farmers to debate professional norms, such as professional practice analysis workshops (Fablet, 2004) or "valuation communities" (Slimi, 2021), seems to us to be an appropriate way for them to redefine them collectively, to appropriate them and to engage in critical reflection on their profession, in order to keep it alive (Clot, 2008).

Theoretical Implications

On a more theoretical level, our work also contributes to a definition of farmers' work autonomy and how to understand and foster it through training**.** Our results allow us to assert that farmers' autonomy at work is not just a matter of decision-making autonomy, but of understanding the reasons for their choices and the norms to which these decisions refer, as well as the origin of the norms that guide these decisions, as the theory of renormalization invites us to do. As (Prairat, 2014) points out, the norm "*sorts, makes choices, affirms behaviors to be followed or recommends practices to be implemented; conversely, it can banish attitudes or ways of doing things*".

We have shown that farmers' professional reassurance comes from being surrounded by the collectives to which they belong, in line with various studies on the subject. However, the developmental dimension of such professional reassurance supported by informal networks remains to be studied: under what conditions and through what processes does it support or hinder the autonomy of farmers?

Beyond the operational avenues we have outlined, the question arises of defining what autonomy at work is, in light of the various works already published on the subject. For example, Stock et al (2014) highlight the way in which farmers themselves grasp the notion of autonomy, primarily to claim freedom in the exercise of their profession and in their choice of lifestyle. Coquil (2023) sees this concept as a means of emancipating oneself from normative socio-professional and socio-technical systems. However, we do not subscribe to a normative approach to autonomy at work, which aims to define externally the bonds of dependence and independence in which individuals would be caught. Instead, we have chosen to focus on autonomy at work as a process of development in and through farmers' activity. This point of view leads us, consequently, to propose an acceptation of the concept as follows in order to contribute to the theorization of autonomy at work:

(1) *Awareness of the origin of the standards that determine choices*
(2) *The ability to reconceive one's own standards, based on the development of know-how and the evolution of one's attitude to one's own activity.*
(3) *Bringing activity into line with the new meaning given to work as a result of the renormalization process.*

In addition, we propose that the processes by which farmers renormalize refer to what (Dewey, 1938) calls *valuation*, in his theory of inquiry, where the reconfiguration of norms and values is triggered when "*something is asked/questioned*" (Dewey, 2011). In order to enrich our analysis and understanding of the farmer autonomy process, we therefore plan to articulate these two theories in the remainder of this work.

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Agricultural Extension Leader’s Leadership Competencies Assessment Technique

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Abstract:

We developed a three-phase assessment technique to define Extension administrators’ leadership competencies. The new three-phase leadership assessment technique can help maximize the individual’s contributions, foster creative small group discussion, and share group vision. However, this tool could be applied to groups of 9-12. Our technique can be implemented within Extension and other organizations to determine future leadership skills needed among top organizational leaders.

Keywords: leader’s leadership competencies, needs assessment technique, Extension leader’s competencies.

Introduction

We want to introduce readers to the newly developed, three-phased leaders’ competencies assessment technique. We believe this technique helps maximize individuals’ contributions, foster dynamic small group discussion, and share small group vision with a larger group. This assessment can help identify leadership development needs among top agricultural organizational leaders.

Purpose: Why Did We Develop the Assessment Technique?

A systematic needs assessment process for health and human services and education has been used in the United States since 1960 (Witkin, 1984). Cooperative Extension organizations use different approaches to identify assets and needs and develop and deliver educational programs. The traditional approach to needs assessment methodology has been widely criticized since the 1970s (Alschtuld, 2015; Altschuld & Kumar, 2009). Major concerns include the following: fully quantitative, costly, negative connotation of needs assessment, which does not inspire an uplifting environment, and voices of the target population are not included in the assessment. Cooperative Extension has investigated leadership development for both county Extension educators (Argabright et al., 2019; Benge et al., 2011; Benge & Sowcik, 2018; Lakai et al., 2014; Ricketts et al., 2010) and state specialists (Radhakrishna, 2001). However, a gap in the literature was identified related to professional development needs and assessments for Extension administrative positions. Leadership needs assessment of Extension administrators should be a concern for the modern Extension organization (Personal communication with Cason, K., October 2018). Due to a lack of needs assessment research on the leadership competencies of top leaders in Extension, we developed a qualitative approach to help Extension administrators better understand the leader (intrapersonal) and leadership (interpersonal) competencies needed to develop future thriving Extension leaders. Day (2000) distinguished leader (intrapersonal) and leadership (interpersonal) development. The authors emphasized “a general need to link leader development, primarily based on enhancing human capital, with leadership development that emphasizes the creation of social capital in organizations” (p. 581). In 1990, Lepak and Snell indicated that organizations primarily invest in a leader’s training and development to enhance and protect their human capital and emphasize individual-based knowledge, skills, and abilities associated with formal leadership roles. Day (2000) described leadership development as “an integration strategy by helping people understand how to relate to others, coordinate their efforts, build commitments, and develop extended social networks by applying self-understanding to social and organizational imperatives” (Day, 200, p. 586). Day’s (2000) leader (intrapersonal) and leadership (interpersonal) development approach helped us to develop an assessment tool with both components.

Method: A Three-phase Assessment Technique

Our qualitative assessment technique is a three-phase methodology. The technique capitalizes on an individual participant's contribution in assessing leaders’ and leadership challenges and competencies needs. In the first phase, participants reflect on four questions at the individual level related to their leader and leadership development based on their experience. During the second phase, participants have small and large group discussions about the team leaders’ challenges. During the third phase, participants work in small groups, assessing organizational leaders’ competencies and skills needs; then, they discuss with large group participants. During the analysis phase, the facilitator independently evaluates participants' responses and synthesizes them into common themes. This approach helps to connect each participant’s past leadership experiences, discuss the leadership team’s challenges, and identify the competencies and skills needed for Extension administrators in their state. The five leading experts in the Extension field reviewed developed questions to establish instrument face and content validity. The leaders’ competencies assessment technique steps are further described in Table 1. The facilitator should welcome the participants and introduce them to the technique format. The welcome should include the introduction, and the three phases of the session can be completed in 90 minutes. We also recommend using the technique with groups of nine to 12 participants. A facilitator guide and a participant worksheet are presented in Appendix A and Appendix B.

Table 1. Steps in conducting the leader (intrapersonal) and leadership (interpersonal) competencies need assessment.

Step	**Time allotted**
Face-to-face session	Before the session
Introduction	
1. Review the facilitator guide (see Appendix B).	5 min

2. Establish and provide a comfortable meeting environment. 3. Describe the purpose of the session. 4. Introduce the audience to the technique and provide the participant worksheet (see below, Table 1).	
Phase 1 – Reflect on experience with a leader (intrapersonal) and leadership (interpersonal) development.	
Individual work: Give participants 4 minutes to address each question. Have them write their answers on the participant worksheet. 1. Looking back over your life, what experience are you most proud of as a leader? 2. What was your most disappointing experience as a leader? 3. List your top 5 leadership activities as an Extension program leader in a year. 4. In what ways do you feel you could have improved in the category of personal growth as a leader?	16 min (for four questions)
Phase 2 –Assessing the team leader's challenge (interpersonal level) Small group work: Give small groups 10 minutes to discuss each question. Have them write their response on their worksheets. 1. What leadership challenges have you faced being a team leader? 2. What factors accounted for these challenges working in a team?	20 minutes (for two questions)
Large group discussion: Give the large group 5 minutes to discuss each question related to the leader's challenge.	10 min (for two questions)
Phase 3 - Leader's competencies need (interpersonal level) Small group work: Give small groups 10 minutes to discuss each question. Have them write their response on their worksheets. 1. What are the most important skills/competencies that will help improve your leadership teamwork?	20 min (for two questions)
2. What contributes to being a thriving Extension leader in the State (portrait of a thriving leader: skills, abilities, traits)?	9 min (for three small groups)
Give each small group 3 minutes to present the results of their discussion on "*Competencies of a future thriving leader at [State] Extension*" to the large group.	10 min

Large group discussion: Give the large group 5 minutes to discuss each question related to the leaders' competencies and needs.	
After session	
Analyze participants' responses and share the results.	

Results

Nine Penn State Extension administrators participated. Participants included the interim director of extension, the acting associate director of programs, program leaders, and talent management professionals. Session layout: The needs assessment had 3 phases: (1) Intrapersonal leadership assessment – (individual level); (2) Feedback on leadership qualities from colleagues; (3) Interpersonal leadership assessment – (team level). We analyzed data from nine participants using NVIVO 12 software. Employing the narrative method of analysis (Clandinin & Connelly, 2000), we applied an open coding approach to the participants' responses, developing codes through consensus reached with at least 90% agreement. Our units of analysis included cohesive phrases, sentences, and paragraphs. The narrative method guided our analysis of the responses' structure, content, and function (Demus & Mey, 2015), resulting in the identification of seven major themes. The results of the qualitative analysis are reported in Table 2.

Table 2: Themes and categories

Lessons Learned from Past Leadership Experiences	
Lead self	Having a vision is important; trust and verify; smart planning is a success; empathetic listening is the foundation of influence; don't react immediately; keep up; and be aware of professional trends.
Lead others	Diversity enriches teamwork; respect is an important component of successful collaboration; communication is a foundation of teamwork.
Most Common Leadership Activities for an Extension Program Leaders	
Needs Assessment & Priority Setting	Identifying the demand for future Extension Program focus; identifying demand for future Extension products.
Strategic Planning	Goal setting; team building; work plan (managing resources, barriers, time, people, etc.); forming and maintaining partnerships & and collaboration with team and stakeholders
Communication	Communicate the vision for the organization; communicate a strategy for the Extension programs; communicate with stakeholders.
Qualities of Effective Leader & Leadership	
Leader Qualities	Create and communicate vision, responsibility, research, problem-solving, managing for change, being inclusive and flexible, decision-making, and an innovative approach to work.

Leadership Qualities	Utilize shared leadership; communicate vision; collaborate and partnership; and challenge others.
Areas for Personal Growth of Extension Leader	
Areas for Growth as a Leader	Visioning; balancing organizational strategies and operational tasks; mentoring; willingness to take risks; communicating organizational changes; engaging external stakeholders; conflict resolution; problem-solving; decision-making; team building; delegating; empowering and motivating others; research on effective extension business models
How We See Ourselves as a Team	
Competencies needed to improve teamwork	Create a clear vision; communicate a clear vision; help employees understand the vision; set priorities and goals; adjust organizational structure; engage across all leadership in the College of Agricultural Sciences; set priorities based on survey data results and communicate across the organization; improve program impact data collection and translation; standardization of Extension practices.
We are a good team because we are...	Honest; respectful; valuing diverse work experience; humble; supportive
Challenges We Face Working as a Team	
Change	The pace of change; team turnover; change in clientele
Times of emergencies and crises	Time pressure; increased workload; unforeseen issues; occupational stress
There are no common policies across program areas	Lack of communication, lack of identified priorities, lack of standardization
Qualities of a Thriving Extension Leader Tomorrow	
Competencies are needed at the individual level.	Emotional and cultural intelligence; ability to communicate innovative vision; dedication to the Extension profession; appreciation for diversity; exemplary communication skills; ability to share impacts and recognize contributions; decisive decision-making; accessible to people; ability to engage in shared leadership

Recommendations: Leader's Competencies Assessment Technique: Benefits and Challenges of Using

In our experience, we found that the leaders' competencies assessment technique has the following benefits:

- It allows practitioners to distinguish between the leader (interpersonal) and leadership (interpersonal) competencies needs.
- It capitalizes on individuals' insights while also optimizing contributions by small and large groups.
- Identifying the positive qualities of a leader provided a more positive connotation and environment for the needs assessment.
- Our assessment tool is only effective when it is result-focused and provides evidence. This evidence can be used to determine which of the possible competencies are most effective and efficient for achieving the desired results.

We have found that implementing the technique has some challenges:

- Preparation is the key, and it is time-consuming.
- Richer data may have been gathered with a longer session.
- Lack of time to discuss how funds may be identified and used to address challenges weakened the strength of the assessment report.

Appendix A. *Participant Worksheet*

Phase 1: Reflect on experience with the leader (intrapersonal) and leadership (interpersonal) development (total time 16 minutes).	Looking back over your life, what experience are you most proud of as a leader? Capture a few details here (1-2 examples). (4 min) (*Individual work*).
	What was your most disappointing experience(s) as a leader? Record your thoughts in the space below. Provide 1-2 examples. (4 min) *(Individual work*).
	List your Top-5 leadership activities as the Extension program leader in a year. Write your Top-5 leadership activities below. (4 min) (*Individual work*).
	In what ways do you feel you could have improved in the personal growth category as a leader? Record your thoughts in the space below. (4 min) (*Individual work*).
Phase 2: Team Leader's Challenge (total time 30 minutes)	Please think about the challenges you have faced as a team leader. Please list the challenges below. (10 min) (*Working in small groups*)
	What factors accounted for these challenges when working in a team? Please list them below. (10 min). (*Working in small groups*)
	Large group discussion on team leader's challenge. (10 min)
Phase 3: Identifying future leaders'	Please list several of the most important skills and things that will help improve your team leadership. Please list skills here: (10 min) (*Working in small groups*)

competencies and creating a thriving leader's portrait (total time 39 minutes) is needed.	What contributes to being a thriving leader in Extension (i.e., a profile of a thriving leader: skills, abilities, traits)? Please write down at least 5. (10 min) (*Working in small groups*)
Note. Note to the facilitator: If using this assessment technique with another organization, replace the word "Extension" with your organization's name.	

Appendix B. *Facilitator Guide*

Materials needed: printed participant worksheets, pens for each participant, three large Post-it sticky note pads, and at least three jumbo markers.	
1.	Establish and provide a comfortable meeting environment. Describe the purpose of the session and explain the protocol for Phases 1, 2, and 3. Provide the participant worksheet. Answer any questions participants may have. Remind them that they can refer to the instructions on the worksheet (see Table 2). (5 minutes)
2.	Use a stopwatch to keep the session on time. This is important because of the number of tasks participants are working on completing. In the facilitator guide and Table 1 in the text, we included times here.
3.	Phase 1. Ask participants to work individually by reflecting on their personal experience with the leader and leadership development (16 minutes).
4.	Phase 2. Ask participants to work in small groups and discuss the leader's challenges (30 minutes).
5.	Phase 3. Ask participants to work in small groups to identify the leadership competencies of a future thriving leader at your organization. Tell each group to assign a scribe. Ask them to write their results on one of the post-it notepads. After, have each group place their post-it on a wall in the room. Tell each group to assign a presenter to read their results to the group. Then, lead a large group discussion on outcomes (39 minutes).
Note. Only one facilitator is needed to facilitate the four-phase leadership assessment.	

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