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AND RESOURCE CHALLENGES

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HYPERLINKED INDEX

THEME 1 – INNOVATION SUPPORT SERVICES

Innovation Support Services / ISS (found in the literature under different labels such as extension and advisory services, intermediary organisations, etc.), conceived as an integral part of Agricultural (Knowledge and) Innovation Systems (AKIS/ AIS), face theoretical and practical challenges. Such challenges relate to our current understanding that, on the one hand, innovation involves the successful combination of 'hardware', 'software' and 'orgware' and, on the other hand, that successful innovations are usually based on an integration of ideas and insights from multiple stakeholders engaged in networks. The latter implies that innovation processes are dependent on dynamics in networks; they are affected by complex inter-dependencies, unintended and unforeseen developments and interactions and may well be conflictive. Therefore, there is a sustained interest in inventing new ways to build innovations and the need for more robust theories, methodologies and tools.

The necessity to deal with interactions between heterogeneous and interdependent stakeholders who do not necessarily share objectives, knowledge, values or practices implies that the role of newly recognized actors (who have been variously been called innovation brokers, intermediaries and free actors), stimulating the mutual learning process, is crucial. In such constellations ISS intermediaries (advisors) still play an important role, but different from what usually was assumed before. This implies the change of paradigm (i.e. the shift from transfer to 'intermediation') and new roles of advisors as facilitators / brokers stimulating and facilitating the process of learning with stakeholders in networks (networking, linking, conflict management, vision building, etc.). In this respect they need to properly utilise participatory and collaborative methodologies for the co-generation, adaptation, and use of innovations at scale.

NEW CHALLENGES FOR INNOVATION SUPPORT SERVICES TO IMPROVE COCOA QUALITY AND SUSTAINABILITY IN CAMEROON

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Introduction

With 241,000 tons produced, Cameroun is the fifth cocoa producer in the African continent. The provision of support services for cocoa sectors experienced transformation since the beginning of the 90's. In fact, with liberalization, the cocoa sector suffered from the effects of the disengagement of the State in production and post-harvest support, and in regulation of the cocoa market and prices. A decline in cocoa quality production volumes has resulted from this situation. In a context of competitive cocoa world market, the strategy of increase quality and thus reputation of Cameroonian cocoa provides lucrative opportunities in terms of development of niche markets. In fact, cocoa quality and sustainability are major issues for Cameroon in particular due to the discount of Cameroonian cocoa on international markets. The inadequacy of phytosanitary treatments coupled with poor fermentation, drying and storage conditions have led to a drop of the quality of Cameroonian cocoa, which was rejected from European ports in 2013 because it contained traces of polycyclic aromatic hydrocarbons (PAHs) (Bagal et al. 2013). Unlike Cote d'Ivoire and Ghana, which set a guaranteed price for cocoa producers, Cameroon's cocoa marketing system is liberalized. The National Office of Coffee and Cocoa (ONCC) each day publishes an indicative price, based on the London Stock Exchange's cocoa price, that is used as reference for negotiations. These negotiations of cocoa prices occur at various levels and conduct to consider various national prices : (1) farm-gate price (which is the price received by the cocoa farmer), (2) the Free-on-Board price (FoB) which is the term of sale under which the price invoiced or quoted by a seller includes all charges up to placing the goods on board a ship at the port of departure specified by the buyer (Laven et al. 2016). Other prices are negotiated at national level based on the transactions among intermediaries involved in cocoa value chain (Coaxers and Licensed buyers). Even if Cameroonian farmers and farmer's organizations have a generally low bargaining power and are consequently mostly price-takers (Laven et al. 2016).Two important variables also play in negotiation of farm-gate cocoa price: the quantity and quality of cocoa (Laven et al. 2016). The higher the quantity, the higher the price; the better the quality, the higher the price. Additionally, sustainability issues could be an argument in the future due to Global warming issues on deforestation. Laven et al. (2016) identify also the location of the community as a variable that affect the price due to accessibility issues. In this paper, we are focusing on the question of quality and sustainability of cocoa beans production and particularly on the support of innovations oriented into the improvement of both areas. The quality of the cocoa beans influences the final chocolate flavor. The attributes of cocoa beans quality has been defined by the World Cocoa economy: *well fermented, thoroughly dry and free from smoky or broken beans abnormal or foreign odors and any evidence of adulteration, reasonably uniform in size, reasonably free from broken beans, fragments and pieces of shell, and be virtually free from foreign matter* (Levai et al. 2015). At farm level these attributes are guaranteed by appropriate and adequate post-harvest processing (Levai et al. 2015). Our focus is oriented on the existence of the innovation services dedicated to support improvement of cocoa quality and sustainability through the identification and characterization of providers and services provided, environment in which these services are provided and the beneficiaries of these services. In a first part, we present our framework based on Agricultural Innovation System (World Bank 2006), which has guided our research. In the second part,

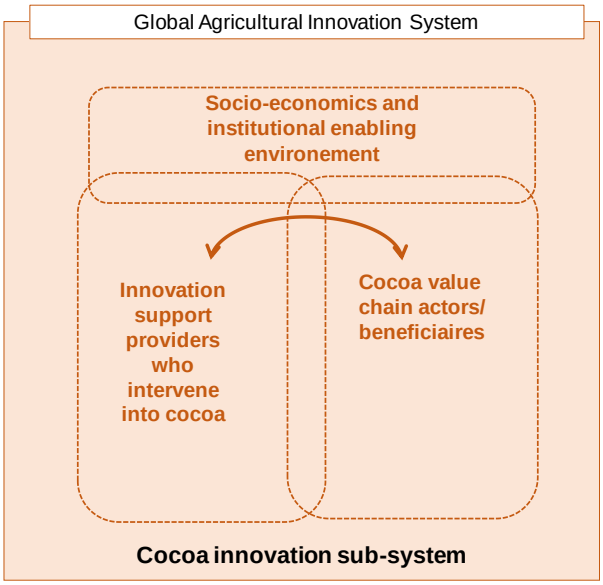
we present the specific characteristics of Cameroon cocoa innovation sub-system. We finish by discussing the challenges to support cocoa quality and sustainability-based innovations.

1. Conceptual framework based on innovation sub-system analysis

1.1. Composition of an agricultural innovation sub-system

We adopt through SERVinnov project the widely recognised concept of Agricultural Innovation Systems (AIS); which is a "*network of actors, organizations or individuals together with supporting institutions and policies in the agricultural and related sectors that bring existing or new products, processes, and forms of organization into social and economic use, including policies and institutions (formal and informal) which shape the way these actors interact, generate, share and use knowledge as well as jointly learn*" (World Bank 2006). While AIS has mostly been recognised as national systems from a normative perspective, innovation processes do occur at multiple levels and within specific fields of the agricultural sector so that not necessarily all AIS components are mobilised in each case. Within our work, we intend to identify the relevant scale and related/interconnected actors where AIS is operationalised in order to support agricultural and agrofood innovations. Various approaches are developed to define the relevant level that fit to address problem with agriculture and agrofoods systems, especially through approaches based on sub-system of AIS (Klerkx et al. 2017, Labarthe et al. 2018, Pigford et al. 2018). Scholars suggest to perform structural approach at the sub-system level (e.g. research and education, agricultural advisory services, private firms) to obtain an in-depth understanding of one or more sub-systems (Klerkx et al. 2017). In cases where an AIS is targeted a regional, sectoral and value chain, it is best regarded as "an innovation sub-system" (IsubS). We therefore define an IsubS as a partial view of the broader AIS operating at a regional (province, district), (sub) sectoral or commodity level (cocoa, horticulture, organic sector etc.), while at the same time, recognizing the whole AIS actors and their interactions occurring within this subsystem boundary. Adapting the framework developed by TAP (2016), we define the sub-system through three main components: (1) innovation support service providers, (2) the actors of the value chain who are mainly beneficiaries/clients of the innovation support services and in some cases also service providers and (3) the enabling environment which includes socio-economic and institutional aspects (Figure 1).

Figure 1. Cocoa innovation sub-system



Source: Adapted from TAP (2016)

1.2. Typology of services and service providers

Within the context of increasing services in economy, targeted literature on service provision is developed to better characterize and address services. Various categories of services exist in parallel with the classification of goods. Services can be characterized as natural/free (e.g. ecosystem services) or economic which mean produced by human activities. In our context, we are interested in innovation support services (ISS) which are economic services dedicated to support innovation particularly in agriculture and agrofoods systems. An innovation support service, as discussed in the economic and agricultural extension literature (Faure et al. 2012, Labarthe and Laurent 2013), is "*by its nature, an ISS is immaterial and intangible and involves one or several support service providers (ISP) and one or several beneficiaries in activities in which they interact to address a more or less explicit demand emerging from a problematic situation and formulated by the beneficiaries, and to co-produce the services aimed at solving the problem. The interactions aim at achieving one or several beneficiaries' objectives based on the willingness to enhance an innovation process, i.e. fostering technical and social design, enabling the appropriation and use of innovations, facilitating access to resources, helping transform the environment and strengthening the capacities to innov*ate" (Mathe et al. 2016). Based on this definition, seven categories of services have been identified with examples of tools related to each category (Table 1).

Table 1. Generic ISS categories, description of activities and examples of tools and methods per category

ISS category	Brief description of activities that make up the ISS category	Tools and methods which form the basis of service activities
Knowledge awareness and exchange	Activities contributing to knowledge awareness, dissemination of scientific knowledge or technical information	*posters, official documents, databases, brochures, banners, fairs, field visits, policy briefs, guidelines, technical reports, thesis report etc. to share and exchange knowledge*
Advisory, consultancy and backstopping	Advisory, consultancy and backstopping activities aimed at solving problems and co-construction of solutions on actors' demand	*A case of visit and advisory, guidance on the job, support to problem-solving*
Demand articulation	Services targeted to connect actors to market	*price organized to award specific product, support to establishing project exposé*
Networking, facilitation and brokerage	Services to organize networks; improve relationships between actors, to align services, all activities aimed at strengthening collaborative and collective action.	*innovation fair with round tables to allow people to discuss together (not just disseminating information), establishing contacts, maintaining platforms and social media devices, acting as a mediator to solve a conflict/ to solve problems*
Capacity building	The services comprise the provision of classical training and of experiential learning processes.	*training on leadership, on management and planning, on how to manage a cooperative, how to work collectively, technical training etc.*
Enhancing access to resources	Services enhancing the acquisition of resources for the innovation process (access to inputs facilities and equipment and funding)	Examples of resources acquired as a result of the enhancing services may include inputs (fertilizers, seeds), funds,

		access to market and acquisition of certification status
Institutional support for niche innovation, and scaling mechanisms	institutional support (incubators, experimental infrastructures, etc.), support for the design and enforcement of norms, rules, funding mechanisms, taxes, and subsidies etc.	*A survey to check if laws are followed, support actors to comply with the procedures/process, deliver certification, provide new authorization to implement new activities that were forbidden before*

Source: Adapted from Faure et al. (2019)

Various actors who are involved into innovation accompanying provide these services. Table 2 presents the generic typology of the actors identify into the literature.

Table 2. Generic types of service providers

Generic type	Specific types
Public organisations	Ministries and parastatal (e.g. national and or regional authorities), public universities and education bodies, Research institutions
Private organisations	Consultancy companies, Commercial companies, Banks and insurance companies, Co-operatives etc.
Third sector farmer-based organisations	Farmer based groups, Professional sector associations, Inter-professional organisations
Third sector civil society-based organisations	Civil society organisations, charity groups; denominational institutions, etc.
Informal service providers	Family members, friends, colleagues, Local authorities, Neighbours etc.

Source: Adapted from Mathe et al. (2016); Knierim et al. (2015); Labarthe and Laurent (2013); Birner et al. (2009)

1.3. Service beneficiaries or clients of ISS

Within the literature, several terms are used to name the recipient of a service provision: Labarthe and Laurent (2013) report that the following 'agent A and B', 'beneficiary and supplier' and 'user' are the most conventional expressions from the economic theory. All the terms have some connotations, be it economical (client = customer), psychological (client = patient) or sociological (beneficiary = dependent person) ones etc. which may induce assumptions about the relationship between the two parties. In our case, we use mostly the term of beneficiaries who are actors receiving services to support the inception, the development or the dissemination of their innovative initiative.

1.4. Data collection

We have collected two main types of data. Firstly, we made a review of grey and scientific literature on cocoa quality associated with a collect of secondary data on cocoa production and quality into national and FAOSTAT databases. The second type of that are primary data collected through semi-directive interviews of services providers and beneficiaries of services. For the service provider, we use a

purposing sampling approach based on the typology of providers previously identify in the literature. For the beneficiaries, we identify them through snowballing approach starting from information on the web and information coming from providers.

2. Quality as an innovation for Cameroonian cocoa

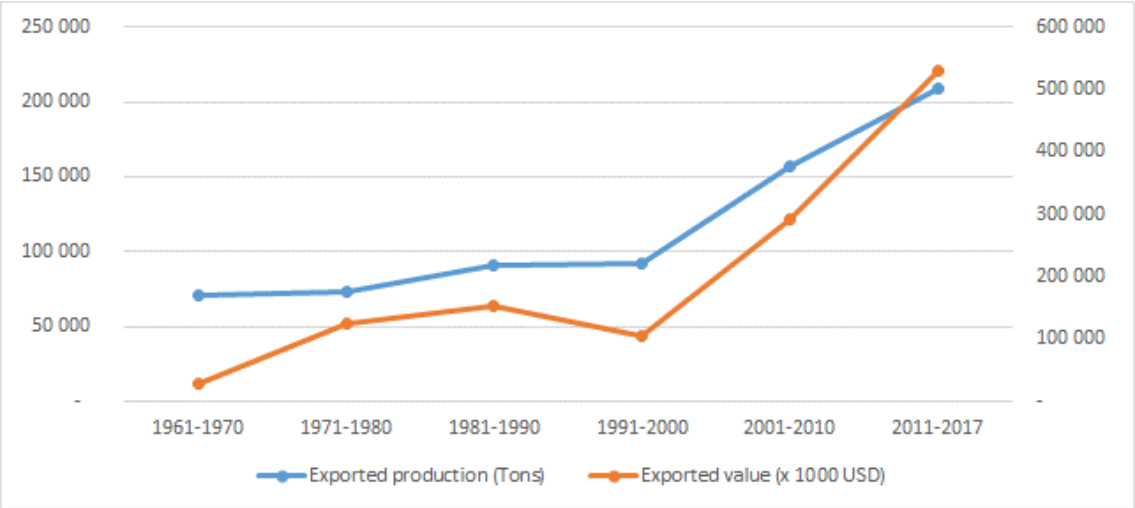
2.1. Liberalisation and jeopardization of cocoa quality

In Cameroon, the cocoa and coffee sectors (robusta and arabica) were closely controlled by the State until 1991 through the National Commodity Marketing Board (ONCPB), the Cocoa Development Corporation (SODECAO), large "parastatal" Agricultural Cooperative Unions (UCA) and "notable farmers" (Fongang Fouepe 2008). Following the fall in world cocoa prices in the late 1980s, the year 1993 marked the effective start of the liberalisation of these sectors with the abolition of the price stabilisation system (Alary 1996). This liberalisation has deeply changed the economic environment, particularly for small producers (Janin 1999). Laven et al. (2016) explained that market reforms have had an impact on price mechanisms and price development in different ways. Firstly, the price stabilization mechanism was abandoned which initially resulted in an increase of farm-gate price. In parallel, it results subsequently to an increase in price fluctuations. Secondly, Laven et al. (2016) noted the loss in farm-gate quality and reliability affected price development and the reputation of Cameroonian cocoa. Thirdly, export become dominated by a small number of foreign firms, creating a situation of oligopsony were exporters set the quality standards and the price, using the world market price as a benchmark. Fourthly, Coxers who informal and non-professionalized intermediate buyers have emerged. Coxers often operate in areas where it is difficult for famers to transport the cocoa themselves. They are more interested in quick availability of cocoa than quality issues (Tollens and Gilbert 2003). They generally work on behalf of Licenced Buying Agents (LBA) who are buyers committed by exporters. Fifthly, farmers find themselves in a weak bargaining position vis-à-vis of coaxers and LBA, which are the both main market channels they use a part of the Farmer Organizations. High quality cocoa is highly related to both the fermentation and drying processes. In fact Cocoa *quality* is used the broadest sense including flavour, purity and physical characteristics that have a direct bearing on manufacturing performance. The Model Ordinance of the International Cocoa Standards defines that cocoa of merchantable quality must be*: "(a) Fermented, thoroughly dry, free from smoky beans, free from abnormal or foreign odours and free from any evidence of adulteration. (b)Reasonably uniform in size, reasonably free from broken beans, fragments and pieces of shell, and be virtually free from foreign matter".* Quality issues are also related to safety with the absence of substance such Hydrocarbures aromatiques polycycliques (HAP) which can be detected when coco have been drying on the ground on bitumen road. Based on these definitions no matter what the genetic origin, the flavour potential of each marketed fine or flavour and bulk variety can only be expressed by appropriate and adequate post-harvest processing. These principles are true for whatever germplasm is being processed.

2.2. Improving quality as future strategy for Cameroonian cocoa production

Cocoa production in Cameroon is 85% to export (ONCC, 2018). The cocoa production is a central crop for Cameroon. It represents a exported production of more than 200,000 tons and an entry of currency of more than half billion of USD per year (Figure 2).

Figure 2. Evolution of production and value of cocoa exported from Cameroon



Source: Compiled from FAOSTAT

The Cameroonian National Cocoa a Coffee Board, which governs the quality of cocoa traded globally, grades cocoa as I, II, or substandard. All cocoa traded must be thoroughly dry and free from foreign matter. The three grades are based on percentage of moldy and otherwise defective beans. Cocoa is supposed to be classified "Grade I" if the number of beans which deviate by more than one third from the average weight of the beans, is not higher than 20 %, a maximum of 6 percent of the beans having mold, a maximum of 8 % of the beans is slate-grey, and a maximum of 6 % of the beans having any other deficiencies. For Grade II cocoa, the maximum percentage for mold is 8 %, for slate-grey beans is 15 % and the maximum of any other deficiencies is 12 % (REPUBLIC OF CAMEROON 2005)

In the periods from 2014 to 2017, almost 98 % of the cocoa exported is in grade 2 (Table 3). Our interviews revealed that this do not means that all cocoa produce in Cameroon is in grade 2. Sometimes, as there are no real differentiation of channels, cocoa in grade 1 are mixing with cocoa in grade 2 and thus are evaluate as grade 2.

Table 3: Evolution of exported cocoa quality from 2014 to 2017

Periods	Grade 1	Grade 2	Non-Standard	Non-Compliant	Broken cocoa beans
2014/15	0,50%	97,42%	1,78%	0,11%	0,18%
2015/16	0,28%	98,23%	0,54%	0,70%	0,24%
2016/17	0,91%	97,59%	0,89%	0,06%	0,59%

Source: ONCC (2018)

Improving quality of cocoa is strategic for Cameroon cocoa for various reasons. Firstly, the global convergence to standardisation of cocoa offer will increase the pressures on the cocoa price on international markets. As cocoa market is liberalised in Cameroon this situation may directly affect cocoa farmers. Quality, *terroir,* and sustainability will be the criteria for differentiation within the global cocoa market. Secondly, the increasing demand for cocoa quality and sustainability from consumers and lobbies. The latter increase the pressure on the cocoa industry to buy sustainable and quality cocoa. This situation conducts to prioritize cocoa with respect to environment (zero deforestation) and using good agricultural and postharvest practices as certified cocoa. With a cocoa production mainly based

on agroforestry system (Jagoret et al. 2018), Cameroon has a comparative advantage to build on that for developing high quality and sustainable cocoa production, even with a terroir approach. The production of quality cocoa is an opportunity for Cameroonian cocoa farming and in this sense the breeding ground for the development of innovative initiatives that must be supported.

3. Cameroon cocoa innovation sub-system: providers, services, institutional environment and demand dynamics

3.1. Diversity of service providers

A diversity of actors intervenes actually in the support of innovation in cocoa value chain. This mapping of providers in table 4, is not exhaustive as we use purposive sampling approach, but allow to appreciate the diversity of providers with cocoa innovation system. The mapping also brought to light the existence of a new category of providers, which are international organizations, involved into research or cooperation fields. Additionally, we note the nature of informal services providers is different with the one met in the literature. In our case, they are represented by informal actor of the value chain (coaxers).

Table 4. Providers involved into cocoa innovation system

Category of actors	Name of organisations	Acronym
Public organisations	National cocoa and coffee board	ONCC
	Cocoa Development Corporation	SODECAO
	Institute of Agricultural Research for Development	IRAD
	Ministry of Agriculture and Rural Development	MINADER
	Cocoa and Coffee Development Fund	FODECC
Private organisations (exporters)	NEALICO	NEALICO
	TELCAR COCOA	TELCAR COCOA
	United Trading International	UTI
	AMS	AMS
	Entreprise AGRIBUSSINESS S.A	AGRIBUSSINESS S.A
Third sector farmer-based organisations	Cooperative Society of Mefou et Akono Cocoa Producers	SOCAMAK
	Interprofessional Council for Cocoa and Coffee	CICC
	Cooperative Society of Nyong and So'o Cocoa Producers	SOCOPROCAON
Third sector from civil society-based organisations	Rainforest Alliance/Tropical Forest	RA
Informal service providers	Coaxeurs	//
	International Institut of Tropical Agriculture	IITA

International and research development organisations	World agroforestery Center	Icraf
	Netherlands Development Organization	SNV
	Deutsche Gesellschaft für Internationale Zusammenarbeit	GIZ

Source: Results of field work

3.2. Recommitment of the State concomitant with the emergence of new actors

In Southern countries, different actors such as Farmers' Organisations (FO), input suppliers, public and private institutions etc. can provide services (Faure et al. 2011). In parallel with the liberalisation process, the Cameroonian State is encouraging the establishment of Farmers' Organisations (FO) based on the legislative reforms of 1990 and 1992 relating to associations, cooperative societies and Joint Initiative Groups (GIC) (Fongang Fouepe 2010). These include services such as input supply, production financing, producer training and product marketing (Fongang Fouepe 2010). The real capacity of FO to provide these services is not effective. This situation contributes to the emergence of coaxers who facilitate accessibility to financial and material resources to farmers. Since the beginning of 2010', we note a recommitment of state on cocoa production support through the programme of revitalisation of cocoa value chain (PRDFCC) (REPUBLIC OF CAMEROON 2014) and the development of a specific fund named FODECC (*Cocoa and Coffee Development Fund*) to implement projects such as the PAGQ2C (*Projet d'Appui à la Gestion de la Qualité dans la production du Cacao et des Cafés*). This project aims at enhancing the quality of cocoa through improvement of agricultural practices. Nevertheless, according to Laven et al. (2016) estimations in Cameroon less than 20% of the farmers is reached by public sector services (primarily extensions and training). These are generally the farmers that are close to the administrative units where governmental support is supplied. In parallel, we note the development of the role of the private sector particularly exporters into supporting cocoa value chain. According to Laven et al. (2016) around 30% of farmers are reached by services from the private sector (like credit, inputs and training). In addition, the ONCC has a department in charge of Marketing and Quality Control (DCCQ). It carries out activities such as packaging control, quality analysis, certification and standardization of raw products. Tableau 5 shows a qualitative estimation of the involvement of the services providers in the various type of services. Capacity building and advisory are the main services provided. Services of Knowledge production, demand articulation and institutional support for niches are less developed. The intensity of service provided doesn't reflect the effective accessibility for potential beneficiaries.

Table 5. Intensity of service provided per category of providers

Type of services / Type of providers	Knowledge	Advisory	Demand articulation	Networking	Capacity building	Resource access	Institutional support
Public organisations	++	+++	+	+++	+++	+++	+++
Private organisations	0	++	+++	++	+++	+++	+

(exporters)							
Third sector farmer-based organisations	+	+++	++	+	+++	++	++
Third sector civil society-based Organisations	0	++	++	++	+++	++	+
Informal service providers	0	+		0	++	+++	0
International research and development organisations	+++	++		+	+++	+	+

Source: Results on field work

+++: Service provided as primary activity

++: Service provided as secondary activity

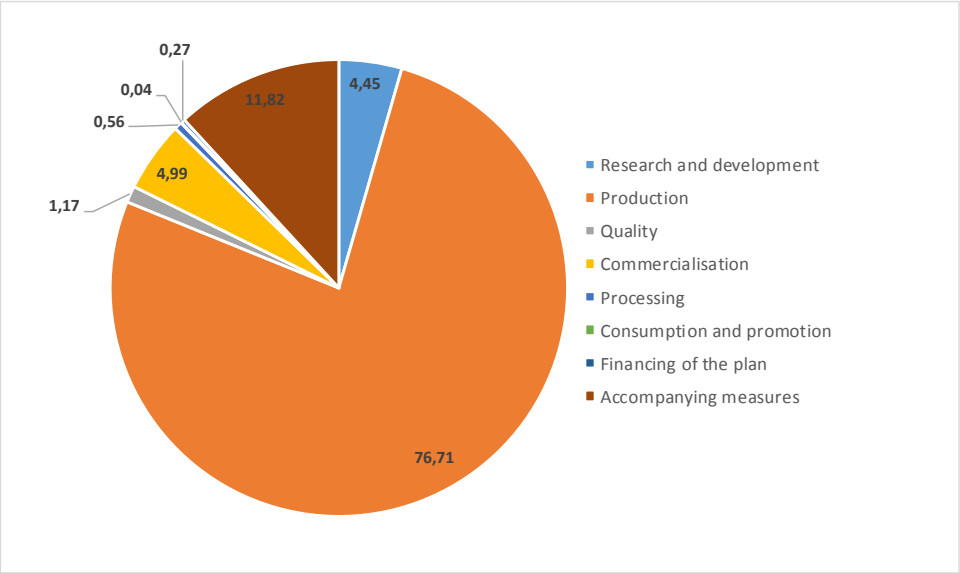
+: Service provided occasionally

0: Service not provided at all

3.3. A national strategy mainly oriented towards cocoa production

Through the plan for the revitalization of the development for the cocoa value chain 2015-2020 (REPUBLIC OF CAMEROON 2014), Cameroon government puts in place various programmes to support cocoa value chain. The PRDFCC plans interventions in: research and development, at the production level, regarding the quality of the product and in the commercialisation. In order to increase competitiveness of Cameroonian cocoa, it is envisaged to improve the quantity (up to 600,000 tons by 2020) and quality of the cocoa predominantly through the encouragement of the use of the Good Agricultural Practices (GAP). We identify that approximately 77 % of the budget are intended to improve the production practices, for which a major emphasis on improving the productivity and the volumes of cocoa produced as well as post-harvest practices. The other major interventions focus on making more easily available the necessary inputs to the producers, improve the organisation of the market and promote the demand for Cameroonian cocoa in the country and abroad. The amount of the budget clearly identified to support quality is less than 2%.

Figure 3. Planned budget for PRDFCC



Source: REPUBLIC OF CAMEROON (2014)

3.4. Emergence of scattered niche innovation based on improved cocoa quality

In the meantime, we identify the existence of scattered niche innovations based on cocoa quality and sustainability improvement. We observe four types of dynamics mainly driven by service providers. These dynamics of innovation service provision benefit directly to farmers and FO:

(1) Dynamics driven by certification agencies as Rainforest alliance with their partner the local NGO Tropical Forest. This agency is involved in the development of certified cocoa. Certified cocoa represents less than 3% of the cocoa produced in 2012 (Potts et al. 2017).

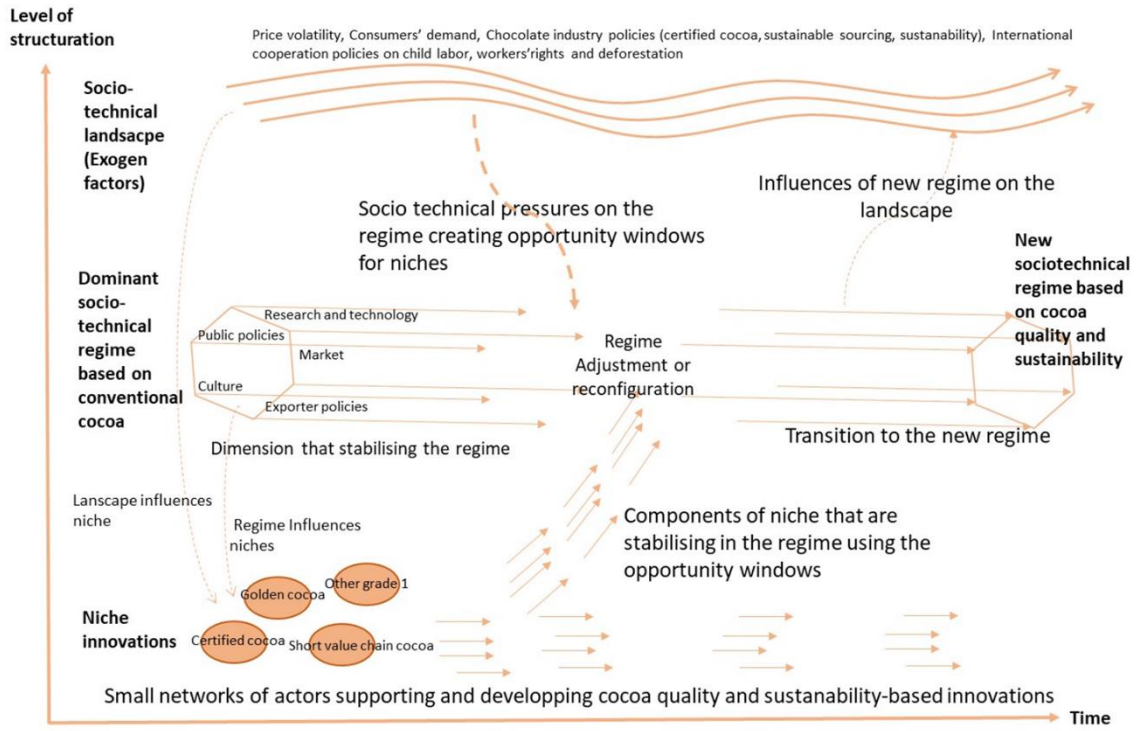
(2) Dynamics driven by national and international development agencies. This dynamic is mainly driven by GIZ and SNV which are deeply involved into development of what they called “Cameroon Golden Cocoa”.

(3) Dynamics driven by FO such as CONAPROCAM initiative, which aims at developing direct market channels with foreign chocolate factories, which are looking for particular flavor.

(4) Dynamics driven by partnership between private and Third sector such as the partnership between Telcar Cacao and CICC to implement Centers of Excellence within which the quality of post-harvest produced cocoa is measured. A measure whereby premium of excellence are offered to the most promising farmers in order to encourage them and encourage the other ones to produce good quality cocoa. This initiative mainly target young cocoa farmers.

These various dynamics are organized as small, scattered and independent networks driven by various actors. These innovative initiatives tend to multiply but they remain at the niche level. The predominant question here is how the quality can be improved on a large scale.

Figure 4. Towards a transition to a cocoa quality and sustainability dominant regime



Source: Adapted from Geels and Schot (2007) and Nuijten et al. (2013)

4. Discussion: what are the main challenges for cocoa quality?

4.1. Embeddedness of cocoa innovation services into intensive production models

Capacity building on good agricultural practices for production are the most provided services. The main beneficiaries of these services are both FO and individual farmers. In almost all the cases, they do not apply to gain access to services. These services are mainly based on intensive models of cocoa production, which aims at increasing yield. These models seems inappropriate for smallholders due to cocoa price volatility and inputs supply difficulties (Jagoret et al. 2018). However farmgate quality getting lower due to pressure of coxers on price negotiation. One of the effects of liberalisation is that some processing functions previously undertaken by farmers are taken illegally by intermediaries (Tollens and Gilbert 2003, Jagoret et al. 2018). These results bring out reflections on the consistency between the actual offer of innovation support services and the transformations that should be supported to increase cocoa quality. The services delivered are based on models of development, which are not align which the development of cocoa quality and the context of cocoa farmers. The main challenge for cocoa quality development will be the change in the mindsets and policies to orient innovation services in cocoa value chain. The new phase of the PRDFCC for the next five years, which is actually discussed, promised to involve these aspects. Furthermore, some interviewees hinted that the cocoa quality in some areas is better than in other regions, so instead of only focusing on global quality, it may be an option to start by using geographical labels. The latter is one of the actual task force of African organization of Intellectual property for "red cocoa" in the Center Region (OAPI).

4.2. Shifting in processing from farmers to intermediaries

Despite its central position in Cameroonian economics, cocoa is not yet a fully controlled and traceable value chain. Since liberalization, producers have had the opportunity to sell cocoa to any intermediaries

who buys it. This raises two main problems. On the one hand in setting the prices granted to producers and on the other hand decrease the capacity for cocoa traceability and quality control. The cocoa beans are sold to intermediate agents who do not necessarily respect the standards on cocoa quality. Quality control was one of the key functions performed by the commodity board (ONPCB) that was abandoned in market reforms of the 1990s. ONCC is actually in charge of the quality control not at the farm-gate but directly at ports. These results lead us to identify ways to professionalize intermediaries of developing the availability of facilities to farmers. We identified five entrepreneurial models of post-harvest activities management: (i) Specialized unit not producing but purchasing cocoa pods to break, ferment and dry; (ii) Unit producing cocoa but purchasing additional pods to complete its production before fermenting and drying; (iii) Producers/cooperatives that make their unit available (rent-out model); (iv) Jointly managed fermentation and drying unit (associated producers or cooperators) for use restricted to associated producers or cooperators; (v) Autonomous mobile unit providing specialized labor and equipment for fermentation and/or drying. The first two cases are prohibited by Decree No. 2005/1212/PM of 27 April 2005 on the regulation, packaging and marketing of cocoa beans, but these practices are still ongoing (REPUBLIC OF CAMEROON 2005). The third and fourth entrepreneurial models are close to those practiced by the Centre's cooperatives with processing units. The fifth model, although observed for other crops such as cassava, has not yet been observed in cocoa in Cameroon. These various models need underline research investigations to determine their efficiency regarding farmer capacity of price negotiation and the level of cocoa quality.

4.3. Drivers of transition to quality and sustainability cocoa regime

Quality issues is not only a matter of technical improvement. External factors can play a role into developing innovations to improve quality and sustainability in Cameroonian agriculture (Bayiha et al. 2019) . Various external factors play in favor of the development of cocoa quality in Cameroun. Figure 4 show the actual situation of the high quality and sustainability cocoa niches regarding the whole dominant regime (Geels and Schot 2007, Bayiha et al. 2019). These analyses based on transition approach framework raised various challenges. Firstly, the need for an exhaustive inventory of the innovative initiatives based on cocoa quality and sustainability. This inventory will permit to better analysis the strength and weakness of those initiatives and their scalability. Secondly, the need to improve and adapt the service offer particularly around the production of knowledge to improve cocoa quality and sustainability, the market articulation and services to support niche development and scaling. Consequently, this transformation of the innovation service offer underlines the integration of new services such as coaching more than training (Österle et al. 2016), creativity capacity building (Faure et al. 2019) and funding dedicated to innovation. Thirdly, we emphasize the need to develop a specific market channel dedicated to quality and sustainable cocoa so that the Cameroonian cocoa quality and sustainability can be visible abroad.

5. Conclusion

Our results show a multiplicity of actors, both formal and informal, involved in provision of cocoa quality and sustainability support service. A particularity of the sub-system is the role played by international research and development organizations, which are involved into providing various services at small scale. Globally, various services are provided: access to resources, capacity building, and access to market, networking, advice and agricultural information. A majority of providers declares that they are involved into building the capacity of cocoa farmers and fewer are involved into production of knowledge on quality, access to the market and scaling of niche market. Even, various external factors play as driver towards cocoa quality production, at national level some challenge are remaining. The first challenge is related to productive model in with the cocoa innovation sub-system is embedded; the second challenge is consequently the need to transform and adapt the offer of service. The last

challenge identify is related to the capacity to build on innovative initiatives which already exist in order to develop strategy of research and development toward a quality cocoa regime.

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REGIONAL AND SUB-SYSTEM SPECIALISATION OF INNOVATION SUPPORT SERVICES PROVIDED IN MADAGASCAR: WHAT KIND OF IMPACT CAN BE EXPECTED FOR FARMERS?

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Abstract: Agricultural innovation is acknowledged as a driver for rural development, particularly regarding southern countries situations, where agricultural sector is the main activity for rural population. The SERVInnov project aims at strengthening innovation support providers' (ISP) capacities to provide efficient and relevant services to innovators to enable them to successfully overcome problems and improve their livelihoods. This communication presents empirical results from Madagascar, by mobilizing AKIS and ISS frameworks. It focuses on organizational and spatial diversity of services provided to innovators. We studied 5 agricultural innovation subsystems (IsubS), namely staple food, exportation crop, organic farming, poultry farming, and digital agriculture. We selected 4 administrative regions, localized in the center highland area of Madagascar, encompassing similar biophysical conditions but with different cropping systems and economic situations: Itasy, Vakinankaratra, Amoroman'i, Analamanga. The method consisted on ISP and services characterization. Then, we identify trends regarding any specialization or homogenization among ISP, ISubS and spatial units. Results show that services provided are specific to IsubS, and rely on several specialized ISP. For example, exportation crops IsubS are mainly composed by market-oriented services, through support to farmers organisations, tracking of food products, contract farming and are mainly provided by private organisations. Staple food and organic farming IsubS are dominated by technical advices provision through training and demonstration plots, mainly provided by public organisations, funded by international donors, whereas poultry farming IsubS focuses on access to resource like inputs, and equipment. Digital agriculture IsubS is a really recent sector, hence services are mainly related to advisory and information sharing through mobile phone, currently provided by private organisations but also by few research centers. Regarding spatial allocation of ISP, exportation and poultry IsubS are mainly localised in regions closed to the capital. Staple food IsubS is mainly concentrated in Vakinankaratra region thanks to its high diversity of staple crops. ISP in organic farming IsubS intervene in specific regions, illustrating an implicit spatial distribution strategy. These results, raise concerns about real efficiency regarding services relevant and able to reach innovators' needs. On one hand, services specialization according to IsubS hinder systemic approach of farming-systems, whereas household's resilience in highland area of Madagascar relies on diversification of farming activities. Then, spatial distribution of services and ISP may imply that provision of services are unequally accessible for farmers, and through different approaches, values and tools.

SUPPORTING AGRICULTURAL AND AGRI-FOOD INNOVATIONS FOR STAPLE FOOD PRODUCTION IN CAMEROON: PLURALISM OF ORGANIZATIONS, DUPLICITY AND DISCONTINUITY OF SERVICES

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Abstract

The innovation systems approach is an analytical framework that is increasingly used to address agricultural innovation support services (ISSs). In the staple food production sector of Cameroon, a plurality of innovation support service providers (ISPs) co-exist, but ISSs are largely delivered within the framework of agricultural and rural development projects or programs. This paper aims to assess the impact of such governance mode on ISS delivery. Using a mixed research approach, empirical data have been collected focusing on the cassava innovation sub-sector in Southern region of Cameroon. ISPs at the local, regional and national levels (n=11) were first identified through literature review. Semi-structured questionnaires were administered to this first sample in order to create an ISP and projects database. A second semi-structured questionnaire was then administered to an enlarged group of ISP respondents (n=27) in order to characterize ISPs and ISSs, as well as to identify and measure the interactions among ISPs. Results indicate that public international and national ISPs dominate the system (high number of projects, ISSs and interactions with other ISPs), and that this leads to duplicity of certain types of services. The private sector and Farmer-Based Organizations (FBOs) are also present and offer rather complementary ISSs, but their number is comparatively lower. The lack of intermediary services to coordinate the overall ISS system, the rather low density level of ISP interactions and their informal quality give the impression of a fragmented ISS system. But, the interactions among ISPs are actually essentially very uneven. Although international public ISPs already interact well with FBOs, partnership strategies towards national public ISPs still need to be implemented. In turn, national public ISPs should also strengthen their links with these FBOs. Overall, ISSs delivered by national and international public ISPs, as well as by the FBO umbrella organization (PROPAC) are mainly funded on project bases, which raises the risk of service discontinuity. Multi-actor partnerships and innovative mixed funding strategies need to be supported to improve the efficacy and the quality of ISSs delivery.

Introduction

Agriculture is the backbone of Cameroon's productive sector representing 22.8% of the Gross National Product and employing 65% of the country's active population. Agriculture contributes to the national food security and sovereignty, to foreign exchange earnings and produces raw materials for the industrial sector (Mouafor et al., 2016).

In Cameroon, staple crop production employs more than 50% of the active population and contributes about 64% of the agricultural GDP (République du Cameroun, 2010). Staple crops include a wide variety of agricultural products: roots and tubers (cassava, cocoyam, potato, yam, etc.), cereals (maize, paddy rice, millet and sorghum, etc.), oilseeds (groundnuts, cotton seed, etc.), fruits and vegetables such as bananas, plantains, pineapples, papaya, but also sausages, avocados, dried vegetables, spices, leafy vegetables, ornamental plants and flowers, etc. (Kidd et al., 2000; Achancho, 2013). Staple crops are less demanding in terms of investment in inputs than export crops, as such, staple crops ensure food security through self-consumption, the supply of local markets and the generation of income for agricultural households and mainly women (Mouafor et al., 2016). Despite this diversity of products and its contribution to the country's food and nutritional security, agricultural yields remain low compared

to their agronomic potential (Kwa & Temple, 2019). Production techniques remain very manual, using few inputs except for some very intensive forms of production such as banana production for exports. The perishability of products and the failure of infrastructural logistics also generate heavy post-harvest losses. Other constraints include weak organization of actors within the food chains, embryonic processing and marketing (FAO, 2018; Ebela, 2017).

The importance of staple food for Cameroon has been taken into account in agricultural and food policies (Ebela, 2017; Fongang, 2008). In particular, the Food Crop Development Mission (MIDEVIV) created in 1981 as part of a national plan entrusted by the State mainly aimed at supporting the production and marketing, as well as the supply of improved seeds to farmers. This orientation has been reaffirmed in the context of the New Agricultural Policy, formulated after the economic crisis that led the State to withdraw from some of its providential functions. The formulation of the Development Strategy of the Rural Sector in 2006 and its revision within the framework of the Strategic Document for Growth and Employment in 2010, which continue to structure the current agricultural policy guidelines take into account the food production sector, but remain quite generic and focused on productivity objectives. Moreover, the recent public policies in support to agricultural innovations (Ntsama, 2009) remain guided by the development model of the 1960s and 1970s Green Revolution in Asia, that is, that of high capital-intensive, input-intensive and highly productive agriculture (Bayiha et al., 2019). This is however in contradiction with the international guidelines, such as the renewed MDGs edited by the Food and Agriculture Organization (FAO, 2020; Dury et al., 2019) which encourage a renewal of conventional agricultural intensification policies by integrating sustainability aspects such as environmental resource management and social inclusion in order to reduce unequal access to food resources.

Agricultural innovations in Cameroon have traditionally followed a “diffusionist” scheme in which innovations - mostly technical such as new varieties, cultural practices and technical itineraries - originate from national public research organizations and are then disseminated to farmers by agricultural extension services through producer organizations (IRAD, 2013). The disengagement of the state from its public functions between 1980 and 2000 has however stimulated the emergence of a myriad of new actors (private organizations, international and national NGOs, NGO networks, inter-professional organizations, farmer organizations (FO) and their grouping). Through specific development projects and programs, these providers are engaged in a wide range of activities such as: distribution of seeds and improved seedlings to farmers, agricultural marketing, rural animation, organization of farmers involved in agricultural chains, technical experimentation, supply of other agricultural inputs, technical advice, agricultural financing, etc. (Temple et al., 2019). These activities can be defined as innovation support services (ISSs). "*An innovation support service is intangible, and involves one or more suppliers and one or more beneficiaries in activities in which they interact to address a more or less explicit request arising from a problematic situation and formulated by the beneficiaries and to co-produce the services aimed at solving the problem. Interactions aim to achieve one or more beneficiary objectives based on the desire to strengthen an innovation process, i.e. to promote technical and social design, enable ownership and use of innovations, facilitate access to resources, help transform the environment and build capacity for innovation*" (Mathé et al., 2016). The consolidation of farmer organizations has received a particular attention from the State that wishes to precisely invest in projects/programs aiming at consolidating farmer organizations and improve food security (Ntsama, 2009).

However, despite the implementation of these strategies and the emergence of projects/programs to increase the quantities produced of certain food crops (cassava, maize and plantain), it must be noted that the volume of the main food crops has remained almost stagnant (Achancho, 2013) or that at least production per agricultural input has slightly increased. This raises questions about the effectiveness of projects/programs as a means of intervention in support to agricultural and agri-food innovations. Project and program-based development interventions can allow a diversity of actors to join forces and thereby contribute to build farmers’ individual and collective problem solving and innovation capacities

(Nagel, 1997). There are however also many examples of partnerships within the framework of projects which have failed to promote and disseminate innovations, in some cases due to a lack of linkages with some local organizations and market actors (Hall, 2006), due to strong network failure blocking the access to external knowledge (Mofakkarul et al., 2013) or due to loose relationships between the actors of a network (Magala et al., 2019), leading to "missed opportunities for collaboration and a limited recombination of knowledge and resources" (Hermans et al., 2015). Projects/programs also constitute a clear risk to the continuity of service provision due to their short time span as it has been observed in other contexts (Martínez-Cruz et al., 2019; Kidd et al., 2000; Faure et al., 2013).

Taking the cassava crop as an illustration of the staple food sub-sector in Cameroon, this paper aims to assess the importance of public project/programs as a mode of ISS delivery. It shall characterize and allow a comparison of the innovation support providers (types of organizations, types of delivered ISS, types of supported innovations and types of funding arrangements) and finally examine their linkages (density of interactions and nature of their relationship). We define "innovation support service provider" (ISP) as any actor (individual or corporate) who offers one or more innovation support services to another actor across the innovation process.

Research methodology

ISPs identification (Phase 1)

The study was conducted within the framework of the SERVInnov project (https://umr-innovation.cirad.fr/projets/servinnov). The Southern region of Cameroon is one of the main staple crop production lowlands area and was thus selected to analyse its Cassava innovation sub-system. Based on a literature review (including grey literature in French), a first sample of 11 ISPs active at the local, regional and national levels were identified (Table 1). A semi-structured questionnaire and face-to-face interviews with these ISPs were then conducted in order to obtain a general understanding of the sub-sector and to identify new ISPs. The interview guide was divided into five sub-sections: overview of cassava's food chain in Cameroon, agricultural innovations developed in this food chain, ISPs engaged, innovation support system and main constraints encountered by ISPs. The interviews took place in the Southern, Central and Littoral Regions from April 26, 2019 to June 08, 2019.

ISPs and ISSs characterization (Phase 2)

Using the answers from the first phase of data collection and using a snowball sampling technique, a larger sample of ISPs was formed. In total, 27 semi-structured interviews were conducted with representatives from 14 organizations and 5 individuals which we classified into the informal sector, as they supply ISSs outside of any formal institution. These individuals are economic actors who have develop some expertise about cassava. All of them are present and active in the Southern region of Cameroon (Table 1). The questionnaire focused on the ISP typology, the offered ISSs, the main beneficiaries of these services, the funding mechanisms and the interactions of the ISP with other ISPs of the subsystem.

Table 1. Number of conducted interviews among innovation support service providers (ISPs) for each study phase

ISP types	Interviewed ISPs	Phase 1: ISPs identification	Phase 2: ISP and ISS characterisation
National public organizations	MINADER (DRCQ)	2	8
	MINEPAT	1	1
	IRAD	1	1
	IMPM		1
	Agricultural chambers		2

International public organizations	IITA	1	1
	CTA		1
	PRASAC	1	1
Private enterprises	CRIFAT		1
	Rural Investment Credit		1
	People's Finances		1
Farmer-based organizations (FBOs)	PROPAC		1
	CNOP-CAM	1	1
	PIP-CV	1	1
Informal sector	Individuals	3	5
Total		11	27

Interview data analysis

Transcriptions and coding of the qualitative information for the two study phases were done without the use of any software. Quantitative data were processed in EXCEL 2013.

ISPs mapping

A social network analysis of the identified ISPs was conducted with the mean of an actor matrix (Biggs & Matsaert, 2004). When constructing the actor matrix, emphasis was placed on the presence or absence of interactions between ISPs. In this study, interactions between ISPs are defined as any type of contact, formal or informal, between two or more ISPs leading to exchange of information, activities, access to inputs or trade related to cassava. The matrix also included the nature of the linkages: informal collaboration (informal interactions between two or more providers), partnership (interactions between two or more providers which are formalized by a contract), and coopetition (collaborative work among potentially competing ISPs in a way that benefits both of them). This matrix was then used to manually draw the ISP mapping. This was done using EXCEL 2013 from Microsoft Office.

Measure of ISP interactions

Using the actor matrix and based on a methodology from Borgatti et al. (2009), we were able to calculate:

Degree of connection

To have information on the weight of each ISP in the network, we calculated the degree of connection of each ISP. According to Mercklé (2004), the degree of connection of an actor is an indicator of its integration or, on the contrary, of its isolation in the entire network, or an indicator of its centrality. An actor's degree of connection is indicated by the number of non-zero entries (numerical sum) that are recorded in an actor's row or column of an actor matrix, in other words, it is its total number of linkages to other ISPs.

Percentage of interactions

To know the total number of interactions per ISP within the system, we calculated the percentage of interactions between ISPs.

Ni= ((n×n)-n)/2, where Ni: maximum number of possible interactions and n: number of ISPs. The totality of the 15 ISPs was used to calculate the maximum number of possible interactions between ISPs in the cassava innovation subsystem.

Density of network

To know the number of ISPs who are actually linked to others within the system, we calculated the density (D) of the ISP network.

D = λ/ (N (N-λ)/2) where λ: total number of linkages and N is the number of ISPs in the network.

Results

The results of the data collection and data analysis are presented hereafter. First of all, a general characterisation of ISPs (governance type, administrative scale of activity) is provided. Secondly, the ISSs are characterised in terms of their type of service and level of importance for the ISPs, as well as in terms of their main funding source (project- or non-project-funded). The different funding arrangements for each type of ISS are then also provided. Finally, the mapping and measure of the interactions between ISPs are presented and the nature of the collaboration arrangements is identified.

ISPs characterization

The cassava innovation system is characterized by the existence of a plurality of ISPs (

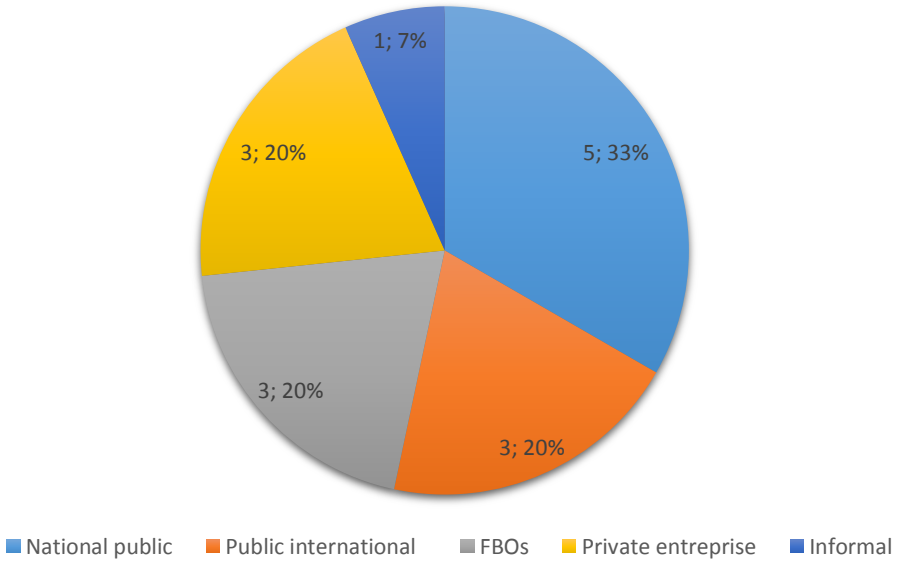


Figure *1*). On the basis of their status, objectives and source of funding, they can be classified into five categories: national public, international public, Farmer-Based Organization (FBOs), private enterprises, and informal (independent individuals). Based on our investigation, the most numerous ISPs in the cassava sector are national public organizations (MINADER, MINEPAT, IRAD, IMPM, and the Chamber of Agriculture). International public organizations (IITA, CTA, PRASAC), FBOs (PROPAC, PIP-CV, CNOP-CAM) and private enterprises (CRIFAT, Rural investement credit and People's finances) each count three organizations and the informal sector counts one individual.

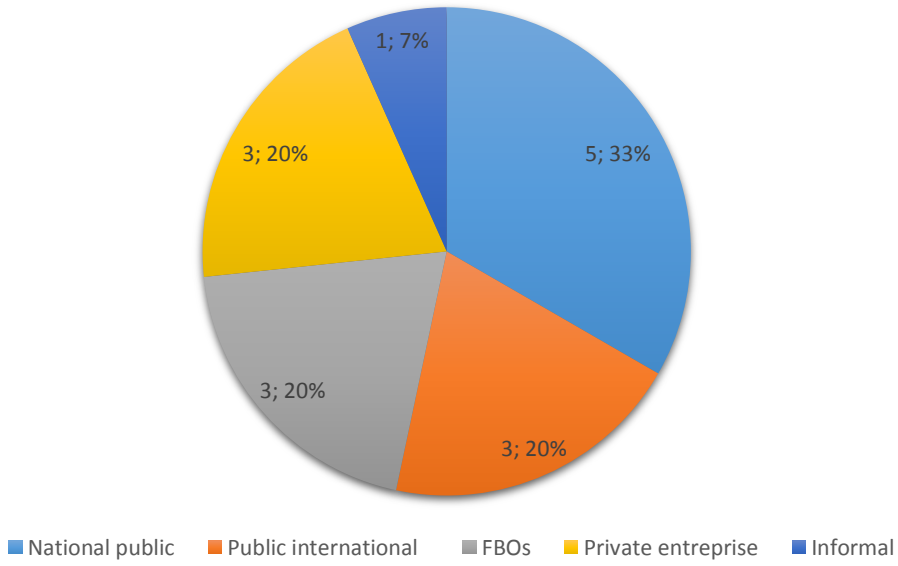


Figure 1. Distribution (absolute numbers) of innovation support service providers (ISPs) types in the cassava subsector in the Southern region of Cameroon

ISSs characterization

Seven categories of innovation support services (ISSs) have been identified within the cassava innovation subsystem (

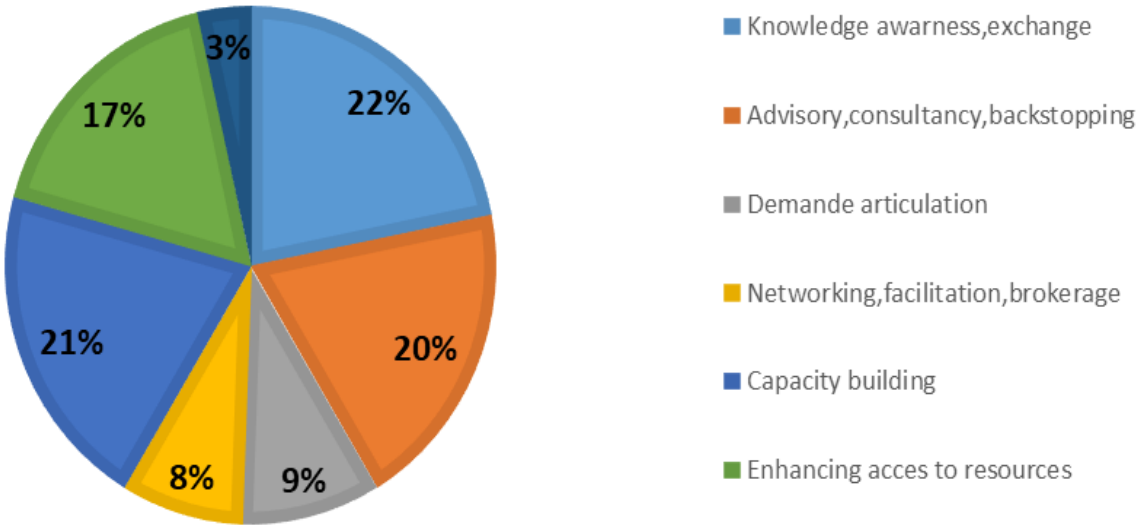


Figure *2*). Knowledge awareness and exchange (22%) is the main provided service followed by capacity building (21%), advisory, consultancy and backstopping (20%), enhancing access to resources (17%) and much less provided are demand articulation (9%), networking, facilitation and brokerage (8%) and institutional support for niche innovation, and scaling (3%).

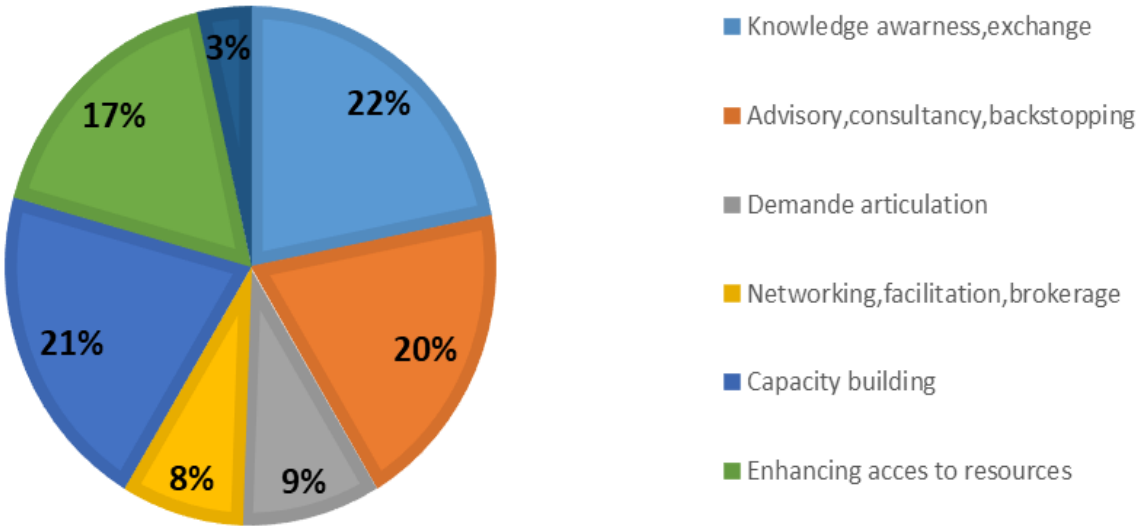


Figure 2. Distribution (%) of innovation support services (ISS) types in the cassava subsector in the Southern region of Cameroon

ISSs / ISPs			KNOWL. (Knowledge awareness, exchange)	ADVIS. (advisory, consultancy, backstopping)	MARKET. (demand articulation)	NETWORK (networking, facilitation, brokerage)	TRAIN. (capacity building)	RESS. (enhancing access to resources)	INSTIT. (institutional support for niche innov., scaling)
Type	**Name**	**Project**							
International public	IITA		++	++	O	O	++	+	+
	CTA	Manioc 21	++	+	+	++	++	+	O
	PRASAC		++	+	++	+	++	+	O
Nation. public	IRAD		++	++	O	O	++	+	+
	IMPM		O	O	O	O	O	++	O
	MINADER	DRCQ	++	++	O	O	+	+	++
		PIMDA	++	+	+	+	++	++	O
		PADRT	++	++	+	O	O	++	O
		APAPE	++	++	+	+	++	+	O
		PROSAPV	++	++	O	O	++	+	O
		PAPMAV-Q	++	O	O	O	O	O	O
		ACEFA	+	++	+	O	+	++	O
		AFOP	+	++	O	O	++	++	O
		PAIJA	+	++	O	O	++	++	O
	MINEPAT	Agropoles	++	+	+	+	++	++	O
	Chamb. of Agriculture	Pionnier	++	++	+	+	++	+	O
		CIP	++	+	O	O	++	O	++

Private Entr.	CRIFAT	YA-Manioc	O	++	**++**	O	**++**	**+**	O
	Rural inv. credit		O	O	O	O	O	++	O
	People's finances		O	O	O	O	O	++	O
FBOs	PROPAC		**++**	**++**	**+**	**+**	**++**	**+**	O
	PIP-CV		++	+	**++**	++	+	+	O
	CNOP-CAM		++	+	+	++	**++**	+	O
Inform.	Individuals		++	++	O	+	++	O	O

++: Main service provided

++: Main service provided mainly through projects/programs

+: Service provided of secondary importance for the ISPs

+: Service provided of secondary importance for the ISPs mainly through projects/programs

O: Service not provided at all

Table 2 Innovation support services (ISSs) provided by innovation support service providers (ISPs) of the Cassava subsector in Southern Cameroon.

Depending on their type, ISPs provide specific ISSs which are either of primary (among the three ISSs that they the most actively provide) or secondary importance to them (Table 2). We further specify whether these services are provided within the framework of projects or programs and whether the share of project funding is the greatest or not in the case of ISS co-funding.

The international public organizations solely supply project-/program-based ISSs. Knowledge dissemination and training prevail (development of and training on local seed varieties, improvement of cropping practices, fight against diseases and rodents, conservation and food products processing). Recent projects (Manioc 21) however entail new types of services aimed at strengthening the entrepreneurship, Marketing, networking and financing capacities of cassava producers and their cooperatives (trainings, development and facilitate access to ICT tools, new marketing linkages and innovative financing schemes). Facilitating access to resources is a secondary activity of all the international public actors. Institutional support is only provided by IITA as an activity of secondary importance.

All the national public service providers – with the exception of IMPM and two projects of the MINADER – deliver ISSs within the framework of projects which largely remain focused on knowledge dissemination, advisory and training. The majority of the national public ISPs are also strongly involved in facilitating farmers' access to resources (e.g. Programme Agropoles from the Chamber of Agriculture, the PIMDA, PADRT, ACEFA, AFOP and PAIJA programs from the MINADER, IMPM). Marketing and networking ISSs are rather secondary activities for those who carry them out (MINADER, MINEPAT and Chamber of Agriculture). Institutional support is only a major activity of two organizations: the Chamber of Agriculture (CIP) and the MINADER (DRCQ). The latter provides, for instance, seed plots certification and the granting of approvals to seed companies.

Private organizations, in contrast, seldom provide services through projects or programmes Only one actor, CRIFAT provides services such as demand articulation, training and access to resources facilitation through the YA-Manioc Project. Moreover, private ISPs are not at all engaged in knowledge dissemination and institutional support. Facilitating access to resources of cassava producers is the main or the secondary activity of private ISPs.

Among FBO's main services are knowledge dissemination (all three FBOs), networking and training (two providers) and advisory (PROVAC, project-funded). The public FBOs consider advisory (PIP-CV, CNOP-CAM), Marketing (PROVAC, CNOP-CAM) and facilitation to access resources (all three) as rather secondary activities to them. Institutional support doesn't count among their activities at all. PROPAC's activities are mostly project-based; whereas the two other interviewed FBOs only fund one of their service types through project (Marketing support and training).

The interviewed individuals support innovative stakeholders with knowledge dissemination, advisory, training and to a lesser extent networking.

Several respondents report a lack of coordination among the actors and duplicity of actions. One member of an FBO ISP explains: "My structure (PIP-CV) has direct partnerships with other ISPs. As far as relationships are concerned, there is no interaction because for the moment everyone is acting on his own. Sometimes they act on the same activity but do not collaborate. An example: CTA came to train the same actors and the same way as PRASAC had already done. We do the same things with the same people and repeat ourselves over and over again." Different projects also focus on the same varietal innovations developed by IRAD and IITA such as: APAPE, PADRT, Pioneer Program, PIDMA and PAPMAV-Q. Indeed, these projects/programs are all involved in the dissemination of the same improved varieties of cassava cuttings (8034 and 96/1414 developed respectively by IRAD and IITA) to women producers located in the same production areas.

ISSs / ISPs			KNOWL.			ADVIS.			MARKET.			NETWORK.			TRAIN.			RESS.			INSTIT.		
Type	**Name**	**Project**																					
International public	IITA		+			+									+			X			+		
	CTA	Manioc 21	+			+			+			+			+			+					
	PRASAC		+			+			+			+			+			+					
National public	IRAD		+			+									+			X			+		
	IMPM																	O					
	MINADER	DRCQ	O			*									*			O			*		
		PIMDA	X			X			X			X			X			X					
		PADRT	X			X			X									X					
		APAPE	X			X			X			X			X			X					
		PROSAPVA	+			+									X			X					
		PAPMAV-Q	+																				
		ACEFA	X			X									X			X					
		AFOP	+			+									+			X					
		PAIJA	+			+									+			X					
	MINEPAT	Programme agropole	X			X			X			X			X			X					
	Chamber of Agriculture	Programme pionnier	X			X			X			X			X			X					
		CIP	X			*									X						X		

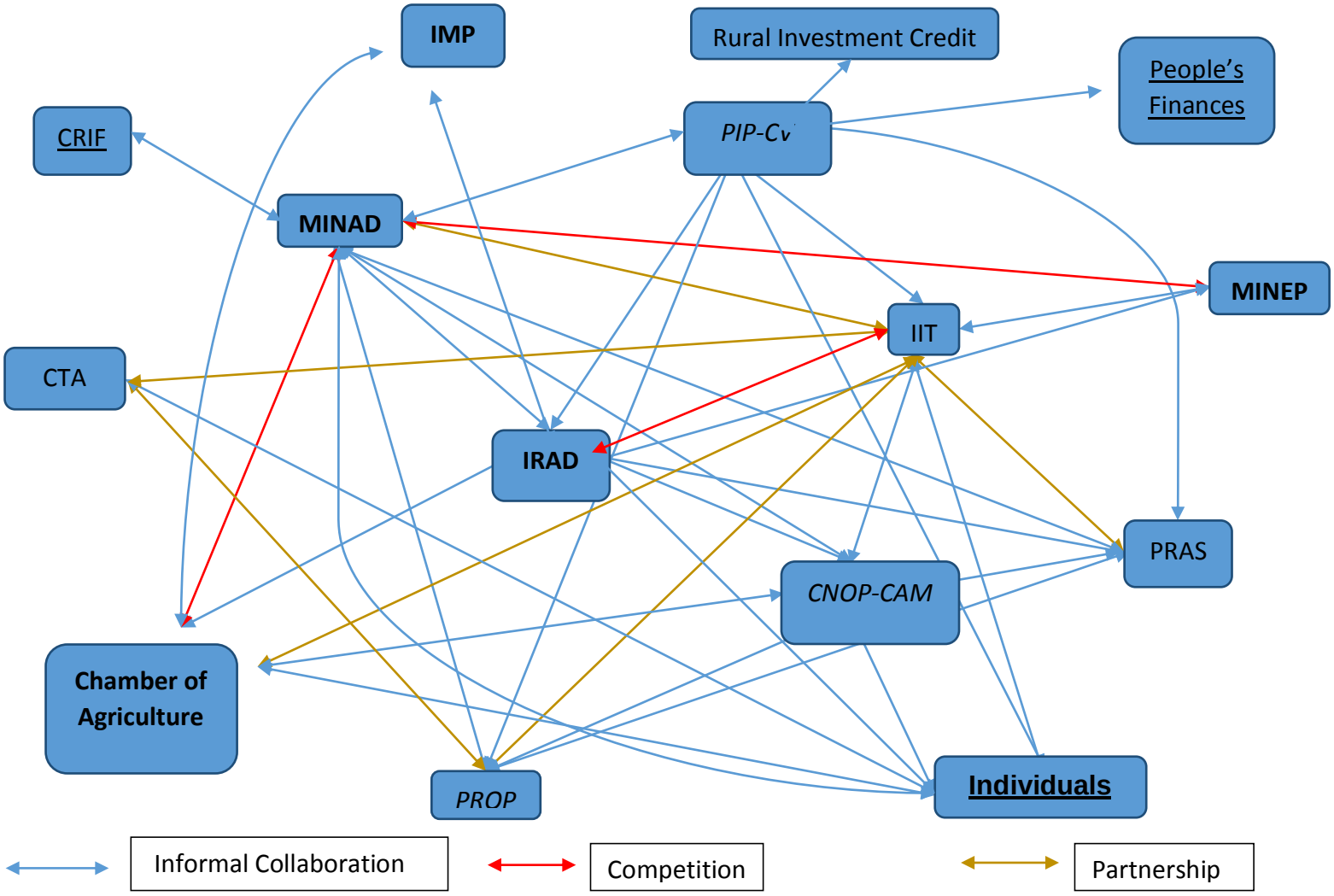
Private Entreprise	CRIFAT	YA-Manioc				*			X						X									
	Rural investement credit																		O					
	People's finances																		O					
FBOs	PROPAC		+			+			+			+			+			+					
	PIP-CV		+	*	X	+	*	X	+	*	X	+	*	X	+	*	X	+	*	X				
	CNOP-CAM		+	*	X	+	*	X	+	*	X	+			+	*	X	+	*	X				
Informal	Individuals		*			*						*			+	*								

+ : Solely Project/Program-funding * : Solely charged to ISS beneficiaries

O : ISP-Beneficiary co-funding X : Project-Beneficiary co-funding

Abbreviations of ISS types: KNOWL. (Knowledge awareness and exchange), ADVIS. (advisory, consultancy, backstopping), MARKET. (demand articulation), NETWORK. (networking, facilitation and brokerage), TRAIN. (capacity building), RESS. (enhancing access to resources), INSTIT. (institutional support for niche innovation, and scaling).

Table 3. Innovation support services (ISSs) funding mechanisms of innovation support service provider (ISPs) in the Cassava subsector of Southern Cameroon.


IMP
Rural Investment Credit
People's Finances
CRIF
PIP-Cv
MINAD
MINEP
IIT
CTA
IRAD
PRAS
CNOP-CAM
Chamber of Agriculture
PROP
Individuals
Informal Collaboration
Competition
Partnership

The funding mechanisms which are used to finance ISSs differ among the various ISP types (Table 3). International public ISPs usually finance the delivered ISSs through project funds as a sole source of funding (16 counts out of 17). Most of the national public ISPs also do so (13 counts), but co-funding with the participation of ISS beneficiaries is even more commonly used (39 counts). The DRCQ, a project of the MINADER utilises alternative modes such as ISP-Beneficiary co-funding (KNOWL., RESS.) or service costs can also entirely be charged to the beneficiairies (ADVIS., TRAIN., INST.). Private enterprises use all types of mechanisms except purely project-funds. Public FBOs use three different types of funding mechanims also within one category of ISS (co-funding by projects and beneficiaries, beneficiary-funding or project-funding). Finally, individuals' ISS charge the beneficiaries (3 counts out of 4) or benefit from project-funding (TRAIN.).

Interactions between ISPs

Nature and degree of connection

As it can be observed on the mapping of interactions (Figure 3), each of the ISPs have at least one informal collaboration with another ISP; this is the main collaboration arrangement. Formalised partnerships happen only among some of the international public ISPs (2 counts), as well as between international and national public ISPs (2 counts) or between the international public ISPs and the Public FBO PROPAC (2 counts). Relationships of coopetition happen among national public ISPs (2 counts) and among national and international public ISPs (IRAD-IITA).

The ISPs interactions mapping also shows the number of interactions of each ISP with other ISPs (Figure 3). Actors who participate in programs have a high number of connections with other ISPs: 9 and 10 connections of the MINADER and IRAD, respectively, 10 connections of the IITA. FBOs are connected to a high number of public ISPs (6-7 connections) and individuals. Only one FBO (PIP-CV) is informally connected to a private actor (the Rural Investment Credit). Private actors seem particularly weakly connected with only one client each. Percentage of interactions and density of network

Our analysis shows that only 38% of interactions (80 interactions) are maintained between ISPs of the cassava subsector, which is relatively low as compared to the maximum number of interactions that could be reached (210 interactions). This result is confirmed by the calculation of a network density indicator which is equal to 0.38, lower than that of an ideal situation (density =1). The relationships to economic actors of the value chain seems to be missing as one interviewee mentioned: "The prospects are not promising because of the lack of real and practical coordination of actions of all stakeholders in the cassava sector towards the main actors, namely farmers, processors, traders and distributors of fresh and processed cassava products" (Y1 - researcher specialized in cassava).

If all types of interactions are taken into consideration, the density of interaction of international ISPs with FBOs is high (78%), medium with national public ISPs (40%) and other international public ISPs (33%). The density of interaction of national public ISPs is high with other ISPs of the same type (70%), medium with FBOs (40%) and very low with individuals (20%) and private actors (7%). The density of interaction of private actors is the highest with FBOs (22%) and FBOs' density of connection with other FBOs is only 50%, 67% with individuals and 11% with private enterprises.

Discussion

Examining the innovation support system of the cassava sub-sector in Southern Cameroon can potentially help identify some hindering aspects to its development. This is at utmost importance

given the need to better align innovation objectives with social and environmental challenges, such as food security, rural employment, and inclusiveness.

From our empirical results, it clearly stands out that ISSs are mostly provided within the framework of public projects or programs (13 have been identified) that apparently follow a top-down approach with little coordination among them. The relative high importance of project/programs can be explained by the dominance of international and national public ISPs and by the relative low representation of other actor types. This illustrates the relative low level of privatization of agricultural extensive services as compared with other African countries (Pelon, 2019). As a result, ISSs still mostly consist in knowledge awareness and exchange, advisory and training on technical innovations (e.g. seed varieties) which originate from international and national Research and Development institutions in a top-down manner. This corresponds to the first STI policy frame described by Schot & Steinmueller (2018). Networking, demand articulation and enhancing access to resources which aim at building links and stimulating learning between elements in the systems, and enabling entrepreneurship (Schot & Steinmueller, 2018) are also well represented, but remain rather secondary activities to most of the public ISPs. In contrast, the private sector defines resource enhancement as one of its main or secondary activity. Finally, FBOs are also key actors in terms of organization of women producers and processors. The private and FBO sector thus seem to complement well the public offer, although many types of ISSs are not enough delivered or are missing (e.g. brokerage functions, institutional support).

Taking informal types of collaboration into consideration, we find that the low percentage of interactions (38%) and density of network (0.38) are similar to those of Spielman et al. (2008) obtained in Ethiopia. This result corroborates observations from other authors on the fact that there is a lack of interaction and coordination among actors of the cassava value chain (Njukwe, 2016; Meyo & Liang, 2012).

Moreover, the high degree of connection obtained by some public organizations and FBOs in the system confirms their central role. The private sector comparatively has a very limited network. This is similar to the situation reported in Costa Rica (Coq et al., 2012). More specifically, the ISPs who are involved in projects or programs are the one having the highest number of connections. Nonetheless, the overall coordination of the network is weak since duplication of interventions have been reported, particularly within the framework of projects. This lack of coordination and capacity to co-produce ISSs with beneficiaries and to align various ISSs could be due to a lack of support to social and organizational innovations (Faure et al., 2019) and to the fact that the percentage of interaction of national public ISPs with FBOs is rather low (40%). FBOs also connect poorly among themselves (50% of interactions). However, international public organizations have developed a relatively higher level of interaction with FBOs (78%) which is promising to align R&D with the needs of smallholder farmers. However, the levels of interaction of international public organizations with national public ISPs (40%) and other international ISPs (33%) could be improved in order to limit the duplication of activities and better coordinate the overall network. National public ISPs already connect well together (70%).

Characterizing the nature of these linkages, we also show that most of the interactions are taking place informally.

One limitation of our study, is that it doesn't show the direction and whether the linkages are impacting or not. It might indeed well be the case that some linkages are ordinary with no implications for the innovation process (Biggs & Matsaert, 2004). As a result, it is hard, for instance, to draw conclusions on the role and true influence of FBOs on innovation processes. Given the technological nature of the supported innovations and the apparent dissatisfaction of FBO representatives about the services they receive through projects, we suppose that the relationship between FBOs and public ISPs gives little space for co-construction of ISSs. Our findings on the funding arrangements pursued by each ISP (Table 3) usefully highlight the fact

that FBOs have recourse to diverse funding modes – except PROPAC a public umbrella organization for FBOs. This can thus give FBOs a certain degree of autonomy (Coq et al., 2012).

A second limitation of our study is that our sampling of ISPs has been formed thanks to interviews with ISPs at the national level (MINADER, extension services and research institutions). This might explain why no other forms of civil society organizations (e.g. NGOs and "Economic Interest Groups") active in the cassava sector were identified. Another reason given by Temple et al. (2017) could be that the relationships between intermediaries and research institutes in Cameroon are rather interpersonal. A more exhaustive ISP mapping should thus be undertaken by the mean of a structured questionnaire sent to a greater diversity of ISPs.

Conclusion

Our study clearly shows that the cassava innovation system of the Southern region of Cameroon is strongly based on ISPs from the public sector, that comprise the so-called mainstream institutions and their projects/programs-funded ISSs. As a consequence, the traditional agricultural extension services that support technical innovations are largely represented in the system. The civil society and private sectors complement the ISSs offer to a certain degree and make use of some alternative funding mechanisms, but there are not many of them. ISSs are mostly dependent on projects funding which can cause some discontinuity of ISS, although FBOs are able to diversify their funding modes. The network of actors is not very dense, but some ISPs (national and international public organizations, FBOs) are strongly linked to a large diversity of other actor types, especially through projects and through informal collaborations. The lack of coordination among actors is felt by FBOs due to the duplicity of ISSs they benefit from. This can be explained by the low percentage of interaction of national public ISPs with them, as well as by the low level of brokerage services in the system.

To address current social and environmental challenges the capacities of the existing organizations need to be reinforced and their coordination improved, especially the one representing farmers' interests. Indeed, our study also highlights the mismatch between FBOs' demand and ISSs offer. This risk which is related to the inability of some project settings to support participatory approaches has already been mentioned in other projects (Klerkx et al., 2017; Coq et al., 2012).

To avoid this, in particular, and as the recent innovation policy framing on socio-technological change suggests, FBOs and other grassroots organizations should become part of multi-actor networks within which they could discuss, experiment niche innovations and collectively learn with other types of actors (Faure et al., 2019; Lowe et al., 2019; Schot & Steinmueller, 2018; Knierim et al., 2017). Some organizations need to develop brokerage and facilitation services, especially to support and facilitate informal and flexible networks or temporary associations of actors at the initial phase of innovations and to more formally structure them at a later stage (Klerkx & Leeuwis, 2009). Such settings also imply searching for some innovative types of funding arrangements which could include the development of some ISSs by FBOs for their members. Ideally, the ISS costs should be shared among different types of actors using mixed funding modes in order to ensure their quality and durability (Nettle et al., 2017; Coq et al., 2012).

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LEARNINGS FROM 12 EU/H2020 PROJECTS ABOUT INTERACTIVE INNOVATION: REFLECTIONS ON THE JOINT SESSION IN THE ESEE CONFERENCE, HOSTED BY TEAGASC, IRELAND, IN JUNE 2021

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Abstract

Interactive innovation is the leading theme in many EU funded projects in Europe. During the ESEE seminar in 2021, hosted by Teagasc, Ireland, a joint session has been organised with contributions from twelve major international projects in the period 2015 - present, in order to find out similarities, differences, common barriers and opportunities for stimulating synergy.

The projects that contributed are: Euraknos / Eureka, IPM, Plaid, AgriDemo, Nefertitti. FairShare, AgriSpin, i2connect, AgriLink, Liaison, Uniseco and NextFood.

The conclusions of this event have not been published so far. IFSA is an opportunity to share the results with the scientific community, and to discuss which issues arise from it for both the scientific and the political agenda.

Key words

Innovation support, interactive innovation, AKIS, European Innovation Partnership programme (EIP), international project management.

Recordings

Pitches: https://www.youtube.com/watch?v=9c26M0684TQ
Summary: https://youtu.be/msFRr0A6mxA

Interactive innovation in 12 EU projects: what did we learn?

After a period in which innovations were supposed to be driven by demand and supply among private partners in the agricultural sector, renewed attention was given in the last decade to the importance of the quality of interaction between farmers, researchers, policy makers and other stakeholders in food and rural development. The European Commission is heavily supporting this movement in its Horizon 2020 / European Innovation Partnership (EIP) programme. This started in 2014 and is prolonged in the new CAP period of 2022-2027. Since then, over 4000 Operational Groups have been -or are being- funded throughout Europe, in which farmers, researchers and other actors work together on developing concrete innovations at farm level. Furthermore, Thematic Networks and other H2020 projects receive EU funding for bringing interactive innovation into practice.

In preparation of the 25th ESEE seminar in June 2021 Tom Kelly (Teagasc), host, and active in a range of H2020 projects, suggested to make use of the opportunity for bringing projects together in an interactive session, in order to exchange experiences and wishes for the future. Twelve EU supported international projects, all focussing on interactive innovation, contributed to the event, which was quite unique for the scientific community: to jointly reflect on work in progress.

Objectives of this event were:

[a] To provide an overview of what is going on in the major EU/H2020 projects on interactive innovation.
[b] To share progress made in the projects regarding the themes of the conference: discoveries as well as questions that still need to be answered.
[c] To create an opportunity for experience sharing co-learning and reflection.
[d] To generate recommendations for policy makers for improving the biosphere in which such projects take place.

Complementarity of the projects

Every project has different objectives and focusses on different aspects of interactive innovation processes. How do they fit into the larger jig-saw puzzle? In an effort to visualise this puzzle, the project representatives were asked to score their orientation on a range of themes along five clusters of key actors in an Agricultural Knowledge and Innovation System (AKIS):

1. *Society*: farmers, actors in the food chain
2. *Experts*: Researchers, technicians
3. *Educators*: Teachers, trainers
4. *Enablers*: managers, policy makers, funding agents
5. *Intermediate actors*: advisors, innovation support agents.

Furthermore, an estimation was made how much emphasis a project gives to:

- *Technical know-how*: technics, economics, data processing and exchange, sustainability.
- *Process know*-how: dynamics of social interaction, methods for participation, co-creation.

During the discussions for preparing the event, a third type of know-how was added:

- *System know-how*: AKIS policies, creating an enabling environment, tools for monitoring.

The result of this quick survey is shown in figure 1.

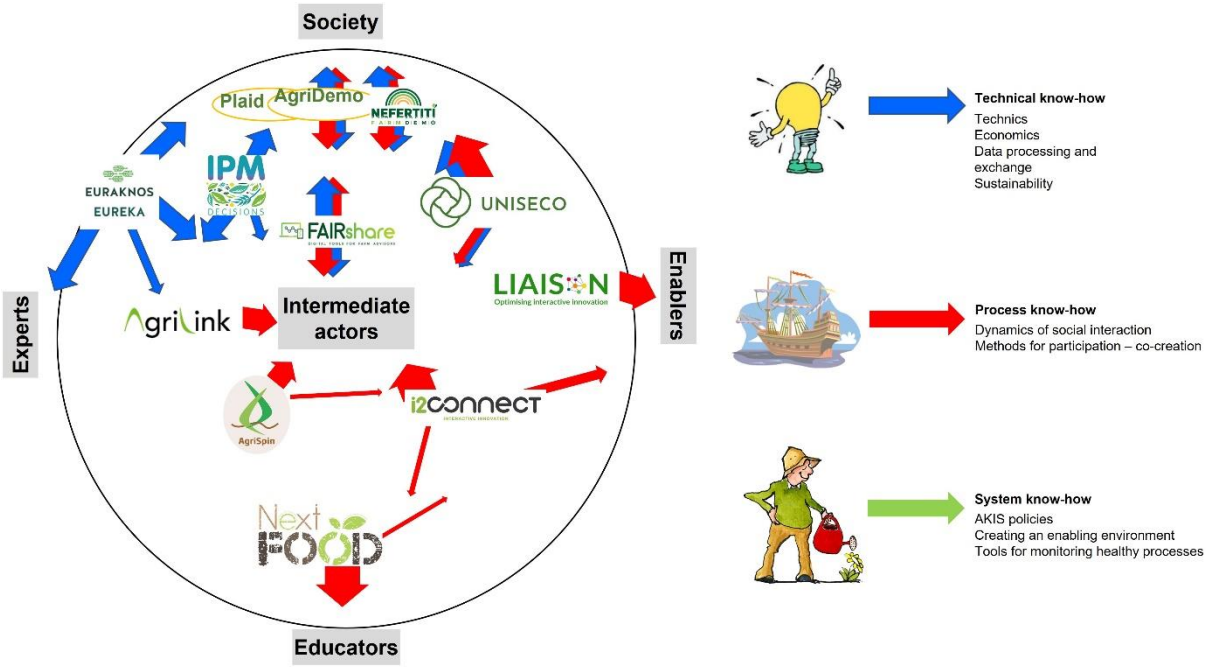


Figure 1: complementarity of 12 projects on interactive innovation

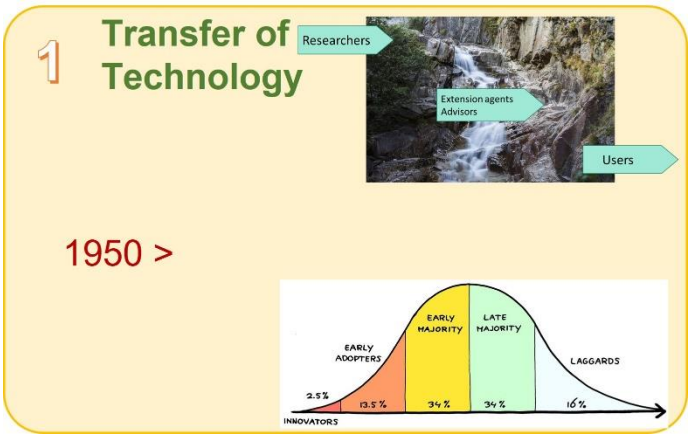
These three types of know-how became the themes for the subgroups in which project representatives discussed the leading questions:

- What are your learnings?
- What do you know by now?
- What is your impact?
- What are your plans and wishes?

The larger picture: 4 successive mainstreams in innovation support

As an introduction to the joint session, the first author of this article placed the current attention for interactive innovation in an historical context.

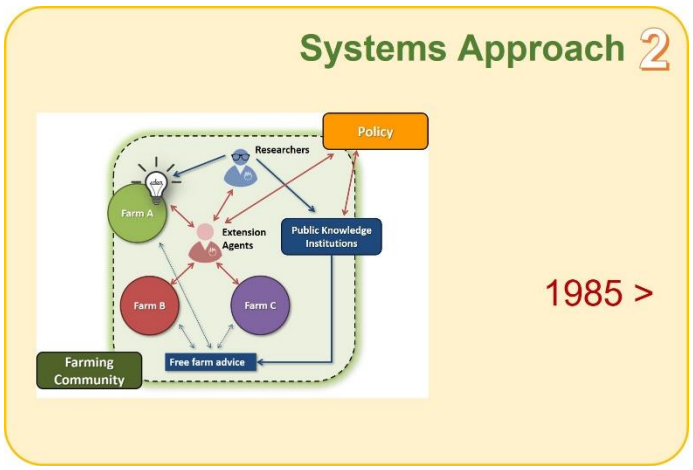
- *Transfer of Technology*



In the years after the Second World War, rapid growth of food production capacity was top priority. Large investments were made in public research institutes, and extension services were seen as public facilities. Knowledge was supposed to flow from research (as the source) via extension (flow) to the farmers (fertile soil). Technicians were in the lead.

In the '60ies, attention was growing for adoption processes. Some farmers are quick to adopt new technologies and others stay behind. In order to stimulate adoption, strategies could be developed by focussing on innovators early adopters first, after which innovations would trickle down to the majority. There will always be laggards who eventually drop out. The adoption curve of Evereth Rogers (1962) became a standard model for extension agents and advisors.

- *Systems Approaches*



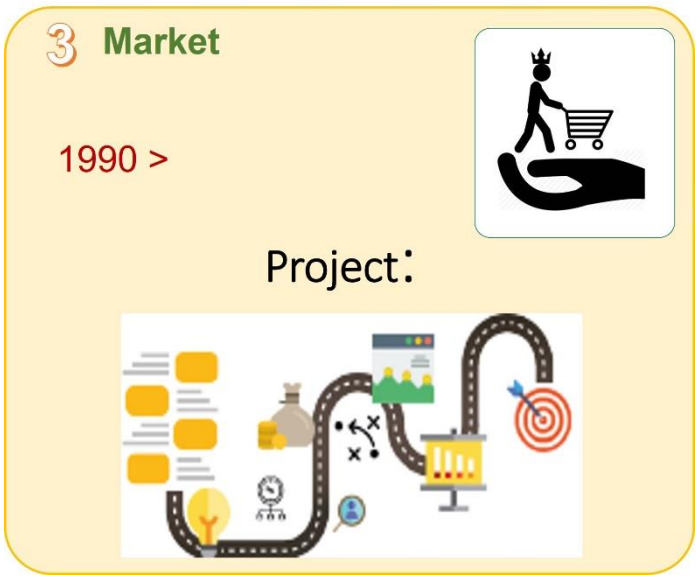
In the '80, awareness grew that the trickle-down assumption could have negative effects for many farmers. So far, the quality of the innovation had been beyond suspicion. 'Laggards' were obviously not so clever and could be ignored. But many farmers had good reasons not to adopt the messages from the technicians. In systems with unequal power distribution, innovations can make some actors rich at the cost of others and limit their access to the knowledge they need.

Furthermore, technicians in their leading role easily ignore relevant knowledge of farmers and their capacity to find new solutions that work for them.

In line with a more general philosophical discourse about society as a system of interrelated actors and connections, the Farming Systems approach became popular among rural sociologists. Instead of just focussing on technical solutions, the entire farming system should be considered by those who aim to stimulate innovations. This includes the economic, social, and political context. Participatory methods were developed in order to give the voiceless a voice in their struggle against oppression (Paolo Freire 1968). It is not the technicians who decide what is best for the farmers: they only assist in the decision-making process of the farmer. 'Extension is assistance in decision making', according to Anne van den Ban (1970).

The capacity of farmers to innovate depends on the quality of the connections between the key actors in a knowledge system. This was the spirit in which AKIS as a concept emerged: Agricultural Knowledge and Information Systems. Information should be distinguished from knowledge: information can be exchanged, whereas everyone develops his own knowledge (Röling 1976, 1988). Innovation support agents have a pivotal role in connecting the key actors in a knowledge system.

- *Knowledge Market*

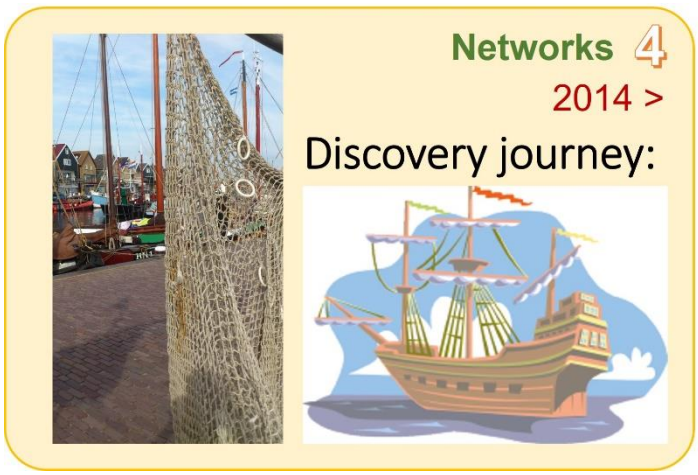


In the '90ies, the market became dominant. The commercial sector was supposed to be more effective and efficient than public agencies. Many public extension agencies were privatised. Knowledge became a product. Researchers were producers. Farmers were clients who pay for knowledge. And extension agents became advisors who were supposed to act as salesmen of knowledge products. Public funding agencies had to learn how to become a client in the market for knowledge products that served the commons. Funding programmes followed the rules of product delivery, with clearly defined goals and measurable results.

Interestingly, AKIS as a concept remained in use, although the distinction between knowledge and information was not so relevant anymore in market thinking. Gradually, *information* was replaced by i*nnovation* in the abbreviation.

Several scholars observed that something was missing: the market does not sufficiently take care of the coherence in the knowledge system. When the pivotal role of innovation support agents in connecting key actors is not collectively paid for, the quality of the wiring of the system decreases. Wielinga (2001) pointed out that the role of the 'Free Actors' in the once so successful Dutch AKIS had been neglected since the privatisation of the public extension service, with detrimental effects on the innovative capacity of the sector. Klerkx (2008) came to a similar observation and promoted the 'knowledge broker' as a concept: agents who match supply and demand in the knowledge market.

- *Networks*



Since the European Commission launched the EIP programme in 2014, the quality of the interactions between the major actors in a knowledge system is back in the focus of attention. It is being acknowledged that not only technicians have valuable knowledge to share, but also farmers and other key actors in the food chain. Solutions are likely to work better for the targeted audiences if they have been actively involved in developing them. Relevant knowledge emerges from interaction.

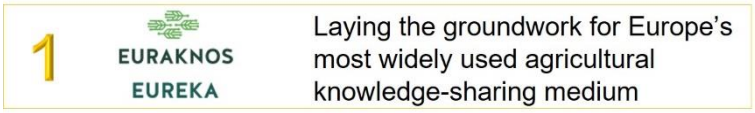
The EIP programme supports thousands of 'Operational Groups' in which farmers, researchers and other actors are supposed to work together on a concrete innovation at farm level. A range of international thematic network projects and interactive innovation projects are being supported as well, in order to share experiences and feed operational groups with support in different ways.

Network approaches consider the quality of relations between actors involved in which hierarchy is not obvious, and initiatives can be taken by any actor, including farmers. The dynamics in such networks differ from those in organisations or projects with clear targets, mandates, and task divisions (Wielinga and Robijn, 2020). A network that works on an innovation is a discovery journey, rather than a production unit. People come together because they share an ambition. The road is uncertain, and the final result is unknown, otherwise it would not be new.

Obviously, it can be expected that structures that have been developed for market approaches do not immediately fit to what is required for efforts into this direction. Within this context, it is now interesting to see how far the different international projects on this track have come, how they fit together, and what can be done to create a more stimulating environment for interactive innovation.

Presentation of twelve EU projects on interactive innovation

Prior to the event, all participating project representatives were asked how they would like to be remembered. Their statements are shown next to the project logo. During the event they presented themselves in a short pitch. What does or did the project aim for? What are the main achievements? And what are key learnings?



https://h2020eureka.eu

Euraknos: 2018-2020

Eureka: 2021-2023: 21 partner organisations in 15 countries.

Pieter Spanoghe (Ghent University, Belgium).

Euraknos and its successor Eureka are forming the network of Thematic Networks. The aim is to collect information that is ready for use, to store it and to make it findable and accessible for users. A major learning of the last two year is that it is a big job to translate scientific knowledge into insights that are concrete, understandable, and useful for farmers.

There is high interest in what the project is doing. The platform will be launched soon[1]. A call to everyone: don't try to do everything on your own. Make use of the platform and let us work together.

[1] https://eufarmbook.eu

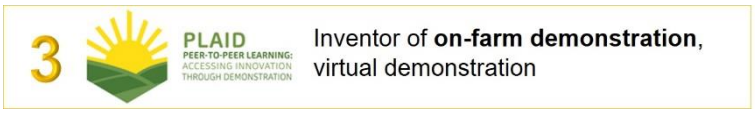
https://www.ipmdecisions.net

Harm Brinks (Delphi, Netherlands)

IPM Decisions: 2019 – 2024. 27 partner organisations in 12 EU countries.

IPM Decisions aims to collect and develop decision support systems for farmers regarding pest control. There are many good examples of practices that have proven to be effective, reducing the amount of chemicals and reducing costs. But the application is still limited. The project aims to promote the use of such practices.

The project supports farmers, advisors, researchers, and IT developers. A platform is about to be launched[2] with open access (end 2021). Furthermore, an IPM demonstration network is being built.



https://plaid-h2020.hutton.ac.uk

https://farmdemo.eu

Plaid: 2017-2019. 23 partner organisations.

Claire Hardy (James Hutton Institute, UK)

The project aimed to stimulate on-farm demonstration activities. What is already happening? How can it be reinforced? How can farmers be encouraged to join such demo's? The value of on-farm demonstrations is in the peer-to-peer exchanges. How can such meetings be facilitated?

The project engaged with farmers, industry, research, policy makers, Operational Groups, etc. With a commitment to open science, it produced easily accessible material.

Virtual demonstrations appeared to be possible and useful. Tools for such demo's were developed, which allow participants to immerse in 360° virtual reality experiences, at times that are convenient to them. Together with its sister project AgriDemo F2F the Plaid project paved the way for Nefertiti.

[2] https://www.ipmdecisions.net/platform

https://agridemo-h2020.eu

AgriDemo F2F 2017-2019. 14 partner organisations.

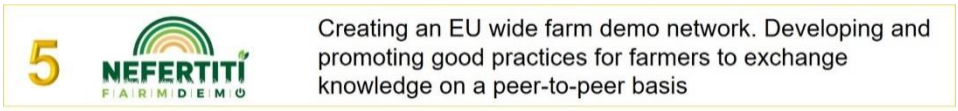
Fleur Marchand (ILVO, Belgium)

The aim of the project was to advance farm-to-farm learning. A European inventory was made of farms engaged in demonstrations resulting in 30 case studies.

The project produced both practical and theoretical output, including a PhD study, on 'spaces for experiential learning'. It showed the importance of accommodative processes of engagement and trust.

Good practices have been converted into design guides, including goals, learning styles and group dynamics. These findings have been embedded in a guide that is available in 11 languages. There is a training kit. This resulted into a request for trainings.

Farm demo platforms have been launched, together with Plaid and Nefertiti. AgriDemo and Plaid became the founding sisters of the Farm Demo Hub *(https://farmdemo.eu).*



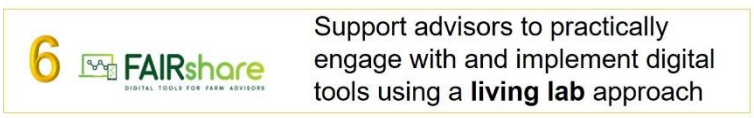
https://nefertiti-h2020.eu

NEFERTITI: 2019-2023. 32 partner organisations in 17 EU countries

Louis Mira (Consulai, Portugal)

Nefertiti is the follow-up project of the previous two: Plaid and AgriDemo. It is a demonstration network of 32 partner organisations. 45 hubs have been established all over Europe. More than 1000 farm demonstrations have been realised with assistance of the project.

The most important heritage from the 3 projects is what has been learned about methodology for successful peer-to-peer learning between farmers during on-farm demonstrations. With the platform and the hubs, Nefertiti has boasted a movement, that is now taken up by national CAP plans. Demonstration has been adopted as an instrument for stimulating innovation.



https://www.h2020fairshare.eu

FAIRshare: 2018-2023. 31 partner organisations. 4 regional hubs for almost 30 countries in Europe.

Tom Kelly (Teagasc, Ireland)

The project addresses the digitalisation of advisory services. FAIRShare is the acronym for Findable, Available, Interoperable, Reusable and Sharable. It is a € 7M project and it is over halfway through its 5 year period.

There are two objectives:

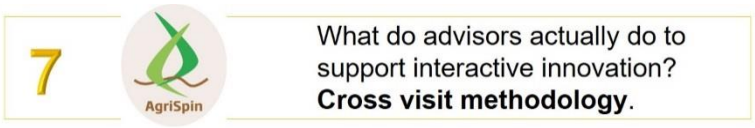
[1] Sharing existing digital tools and services being used in advisory services.

[2] Funding practical use and engagement with digital tools and services at advisory level across Europe using a 'living lab' approach via the development of User Cases.

Where are we now? We have developed a Permanent Network Facility (PNF) with over 260 digital tools and services, ranging from communications and analytical tools to advisory organisation tools, etc. To date, we have collected over 50 good practices and our first iteration of good practice vignettes have been developed. We have also developed our training frameworks: an assessment tool and we have made a field analysis of challenges for both farmers and advisors. We have 29 large User Cases underway with a further 13 smaller user cases undergoing selection at the moment. These user cases aim to facilitate farm advisors to practically engage with digital tools in a number of ways.

A key learning so far is that degree to which farmers use digital tools is heavily influenced by their advisors. But not all advisors use digital tools to the same extent. There is a big digital divide.

Another learning was about a motivating environment. At the start we tended to look at tools and trainings. But then we found out to our surprise that the motivational side of an enabling environment appeared to be most challenging. And then the COVID situation turned out to be very helpful to highlight the importance of digital tools and services!



http://agrispin.eu › wp-content › uploads › 2017/08

https://cordis.europa.eu/project/id/652642

AgriSpin: 2015-2017: 15 partner organisations in 13 EU countries

Andrea Knierim (University of Hohenheim, Germany)

AgriSpin was the first Thematic Network in the EIP programme, collecting experiences on specific topics across borders. The aim was to create space for innovations, by amplifying good examples from Innovation Support Services. The project studied innovation cases through cross visits.

Selected examples, presented by host partners, were visited by team composed of colleagues for other partners. The cross visits had a duration of 3-4 days, and visiting teams consisted of 7-10 colleagues.

The methodology developed in AgriSpin has been modified and widely spread in Europe. Several tools to better understand innovation processes emerged, such as the Spiral of Innovations, the timeline and rich picture analysis, 'pearls and puzzles', and a way to categorise innovation support services.

A key finding was that innovation support agents often made the difference in interactive innovation processes by connection the right partners in the right moment.

8 i2connect — Training and coaching for innovation support agents. Toolbox for advisors, trainers and enablers

https://i2connect-h2020.eu

i2connect: 2019-2024. 42 partner organisations in 23 countries

Sylvain Sturel (APCA France)

The project focusses on the role of farm and forestry advisors in interactive innovation processes, in support of the transition towards a more sustainable agriculture in Europe.

It is is a young project, with three main objectives:

- To strengthen the skills of advisors
- To strengthen the role of advisors in the wider AKIS
- To create a European network of innovation advisors

The project has a scientific component: to collect literature and to organise reflections. In almost all EU countries it searches for practical cases to be better understood and described. A toolbox is being developed for training modules for different target groups: advisors, trainers, enablers, and educators. Training courses and cross visits take place, and the project aims to create a professional network for continuous sharing and learning about interactive innovation processes. For doing so, it relies strongly on existing networks: IALB, EUFRAS, FiBL, SEASN. All these umbrella organisations are actively participating in i2connect.

Achievements so far: the inventory of AKIS descriptions, that has been made in the ProAkis project (2011-2014) has been updated. A study on necessary competences of innovation advisors is ongoing. A database of advisors throughout Europe is being built. And trainings for trainers and advisors are being carried out. It is a network project with many practical activities, rather than research.

9 AgriLink — Better understand role of advisory suppliers. Enhance their contribution to learning and innovation.

https://www.agrilink2020.eu

AgriLink: 2017-2021. 16 partner organisations in 13 countries.

Pierre Labarthe (INRA France)

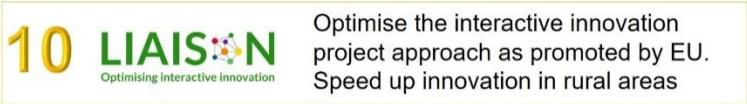
AgriLink stands for Agricultural Knowledge – Linking farmers, advisors, and researchers to boost innovation. Our ambition was to stimulate transition towards sustainable agriculture, by furthering the understanding of the roles of advisory suppliers in farmers decision making and enhancing their contribution.

From the academic perspective, AgriLink wanted to develop new concepts, with strong empirical basis. Interviews were made with 1100+ farmers and 300+ advisors. The concept of 'microAKIS' and farm advisory regimes emerged.

For policy making, recommendations were made, well informed by data about the relation between demand and supply for advisory services in various areas. The link between the project and policymakers was short, thanks to informal connections in the ScarAKIS group for example.

For advisors, new methods for co-designing innovative methods and pedagogical material have been developed. The LivingLab approach for joint learning between farmers, advisors, and researchers was promoted successfully.

We learned that there is a huge heterogeneity of microAKISes between farmers. Many farmers only rely on one or two main suppliers of information. Digitalisation changes the landscape of informal connections.



https://liaison2020.eu

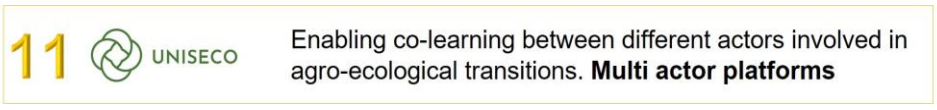
Liaison: 2018-2021. 17 partner organisations in 15 countries.

Susanne von Münchhausen (Eberswalde University for Sustainable Development, Germany)

The aim of the project was to optimise innovation processes by linking actors, instruments, and policies through networks. It is a research and innovation project. Now we are in the dissemination phase.

For developing the methodology, we made a conceptual framework, and then we made consultation rounds with multi-actor stakeholder groups in four European Regions: Nordic/Baltic, Danube/Balkan, Mediterranean, Atlantic/North Sea. After this we started funnelling. There was a contest with 175 entries, 200 cases were reviewed (light touch), and 15 cases were studied in-depth.

Then we nominated 15 rural ambassadors who were rewarded with a video. These videos are now available. There is a fancy over-all video, which you can use for your own events when you want to explain about interactive innovation. In the catalogue you can find 35 cases. There is an interactive map. Several scientific papers have been published. And in September 2021 the final conference will be held.



https://uniseco-project.eu

UNISECO: 2018-2021. 18 partner organisations in 12 countries.

Gerald Schwartz (Thünen Institute, Germany)

The name of the project stands for 'UNderstanding and Improving the Sustainability of agro-ECOlogical farming systems. The main aims were to improve the understanding of agro-ecological processes and impact on the transition in different contexts across in Europe, and to initiate and co-develop with local actors new solutions, as well as strategic pathways in order to enhance transitions.

We looked into questions such as: (a) What are the sustainability impacts of implementing different combinations of agro-ecological practices? (b) What are barriers? (c) Why could not they be overcome in the past? (d) How can they be addressed in the future?

Multi actor platforms were a central element in the project, to stimulate continuous engagement of different actors: farmers, advisors, different rural community representatives. Who could be potentially engaged in agro-ecological transitions?

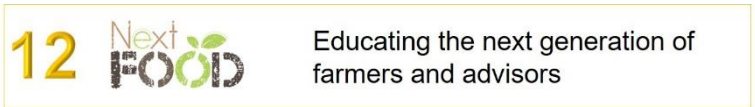
The focus was on co-learning, in particular about the roles of different actors. Who are they? Who should be invited as well to join? When these roles are properly understood, the next step was to propose jointly strategic pathways to how to move forward.

We did this in case studies that covered rather conventional systems. There it was about initiating agro-ecological transitions. Other cases were more on enhancing ongoing transitions.

What stands out is the importance of knowledge sharing and knowledge creation. We have seen the important role of trusted advisors as intermediaries and champions in building the trust between the different kinds of actors that are needed to do so.

There was also a focus on young generation. Linking the knowledge creation and the awareness raising with vocational schools, public school programmes, and here also the particular role of farmers and advisors in terms of exchanges about innovations.

On the Uniseco website story maps can be found that tell the experiences from the perspectives of the various actors involved. This is interesting read.



https://www.nextfood-project.eu

NextFood: 2018-2022. 19 partner organisations in 13 countries (including 3 outside Europe)

Martin Mellin (Swedish University of Agricultural Sciences) 51:30

Next Food is short for 'Educating the Next Generation of Professionals in the Agricultural Food System'. It is a research and action project, which started 3 years ago, and we still have one year to go. We developed new ways for educating future sustainability leaders of the agri-food and forestry sector. The purpose is to make sure that the professionals (farmers, advisors, business representatives and students) have the right set of skills and competences for the sustainability challenges ahead: food security in the context of climate change, loss of biodiversity, etc.

Most of the 19 partners are from the EU, but some come from outside outside: Egypt, Ethiopia, India and Chili. Most of them are universities, but there are also NGO's, business networks and intermediaries.

We developed a roadmap for transforming education. It will be tested and evaluated in a learning process of four steps. [1] Gather empirical data from food system actors: what skills are necessary in the future? These are compared with existing curricula. Where are the gaps? [2] Action oriented educational approach. The starting point is the lived experience of the students: they lived in farms or in communities. [3] The new approach is tested in different contexts: geographical areas, parts of the food system, cultures. [4] Evaluate the barriers and opportunities for the learners (students, teachers and institutions) to adopt the NextFood learning approach.

The basic idea in NextFood is to challenge the conventional learning model, where knowledge is seen as a package that can easily be passed on to passive receivers. Instead, we focus on transdisciplinary and action-oriented learning model where learners learn in action and in interaction with others (farmers, field experts).

Summaries of the sub-sessions

After the representatives gave their pitches of the projects, they were divided into subgroups, following the three knowledge orientations mentioned earlier: Technical know-how, process-know-how and system know-how. There they discussed the following questions:

a) What do we know by now?
b) What did we learn?
c) What is our impact?
d) What are our plans and wishes?

At the end of the lively sub-sessions, the chairmen summarised the most important conclusions that emerged from the discussions.

Sub session 1: innovative knowledge.
Chair: Magnus Ljung
Projects represented:

Innovative knowledge	*cluster 1*
Euraknos	Pieter Spanoghe
IPM Decisions	Harm Brinks
Plaid	Claire Hardy
AgriDemo	Fleur Marchand
Nefertiti	Luis Mira

Fairshare	Tom Kelly
chair	Magnus Ljung

Need for long term perspectives

Projects always have a limited period for delivering results. Developing knowledge in an interactive way is an ongoing process. It takes time to build contacts between professionals in different regions and sectors, and to establish trust. By the time a project gets leverage, it stops.

Some projects manage to build professional platforms for exchange and development. But also, these platforms stop when the projects funds dry up.

Need for more flexibility in using funds

Projects feel little room to deviate from the planning for which it receives funding. When experts meet colleagues in other projects and see possibilities for collaboration, this was not foreseen in the planning and joint activities seem to be impossible within the current projects.

Tension between project frames and desired movement

The movement all projects try to enhance is developing innovations through collaboration, by trial and error, by discovery and coping with unexpected events and outcomes. The way in which international projects are currently framed, with clearly defined deliverables and detailed planning for producing them is not appropriate for this desired movement.

No room for failure

Is it OK to fail? The answer is no. This affects the risks people are prepared to take, while innovation efforts are inherently risky.

Sub session 2: interactive innovation processes.
Chair: Alex Koutsouris
Projects represented:

Innovation processes	*cluster 2*
AgriSpin	Andrea
i2connect	Sylvain
AgriLink	Pierre Labarthe
Liaison	Suzanne von Münchhausen
Fairshare	Teresa Hooks
Uniseco	Francesco Vanni
chair	Alex Koutsouris

No standard for innovation processes
There is a great diversity in innovation processes that can be observed. Under different conditions and regional contexts such processes develop in different ways. It is impossible to say what is best.
Several projects have produced models for identifying phases, with which interactive innovation processes can be described:

- AgriSpin: the Spiral of Innovations. 7 phases.
- AgriLink: The Triggering Model. 3 phases.

Sometimes phases can overlap.

Where do innovation support agencies enter?

It can be concluded that agents are needed in every phase, where they do different things. Consequently, there is a great diversity of innovation support agents and the roles they perform.

The issue of trust
Farmers usually make use of one or two trusted agents. Trusted intermediates are very important. It is said that they should be independent. But practice is divers. For example, in high tech companies are important drivers of innovation, and their highly qualified agents usually are trusted.
When it comes to issues regarding the commons, such as environment and animal welfare, public and farm-based organisations as well as NGO's are more important.
Sometimes it can be questioned if agents from such organisations represent the real world.

Networks are very important

For interactive innovation processes, building networks is crucial. This requires new capacities and skills of support agents.

Part of this is the insight and capacity to provide the right service on the right place and the right moment.

Digital skills have become high priority for innovation support agents

Mindset to reflect

To a large extend the necessary insights and skills for guiding interactive innovation processes must be acquired through learning by doing. This requires a mindset of reflexion and capitalising the learnings.

It is great when professionals take time to reflect, preferably with peers.

But many agents do not experience the space for doing so within the current management culture, which is target oriented and money driven. Under pressure, time for reflection is often the first victim.

Sub session 3: enabling environment.

Chair: Laurens Klerkx
Projects represented:

Enabling environment	*cluster 3*

Nextfood	Martin Mellin
Uniseco	Gerald Schwartz
AgriLink	Jorieke Potters
Liaison	Anna Häring
i2connect	Jos Verstegen
chair	Laurens Klerkx

Similar difficulties in various circumstances
Although the external environment is very different throughout Europe, many of the difficulties that projects encounter are similar. What differs is how people in different countries deal with them.

Innovation processes are unpredictable
Within the H2020 environment there is tension between the needed flexibility and project structures of projects. This has to do with the preparation phase in which you have to say: "We work with 'Living Labs". But then, during the project period you discover that this approach is not the most appropriate one for the circumstances. The type of approach needs to be adjusted to the situation at hand. Projects should have a good diagnostic phase after which you can choose the proper approach, but this is not accommodated.

Innovation as a journey.
The structure with milestones, fixed work packages, etc. does not follow the dynamics of a journey. Projects encounter unexpected barriers, for example at the institutional level, that take more time to deal with than the project agreement allows for. Rather than to check if everything has been done what was promised.
Mid term evaluations could become more useful if these were moments to reflect, to learn from what has been encountered, and to adjust the project accordingly. But such reflexive monitoring is quite a task, and that requires capacity. Which often is missing. Not only within the project, but also in the external environment. You need project officers who can think along, while we usually find the tick boxing practice to be dominant. Making amendments on the project agreement should not be the last resort, but a kind of standard for changing the course of a project.

People have different expectations
Advisors have to reach their targets. What do people get back in uncertain projects on innovation? It should become clearer what would be the payback in the long end for the time they spend in the project. What is the revenue model? These are not so much the needs of the funding agency but those of the people you work with in a project. Take time to clarify expectations about the gains.

People have different mindsets
People in a project might have different mindsets, that might be related to their generation. It requires attention to transfer experience over generations, otherwise you

keep on doing projects with the same people who feel comfortable with each other. That needs to be accommodated in the project design, and this is often not the case because there is too much pressure on producing results.

Some remarks concluding the session

There is a lot to learn from the exchange of the different projects. Actually, we should take time to sit down together with key persons from different projects to see what we can learn from each other. But where do we find the time when this is not foreseen in the project design? We really need to develop new approaches to build in this flexibility into project schemes.

It also a kind of thinking at the level of the enabling environment that allows for discovery, rather than checking deliverables. We need tools that feed trust and enable.

In the preparation of this joint session, Inge van Oost (European Commission) explained enthusiastically about new possibilities for supporting Operational Groups: measures that already are into the direction of providing space for discovery[3]. But meanwhile at the level of for example the Dutch Provinces that are responsible for managing the OG schemes, or the national subsidy agency checking all the subsidy expenses, there is a lot of fear for what 'Brussels' supposedly does not allow. Maybe we have to organise also the interaction between the Managing Authorities in the member states and the auditors of the European Commission.

Reflections and new opportunities in the CAP 2022-2027

Puzzles

Projects versus discovery journeys

The joint session on international projects for interactive innovation under the H2020 programme of the EU made clear that these projects encounter a number of structural difficulties, due to the tension between the political and financial structure in which they are framed and the dynamics that are inherent to the ambition to create new things together. The structure is fit for production processes with clearly specified outcomes and pathways to produce measurable deliverables. The dynamics of multi-actor projects are more like discovery journeys, with a shared ambition as a reason to embark, and lots of unexpected events underway which require flexibility and the capacity to respond in unforeseen situations.

In the multi-actor approach, the development and implementation of an outcome/innovation involves a diversity of actors in iterative and joint learning processes. To be productive, such processes require creating conditions in which solutions and ideas can be discussed by effectively combining each other's knowledge, perspectives and resources. This is hardly the case in projects with a limited lifetime and a strong result-orientation (both Horizon projects and operational groups): already at the planning stage, all resources are allocated to achieve expected results within the set timeframe. The

[3] She was supposed to give her input at the end of this joint session, but unfortunately, she she had to cancel it in the very last moment. In the last chapter, a summary of her input is given, and updated with the latest developments (early 2022).

pressure to achieve results and the focus on delivering measurable outputs leaves no room for discussion, reflection and capitalisation of results.

What tools to monitor progress?

Deliverables and milestones are needed to monitor the project's progress and gain insight into the efficiency of spending, but are they the only effective tool? Would it be possible to envisage the introduction of mechanisms for rewarding/incentivising and monitoring knowledge co-production processes?

Progressively involving partners does not fit into current project agreements

The multi-actor approach has led to an enlargement of partnerships which aim to foster the integration of different knowledge not only in terms of types of actors but also of geographical coverage. However, the involvement of many players, who enter the project with different motivations, interests, and resources, often results in growing complexity in managing exchanges and reflections as well as in creating a climate of trust, which undermines the effectiveness of multi-actor approaches. This is not always due to a failure in combining knowledge and visions, but also to a difficulty in actively engaging actors who have different timescales, perspectives, and attitudes towards research. Indeed, the development of a common vision and the sharing of knowledge building processes require time, involvement, listening to the different needs and points of view of other partners.

Therefore, the question of how to actively involve all actors from the planning phase onwards in productive interactions still remains open: how can high quality knowledge exchange activities be improved throughout the project? What actions can be really effective to involve practitioners and make them invest more time in the co-production process? It is not only a question of identifying the most appropriate facilitation methods....

How to involve multipliers and intermediaries?

How to improve the impact of the multi-actor approach is still an open question. In spite of the efforts made by the programme maker to improve the dissemination and exploitation of results, there are still many shadows on the extent to which Horizon projects impact on the ground. The ability to build networks is crucial. For this reason, the involvement of multipliers (e.g., representative bodies or networks) who are already part of broad networks has become a prerequisite for partnerships. The high level of "presence", however, risks being a double lever for these actors, requiring ever greater efforts and resources to effectively channel communication between different levels of the knowledge system even in the face of multiplying inputs. Achieving effects aimed at accelerating dynamism towards more sustainable agri-food systems requires specialised and focused competencies in influencing change by linking actors and activities, skills, and resources, and creating collaborations between different levels of knowledge generation. While intermediary actors having such competences are indeed available in all EU Member States, their participation as project members would considerably enlarge the dimension of partnerships, thus increasing their manageability. Actually, new capacities and organisational models are needed. New governance models are also required to legitimise and facilitate a possible intermediation role. Which governance model could fit the need to keep an efficient partnership management while allowing intermediary

actors to get ownership of the project results? What approaches could be used to establish iterative learning loops between research (European level - Horizon) and innovation (local level - operational groups)?

Activating synergies between international projects

Another interesting aspect to maximise the impacts of multi-actor projects concerns the possibility of activating synergies between projects funded at European level (e.g., HE, Erasmus+, etc.). The high level of competitiveness in the calls leads to maintain an absolute level of confidentiality on project proposals. Therefore, possible synergies and common objectives only become known after the projects have started, usually with the beginning of the communication phase. Although dialogue can be built at any time, each project remains committed to the submission of its own deliverables, which may also be very similar to or overlap with other projects. This, in addition to creating possible confusion among end-users, may compromise the development of complementary outcomes and synergies in both knowledge generation and impact maximisation. The question we are asking is whether there is a way to facilitate connections between projects and to create common working paths, thus contributing to a better use of resources.

Opportunities in the new programming period

Instruments for reinforcing AKIS in Member States

The new Horizon Europe and CAP planning under the common EIP-AGRI framework envisages a strengthening of Member States' AKIS to advance knowledge exchange and build capacity in support of the Green Deal, CAP and farm to fork objectives. The aim is to organise future AKIS as inclusive strong knowledge ecosystems at all levels, by integrating, without constraints, all those who generate, share and use knowledge and innovation for the development of agricultural systems, enhancing knowledge flows between the AKIS players (farmers/foresters, advisors, researchers, organisations, NGOs, networks, education, retailers, media, services, various ministries) as well as strengthening links between research and practice.

Achieving this goal requires insights and tools to interconnect actors within the AKIS and link them with practice-oriented information derived from different sources that are readily available.

To this aim, the CAP Strategic Plans regulation, under the cross-cutting objective, requires Member States to:

(i) have impartial advisors integrated within the AKIS covering all sustainability fields with up-to-date knowledge and information, needed to achieve the Green Deal objectives and targets

(ii) provide support for knowledge exchange and information events, including for advice, demo and training, thematic and cross-sectorial events,

(iii) provide innovation support for operational groups, from grassroots ideas to project development and drafting,

(iv) organise CAP networks to connect AKIS actors, as well as existing operational groups and interact with Horizon Europe National Contact Points (NCPs).

Knowledge repositories

Regulatory provisions highlight a growing need for actors and tools able to support, mediate, multiply knowledge and integrate different sources of information. In this perspective, the new CAP broadens the role of Networks, which will no longer be called Rural Networks but CAP Networks, and will have, among others, the role of supporting the development of connections between research/practice, trans-national/national/local knowledge systems (Horizon Europe/other national instruments). The supporting role of knowledge repositories collecting information on all MA projects in the Member States is also emphasised, both at the wide EU level, with the funding of the EU FarmBook platform, and the national one. The aim is to make an increasing volume of practice-oriented knowledge easily accessible at EU level and foster knowledge-sharing platforms.

Creating access to novelties

These novelties will also be supported through the Horizon Europe programme, which provides a specific budget of EUR 10 billion for issues encompassed by the European Green Deal, the Farm to Fork Strategy and the CAP, the Biodiversity Strategy, and the wider bioeconomy policies. Specific calls have been issued to:

- improve preparation of multi-actor projects to enable the relevant actors to work in a co-creative way (HORIZON-CL6-2022-GOVERNANCE-01-14),
- support knowledge exchange between all AKIS actors in the Member States (HORIZON-CL6-2021-GOVERNANCE-01-24),
- improve national AKIS organisation across the EU (HORIZON-CL6-2021-GOVERNANCE-01-25),
- deepen the functioning of innovation support (HORIZON-CL6-2021-GOVERNANCE-01-26),
- broaden EIP Operational Group outcomes across borders (HORIZON-CL6-2021-GOVERNANCE-01-23),
- mobilise the network of national contact points in Cluster 6 (HORIZON-CL6-2021-GOVERNANCE-01-01),
- develop EU advisory networks on consumer-producer chains (HORIZON-CL6-2021-GOVERNANCE-01-27),
- and further topics.

Funding for Multi Actor Approaches

Furthermore, in cluster 6, the multi-actor approach is strengthened and streamlined as an eligibility criterion for funding. In their CAP Strategic Plans, Member States will need to scale up support for EIP-AGRI and AKIS. This entails a stronger targeting of end-users' needs and opportunities, the involvement in consortia of key relevant actors with complementary knowledge, including local interactive innovation groups, able to ensure a broad implementation, the active participation of all actors from the planning phase onwards. The process of cross-fertilisation, i.e., exchange of high-quality scientific, tacit-

and practical knowledge throughout the project, should be facilitated by the most appropriate methods and proven through demonstrating its added value.

How far could new regulatory provision and instruments solve the problem?

The instruments provided through the Horizon Europe programme and the new CAP framework to strengthen AKISs and knowledge flows within them seem to address some of the gaps previously identified.

Independent advice and intermediaries

The two most relevant opportunities within the new CAP certainly concern the reinforcement of the role of advice within AKISs and the strengthening of networks as intermediaries for innovation. The framework set out by the European Commission gives the Member States broad room for manoeuvre, but the question is whether the different administrative systems will be sufficiently prepared to use the tools effectively.

Much depends on national implementation

Certainly, the institutional arrangements of the different Member States will play a key role in the implementation of these measures, for instance in terms of differences between those Member States that have public advisory services and those that have pluralistic ones. The integration of advisors into the AKIS requires the development of a system perspective. The question is what strategies, mechanisms and policy instruments should be put in place to promote and support the effective empowerment and integration of advisors within the AKIS. The answer to this question concerns not only decision-makers, but all relevant actors in the AKIS: what strategies, policy mechanisms and tools should be put in place for farmers, advisors, policymakers, researchers/academics to engage in stronger interconnections with advisors?

Again, to what extent do advisors in different socio-economic contexts and with different backgrounds perceive the need/opportunity to better integrate the AKISs? What barriers/obstacles do advisors experience when interacting within the AKIS, and how are Member States addressing this issue (if at all), and what are their strategies?

Moreover, it will be interesting to understand how innovation support services and back-office services for advisors will be organised, as they could represent, if appropriately organised, important moments of connection between different type of knowledge, actors and domains (e.g. innovation/back office hubs).

The important role of CAP networks

Of great interest is the role of the CAP Networks, which are called to foster the strengthening of knowledge exchanges on all 9 CAP objectives, contributing to the development of an innovation-friendly environment. They are expected to systematise (and translate) all the resources (in terms of knowledge) resulting from operational group projects, Horizon 2020 multi-actor projects, the EIP-Agri website and new knowledge reservoirs. Linking all this information undoubtedly provides an impressive knowledge pool for local AKIS actors, which could be used for training, peer-to-peer events, on-farm demonstrations, websites, and other dissemination activities.

To support the exchange of knowledge and the strengthening of innovation, the PAC networks should organise knowledge events and platforms where all AKIS actors could

meet regularly to discuss problems and opportunities, building connections with existing projects, even beyond national borders.

In the new programming period, therefore, the CAP Networks are called to be more proactive, promoting OGs and their work, exploring Horizon themes, and inviting actors from both sides to collaborate around specific themes. This means intensifying synergies between OGs and Horizon groups, between CAP networks and the National Contact Point (NCP - Horizon Europe). This role of multi-level intermediary is certainly aimed at overcoming many of the critical points highlighted above. However, it is a very ambitious task that requires significant human resources in terms of time and skills.

High demands on expertise of the implementors

To carry out these functions, networks should be equipped with employees having adequate technical, communication and soft skills, as well as reorganise their activities. Moreover, policymakers and managing authorities should be able to plan these activities, which also require interconnections between different policies and sectors, such as research and innovation supported under the rural development umbrella, which, as the recent i2connect study shows, are generally organised by different managing authorities. Once again, Member States will play a key role in designing multi-level and cross-sectoral governance that fosters coordination and complementarity between multi-actor projects and, above all, between different levels of political and administrative responsibility.

The Horizon Europe programme certainly includes some interesting new features. For instance, the compulsory participation of operational groups in thematic networks should facilitate the exchange between research and innovation projects at territorial level.

Moreover, some recent calls are open to the implementation of projects running over a period of several years (up to 5-7). However, the extension of the period corresponds to a multiplication of deliverables and milestones and does not help solving the problem of building common vision and trust among the consortium partners.

Calls for proposals on connecting actors and bridge builders

Certainly, some of the projects announced in cluster 6, which have the objective of connecting actors and bridging knowledge, could facilitate the development of new models of governance at Member State level, thus supporting the process of strengthening AKIS envisaged in the CAP regulation. However, these projects should be able to coordinate in order to identify possible synergies and maximise territorial impacts. With the ModernAKIS (HORIZON-CL6-2021-GOVERNANCE-01-25), ATTRACTISS (HORIZON-CL6-2021-GOVERNANCE-01-26) and EU-FarmBook (HORIZON-CL6-2021-GOVERNANCE-01-24) projects, this synergy has already been explored in drafting the proposals, but opportunities for dialogue and interaction, that go beyond formal exchange, should be identified among all the projects of the cluster.

Knowledge repositories need to be embedded into supporting structures

One last consideration, among many others, concerns the development of knowledge repositories. The repository is undoubtedly a relevant knowledge infrastructure, but it should be supported by appropriate tools able to deliver knowledge to the final users. It is not sufficient that documents can be immediately accessible in terms of location and comprehension (and here we might also ask ourselves how the outputs of all research

and innovation projects could be translated into immediately usable knowledge), but it is also necessary that this knowledge can reach all end-users, not only the pioneers or innovators, who are familiar with digital tools, but also the 'silent non-participating' actors.

INNOVATING AMIDST A WEAK AND FRAGMENTED AKIS: EXPLORING THREE GREEK CASES

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Abstract

Based on the idea of farmers' micro-AKIS (Agricultural Knowledge and Innovation Systems), developed within the AgriLink (HORIZON2020) project three innovative Greek cases are explored aiming at identifying the actors (and their roles) who supported farmers along the innovation process (from awareness, to assessment to implementation) following the 'Triggering Change' model claiming that major changes in farming occur as a result of trigger events that deviate farmers from the dependency path they are locked-in and bring them in a fragile position while searching for support in assessing and implementing innovations. The innovative cases explored concern: a) the cultivation of stevia in the area of Karditsa (Central Greece); b) the cultivation of avocado in Chania (Crete); and c) the implementation of a method of sexual confusion of insects in the framework of Integrated Pest Management in Imathia (Northern Greece). These innovations took off amidst the weak and fragmented Greek AKIS, notably the demise of the public Greek extension service. And while there has been a number of studies exploring this at the macro-level, the utilization of the concept of micro-AKIS, on the one hand, sheds light on the question who supports farmers (at the local level) to take up innovations and, on the other hand, supplements the macro-level studies.

Introduction & Conceptual framework

The Greek Extension Service has, during the last three decades, been in a painful process of bureaucratisation leading to its absence from the rural development field. This largely owes to the fact that following the accession of Greece into the EC (1981), the administrative burden of the Common Agricultural Policy (CAP) implementation was designated to the Extension Service. However, no major functional re-structuring of the Service took place; thus, extensionists were entrapped in a bureaucratic-administrative role. Extensionists became more than ever severely restricted vis-à-vis the provision of advice to Greek farmers; information was provided to those of the farmers who actively sought for it albeit in a rather fragmented, inadequate and inefficient manner. Furthermore, changes, which took place in the mid 90s, such as the Ministry divisions' restructuring, the decentralisation of services and the establishment of semi-autonomous organisations for training and research respectively did not yield any substantial positive effects and did not make extension services more flexible and relevant to the needs of farmers.

In addition, the remarkable cultural homogenization of the extension field in Greece, implying the existence of a dominant culture restricted within a narrow 'progressive farmer strategy' and Transfer of Technology (TOT) model (see Koutsouris, 2018) has to be underlined (Lioutas and Charatsari, 2011; Papaspyrou and Koutsouris, 2018).

Such a situation has been verified by a number of studies which have attempted to explore both farmers' perceptions about the Service's interventions and the intervention policy and practice of the Service. (see, inter alia, Koutsouris and Papadopoulos, 1998; Koutsouris, 1999; Gidarakou et al., 2006; Alexopoulos et al., 2009; Charatsari et al., 2011; Kaberis and Koutsouris, 2012; Pappa and Koutsouris, 2014; Österle et al. 2016; Lioutas et al., 2019; Charatsari and Lioutas, 2019). Thus, for example, Koutsouris and Papadopoulos (1998) have criticized the mainly bureaucratic role of public extensionists given that they have abolished their advisory role due to their involvement in controlling the implementation of Regulations and farmers' applications for subsidies and

compensations, often creating a tension between extensionists and farmers. In this respect, Kaberis and Koutsouris (2012), Pappa and Koutsouris (2014) and Charatsari and Lioutas (2019) point to the negative perceptions of Greek farmers vis-à-vis public agronomists who are nowadays conceived of as 'bureaucrats' not serving farmers' interests. Such an inefficient and inadequate advisory function is found to be a key factor with respect to the current socioeconomic and environmental problems facing the Greek agriculture (see Alexopoulos *et al.* 2009) while also eliminating farmers' willingness to engage in public extension activities (Charatsari et al., 2011).

The vacuum created due to the weakness of the public as well as of farm based organizations to provide efficient advisory services to farmers is covered, locally, by private agronomists - consultants and input suppliers (Koutsouris, 2014; Kaberis and Koutsouris, 2012). Private consultants mainly support farmers interested in having access to EU programmes so their scope is rather limited. Input suppliers/retailers (private agronomists) provide advice for free in the framework of their commercial activity. Their shops are the main points where farmers seek and obtain free information on inputs and technical requirements; shops, in turn, generate income from the trade of inputs. On the other hand, Michelsen *et al*. (2001), Dinar *et al.* (2007), Kaberis and Koutsouris (2012) and Pappa and Koutsouris (2014) clearly point to the potential conflict of interest arising from the involvement of private agronomists (input providers) in the provision of advice.

Private agronomists/companies also support producers' groups mainly in the framework of Integrated Production schemes, thus constituting an exemption to the general "rule", according to which technical advice is not paid, since in their case the provision of advice is their exclusive job.

At the same time, on the international scene, based on Systems of Innovation (SoI) approaches, there has been a conceptual shift in agricultural extension literature from the ToT model to network and systems approaches (see Koutsouris, 2018). In the latter, the major role of extensionists/advisors is that of the co-learning facilitator ('facilitator' or 'broker'), bringing together stakeholders, organising the dialogue among them and stimulating change and innovation. However, according to Papaspyrou and Koutsouris (2018), Greek extensionists/agronomists are not equipped and do not seem proficient to get involved in the emerging paradigm of advisory services. In parallel, Greek extensionists do not seem to be in a position to comfortably follow the current developments within the EU policy - and practice (Österle et al., 2016), according to which networking, knowledge co-creation and collaboration between different partners in AKIS are becoming of paramount importance as means to stimulate innovation (Koutsouris, 2018).

Given the abovementioned considerations, especially the highly fragmented farm advisory landscape, characterized by complexity as well as by extremely weak linkages and lack of coordination among the AKIS actors (Koutsouris 2014), one would wonder how innovations are generated and/or disseminated in Greece. To answer this question three innovation cases from Greece were explored in the framework of the AgriLink project:

1. The case of mating disruption (MD; also known as 'sexual confusion');

2. The case of avocado in Chania (Crete);

3. The case of the cultivation of stevia in the area of Karditsa (Central Greece).

The analysis is based on two concepts as conceived within the AgriLink project proposal. The first one 'reduces' the concept of Agricultural Knowledge and Information Systems (AKIS; see Koutsouris, 2018) to the local level defining the micro-level AKIS (micro-AKIS) as the knowledge system that farmers personally assemble, including the range of individuals and organisations

from whom farmers seek services and exchange knowledge, the processes involved, and how they translate this into innovative activities (or not). The second one concerns the Regional Farm Advisory System (R-FAS) denoting the full range of organizations providing advice to farms in a given region, and their connection to wider AKIS organizations. Furthermore, the description of the innovation cases is supported by the 'Triggering Change' model of farm decision-making (Sutherland et al., 2012). Its basic premise is that owing to path dependency, farm managers maintain a steady course of minor incremental changes to the farm operation, until an event or opportunity occurs which leads to a decision to actively consider a major change. Then, farmers more actively seek and assess information. New changes are implemented but take time to develop and consolidate, and if unsuccessful, the period of active assessment continues; if successful, the changes become the new norm and farmers become path dependent on using the new innovation.

The paper explores who are the actors who support(ed) farmers throughout the abovementioned innovation cases and their distinctive roles. It also examines the broader conditions and events that triggered and guided adoption processes and highlights the advisory methods used throughout the innovation processes.

Methodology

The study draws data from interviews conducted from April to December 2018 with farmers and regional AKIS-actors involved in the abovementioned innovations. It follows the methodological framework of the AgriLink project, employing a mixed-method approach. Farmer's survey was conducted on the basis of a questionnaire with open and closed questions aiming at gathering both qualitative and quantitative data. A total number of 113 farmers (Table 1) were interviewed based on information provided by key informants: The interviews were recorded, entered in a database and analysed; nine of the interviewees (3 farmers per innovation case - i.e. adopter, non-adopter and one/or dropper where appropriate) were selected to provide an in-depth account (narrative) of their involvement (or not) with the respective innovation. The selection criteria were specific for each case in view of the need to produce a rich picture of the innovation processes. The overall aim was to increase the understanding of the rationale that governed farmers' decision making and the advisory challenges they faced vis-à-vis awareness, assessment and implementation of the innovations.

The AKIS survey addressed 23 advisory suppliers; all identified key actors were interviewed and were asked to suggest other actors engaged in the innovation processes. In the case of Peach Producers' Groups representatives of three private independent advisory organizations (which comprise all the advisory services engaged with the innovation), one public research institute, two cooperatives and four input supply shops were interviewed. For the case of avocado key actors employed in the relevant public service, one public research institute, a nursery, two cooperatives, an input supply shop along with a pensioner academic (with significant contribution and continued presence in the innovation process) were interviewed. For the case of stevia two researchers, the local development agency, and members of the cooperative of stevia were interviewed; additionally, a number of actors/organizations mentioned by the interviewed farmers (a coop/limited company, an input store and a private consultant) were also interviewed aiming at providing insights on the innovation.

Table 1: Farmers interviewed per case study

Innovation case study	Adopters	Non-adopters	Droppers	Total
The implementation of IPM–MD by Peach Producers' in Imathia	25	17	0	42
The dissemination process of avocado in Chania,	27	9	1	37
The introduction of stevia in Karditsa	12	19	3	34

Source: AgriLink – Country Report, Greece

Results

The implementation of IPM- MD by Peach Producers' Groups in Imathia

IPM (Integrated Pest Management) was introduced in Imathia, a region of highly intensive agriculture, by a leading cooperative (A-Coop) that, placing their produce in highly competitive international markets, identified a demand for high quality, certified fruits. This became clear in 1999 owing to a failure in the peach market of the USA, a fact which made the A-Coop to turn to IPM (Vlahos et al., 2017). This event also resulted in the launching of collaboration with an independent advisory company (A-Co) specialised in the implementation of quality systems. The collaboration between the advisory company and the cooperative initiated their search for techniques that would help the cooperative to get rid of the use of pesticides and strengthen its environmental-friendly profile.

In 2001, during a visit to a Research Institute in Italy, the advisor in charge of A-Co became aware of MD; simultaneously he was informed that the Department of Deciduous Fruit Trees of Naoussa (DDFT), Greece, carried out relevant experiments. Along with the A-Coop they decided to test MD locally; however, this proved difficult since the necessary materials (esp. micro sprayers) were not registered and thus were not available in the market while implementation incurred considerable costs as well. The situation changed in 2003 when the advisory company was successful in its proposal for a relevant, three-year pilot project. Thus, in 2004 a small number of peach producers installed a network of micro sprayers across their fields and started implementing MD in close collaboration with A-Co, who were in charge of its implementation monitoring and evaluation.

The promising results of the pilots encouraged two other cooperatives to join the initiative; together with A-Coop they exerted pressure to the Ministry of Rural Development and Food (MRDF) to register the necessary materials. When this was done (2008), the cooperatives decided to subsidize the adoption of the MD up to 50-60 % of its cost through their producer groups' operational programs. In parallel, the cooperatives lobbied at the MRDF for the inclusion of MD in the agri-environmental measures of the National Rural Development programme (NRDP). The attempt was successful; the relevant action, implying the subsidization of MD, was activated in 2014 and resulted in the rapidly increasing dissemination pace of the method by more than 2,000 peach growers, covering 2,800 and 5,500 Ha in 2017 and 2018 respectively.

The very first, few adopters of the method were members of the A-coop Board or friends of them, who shared common interests and were connected with long time, trust relationships. Gradually more farmers were becoming aware of the method as a result of information activities based mainly on their personal interactions with advisors and events jointly organized by the cooperatives and the advisory company as well as through personal contacts with peers The

dissemination of the innovation, however, has not been uncomplicated, since many growers, although they recognize MD's potential, are reluctant to adopt the method, since they do not trust that their neighbours will be also involved to the extent necessary for its success. Figures 1-4 depict the actors who influenced farmers by raising their awareness and providing them with advice during the implementation of the innovation as well as the communication/ advisory methods used.

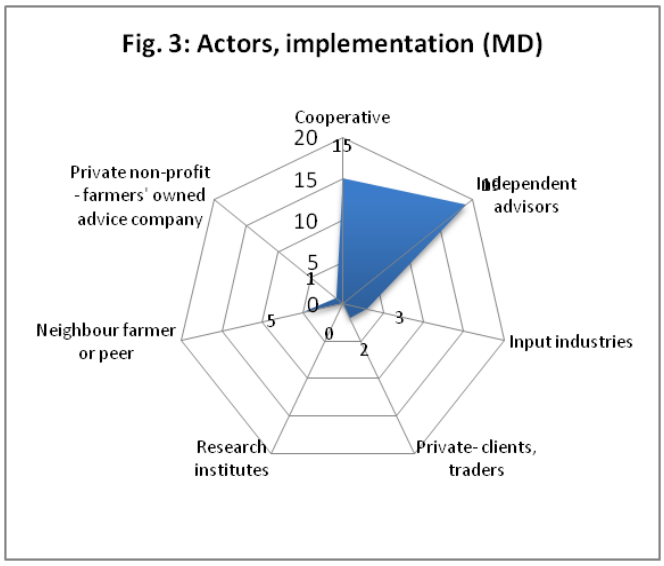
AKIS-actors in Imathia

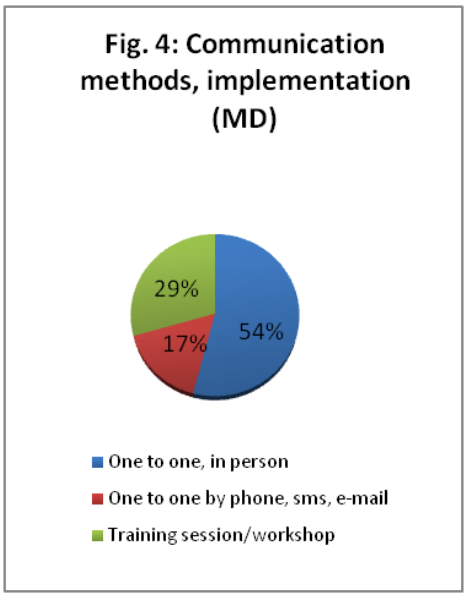
The advisory landscape of peach production in Imathia comprises a combination of private, public and farmer-based organizations, some of which are activated beyond the local or regional (Prefectural) level (Table 2).

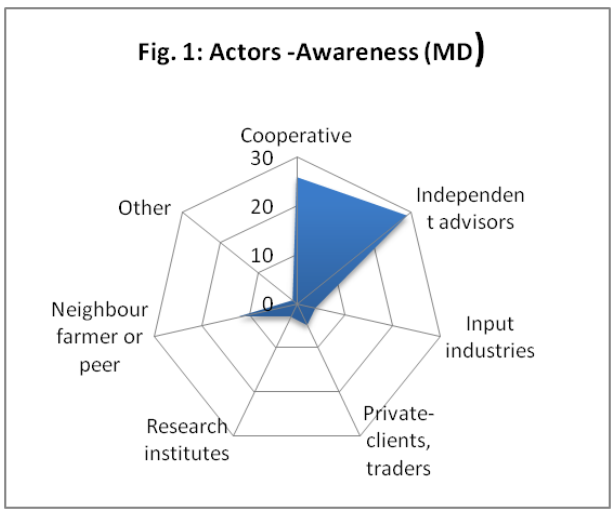
Table 2: The advisory landscape of peach producers in Imathia

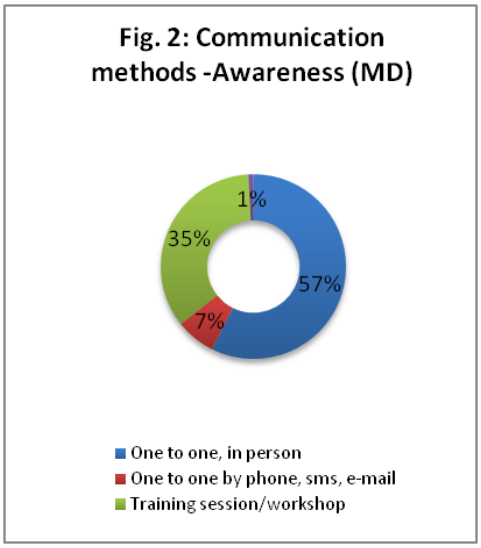
Advisory organization	Type of organization- Scale of action
The Department of Deciduous Fruit Trees of Naoussa (DDTN)	Public Research Institute - National
The Directorate of Rural Economy & Veterinary	Public sector- Local (Prefectural)
3 advisory and consultancy companies	Private sector- Local-Regional- National
Individual consultants	Private sector- Local
Input supply shops	Private sector – Local
Cooperatives- Producers' Groups	Farmer-based– Local

Source: Fieldwork, 2018









The dissemination of MD in Imathia owes to the efforts of the A-Co and other local cooperatives that achieved its inclusion in the agri-environmental measures of the NRDP. This event, along with the 'collegial pressure' exerted by A-Co, helped the two other independent advisory companies activated in the region and, also, several input supply shops to start supporting the adoption of MD. Nevertheless, A-Co still plays a leading role in all stages of the innovation process. While continuously exchanging opinions and influencing each other, producers may occasionally ask the DDTN as well about the effectiveness of the method.

On the other hand, the aforementioned producers' reservations, the lack of knowledge and of interest to participate in information/training activities, along with exceptionally adverse weather conditions in 2018 which discouraged new undertakings, make farmers adopt a wait-and-see attitude, which slows down the pace of adoption and prevents positive outcomes from becoming widely visible. In this respect, local actors recognize the all important role of the coops in influencing farmers' behaviour, including participation in MD training. Moreover, the inclusion of MD in the agri-environmental measures and the relevant subsidy constitutes a strong incentive for adoption, alleviating (some of) these fears.

Finally, it was noticed that the involvement of certain actors in the endorsement of the innovation was poor, especially in the very beginning of the process, and that the links between the local AKIS actors remained weak. But the critical challenge for the advisors involved in the development of the innovation is that the flow of information to farmers remains slow, mainly because the number of advisors activated is not enough to cover needs.

The dissemination process of avocado in Chania

The cultivation of avocado, in the first place, attracted the scientific interest in 1968, when the Research Institute of Olive Tree, Subtropical Plants and Viticulture of Chania established an experimental plantation with avocado. The first adopters who stimulated the interest of other farmers for avocado were an individual producer, who first cultivated and exported avocado in France, and a private company, which tried to establish a commercial avocado plantation but soon abandoned it. In 1985-1995 a project aiming at the wide-spreading of the cultivation, through its subsidization, took place in the framework of the Integrated Mediterranean Programmes (IMP). However, the project did not bear fruits; only 11% of its original target was reached, since olive and citrus growers were reluctant to abandon traditional and profitable cultivations to adopt a new one for which the demand, at the time, was low.

This situation started changing in 2008 due to decreasing/collapsing prices in the olive oil and orange markets and the increasing demand for avocado, globally. This triggered an explosion in demand for locally adapted varieties of high marketability as well as for healthy propagation material. Estimations refer to a rapid expansion of cultivated with avocado areas - especially over the last 3-4 years (80,000-100,000 new trees per year) - expected to cover more than 1,000 ha, in comparison to 450 ha. in 2000. In fact, only farmers who are near retirement, without a successor or farmers whose farm for self-consumption have not been engaged in the cultivation of avocado; the cultivation has been expanded even in marginal fields.

The raising of awareness about and the dissemination of the cultivation of avocado in Chania was a long process involving several private and public actors with peer farmers playing a key role throughout the process (Fig. 5). The most widely used communication method for awareness and assessing the cultivation of avocado was one to one in person contact among the actors involved (Fig. 6). Peer-farmers had a leading role in awareness activities; during the assessment stage the role of researches was strengthened since farmers searched for research evidence to support their decision (and investment). During implementation, local departments of public services and input suppliers emerge as equally important actors. The most valuable sources of knowledge for farmers were discussions with others, their conclusions from running tests and experiments in their farms and their observations on other farms.

Fig. 5: Actors- Awareness (avocado)

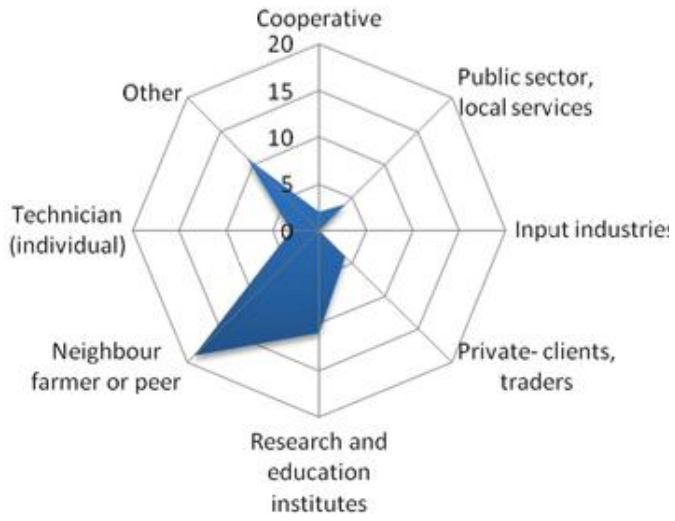


Fig. 6: Communication methods – Awareness (avocado)

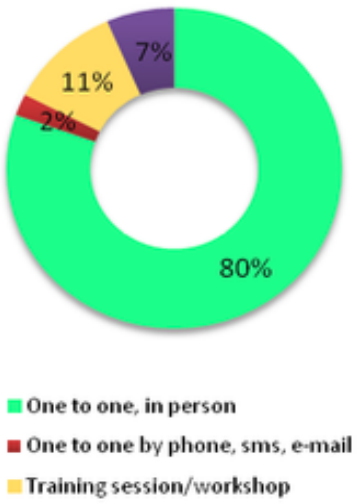
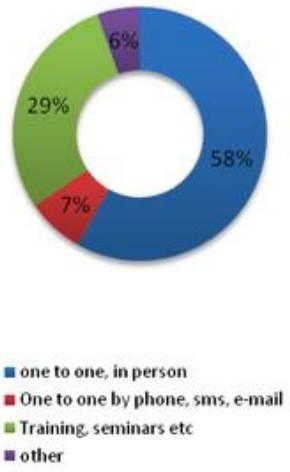


Fig.7: Actors- Implementation (avocado)

Fig. 8: Advisory methods- assessment (avocado)



Nevertheless, the whole innovation process has been hampered by poor organization and coordination of actions related to the production and dissemination of reliable knowledge (including appropriate propagation material) tailored to farmers' needs; farmers do not consider their interaction with public and private advice suppliers satisfying. Among others, the fact that, on the one hand, public organizations/ services, in general, are not able to provide proper answers to growers' questions as well as that the seminars they organize are not enough to guide growers to find solutions to their problems while, on the other hand, private input retailers are just traders and not reliable advice providers, has been underscored by farmers. Farmers also pointed out that the local agricultural cooperatives fail to support farmers as opposed to some successful cooperatives in the Northern Greece which play a leading role in the exportation of certain agricultural products.

The AKIS-actors in Chania

The advisory landscape of avocado production in Chania is formed by private, public and farmer-based actors/organizations activated at local, regional and/or national level (Table 3); they are also characterized by the fact that their primary mandate is not to provide advice to farmers. Advice is provided mainly on the basis of one-to-one in person communication.

Table 3: The advisory landscape of Chania

Organization	Type/ Scale of action
The Mediterranean Agronomic Institutes of Chania (MAICH)	Intergovernmental organization/ International
Institute of Olive Tree, Subtropical Plants and Viticulture	Public research institute/ National
Directorate of Agricultural Economy and Veterinary	Public organization/ Local
Organic Producers' Cooperative	Farm based organization/ Regional
Agricultural Cooperative of Chania / Orange and avocado producers' group	Farm based organization/ Local
Input supply shops/ Nurseries	Private sector –Local / Local - Regional
Individual consultants	Private sector – Local

The Institute of Olive Tree, Subtropical Plants and Viticulture of Chania was the critical player triggering the initiation and the dissemination of the innovation for more than a decade, resolutely affecting the decision of the first adopters, partly due to the efforts of its director who was a well-respected and influential actor locally. Nevertheless, some of these early adopters soon found themselves dealing with severe cultivation and marketability problems and some of them started decreasing or abandoning the cultivation. In parallel, the Institute gradually stopped playing its leading role due to administrative problems. However, its impact is still evident since the majority of the nursery owners and researchers who played a key role in the dissemination of avocado the subsequent years had, earlier, collaborated with the Institute. Recently though, the situation in the Institute started changing as new scientific staff, willing to collaborate and support avocado producers, has been recruited.

In this framework, a scientist of the Institute participates in an informal working group along with three other agronomists employed in the local Directorate of Agricultural Economy and Veterinary Service, the local Organic Producer's Cooperative, and MAICH as well as a retired academic who has been providing advice to avocado producers since 1970s, when he started

collaborating with the Institute as a young researcher. This group aims at supporting avocado growers by putting forward project proposals, which the regional government is invited to accept and realize. Their cooperation includes regular meetings on a voluntarily basis and the organization of information events and training for farmers.

The abovementioned actors recognize the importance of establishing permanent communication channels with farmers. They also point to the significance of peer–to-peer exchanges among producers but also highlight that, these exchanges often result in the perpetuation of false cultivation practices. In addition, they agree that this communication behavior accelerates the dissemination of avocado but they attribute the rapid expansion of the cultivation mainly to the worsening conditions in the citrus and olive oil markets.

The introduction of the cultivation of stevia in Karditsa

The introduction of stevia in the Prefecture of Karditsa was based on the results of research programs co-funded by the EU aiming at alleviating the severe competitiveness problems of traditional crops such as tobacco, cotton and sugar beet. Searching for alternative crops, two public research institutes -the Tobacco Research Centre and the University of Thessaly- carried out experimental fields with stevia and concluded that it is well adapted in several areas throughout the country, including the Prefecture of Karditsa. The outcomes of these projects were disseminated through the press and seminars targeting specific groups of farmers.

In 2012, a local group in Karditsa Prefecture took the initiative to organize such a seminar. This group, named Fanariotes, originating from the local community of Fanari, was active in calling experts to provide information on topics of interest to local farmers. They invited two academic researchers from the University of Thessaly and the Technological Education Institute (TEI) of Larissa as key speakers, who provided information on stevia cultivation practices and a new experimental method for the production of steviol glucosides, respectively. During the seminar participants also became aware of a preliminary market assessment showing a growing interest for stevia in the international markets. The fact that the academic from TEI could make the processing method freely available to farmers convinced some of them to establish a cooperative engaged in the cultivation, processing and trading of stevia (ASYST), aiming at the vertical integration of the production chain through the establishment of a processing unit. The cooperative was established by 21 farmers and its membership increased over time to 64 (Koutsouris and Zarokosta, 2018). During the next cultivation period the cooperative run pilot fields, under the guidance of the University professor; the following cultivation period the farmers, acting on their own, imported seeds from Paraguay and Spain and started establishing their stevia plantations.

Raising awareness for stevia among Karditsa farmers was the result of the abovementioned seminar with the two researchers stimulating the interest of farmers; some of them had already been in a process of thinking about changes and recognized stevia as an opportunity to increase their income. In the following years awareness activities were undertaken by ASYST members on the basis of one to one in person interaction or through workshops and group discussions (Fig. 9-10).

The assessment process for most of the adopters was triggered during the seminar and continued during the subsequent cultivation period, when they run pilot fields; members of ASYST attended seminars delivered in the University of Thessaly, while the University professor visited some farms and suggested cultivation practices to farmers (Fig 11). Then the farmers disseminated the knowledge they gained to their colleagues through discussions and visits to the pilot farms (Fig. 12). Some farmers also sought information from a company engaged in the production and trading of aromatic and medicinal plants and stevia in another region; additionally, some looked for information from the input suppliers they collaborate with but none of them could advise

them since stevia was unknown to them. During assessment the main motivation for adoption concerned the prospect of profits related to the potential operation of the processing unit. On the contrary, factors of non-adoption included financial constrains since farmers' involvement entailed the financing of the processing unit; uncertainty as regards the efficiency of the experimental processing method to produce products of the expected quality along with the lack of an alternative marketing plan; lack of advice on cultivation issues and worries of loss of income were also important.

During the implementation process ASYST farmers collaborated closely, organizing discussions, paying farm visits and exchanging valuable knowledge. The main challenges they had to overcome were related to the supply and the treatment of seeds and planting material as well as to the drying process requiring special and very expensive facilities.

Though ASYST managed to build an environment conducive to interaction and learning, at least two of its members abandoned the cultivation since the cooperative stopped collecting stevia leaves, after failing to get the processing unit into operation, and the lack of an alternative plan of placing the produce in the market. This reason is also referred to by half of the non-adopters as the main reason of their decision; other reasons concern the lack of know-how and support on cultivation issues, uncertainty as the innovation is at an experimental stage and financial restrictions given the high investment cost of the processing unit. Nevertheless, droppers intend to be involved again in the cultivation of stevia, in case the problem with the processing unit is solved.

Fig. 9: Actors- Awareness (stevia)

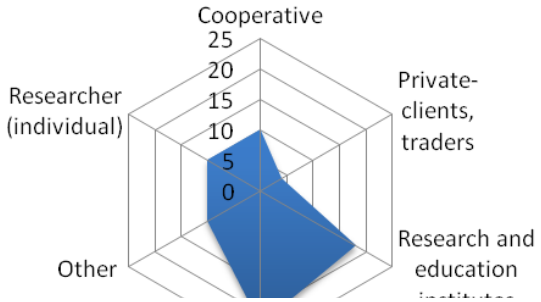


Fig. 10: Communication methods- Awareness (stevia)

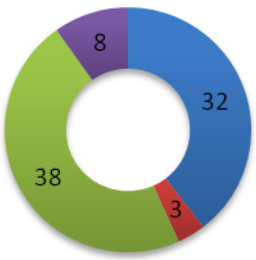


Fig. 11: Actors - assessment (stevia)

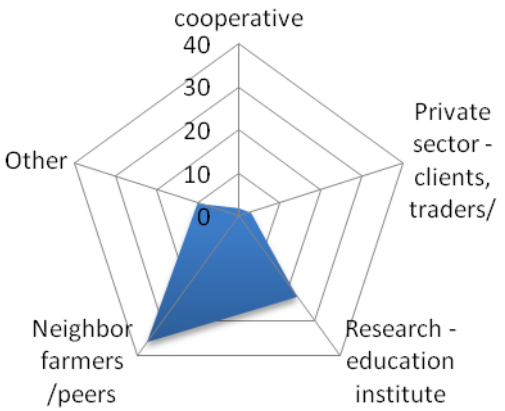
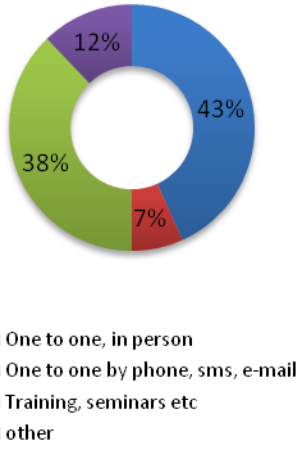


Fig. 12: Advisory methods, assessment (stevia)



The AKIS-actors in Karditsa

The key players in the case of stevia were mainly the abovementioned two researchers as well as the stevia cooperative (ASYST) and its members. However, the advisory landscape also includes actors who played a secondary but important role in the initiation of the innovation such as the local group of Fanariotes and the Development Agency of Karditsa providing consultation mainly concerning the establishment of ASYST.

All external advice suppliers were activated only during the awareness and assessing stages, while ASYST supported the implementation of the innovation through interactive activities among its membership. ASYST's practice not to seek continuous support for cultivation issues from a knowledgeable scientific partner was criticized by some AKIS actors and non-adopters, claiming that ASYST underestimated the need for scientific knowledge.

Conclusion

Given the weak and fragmented AKIS, notably the demise of public extension, in Greece, this paper explores the existence (or absence) and the roles of advisors/supporters in three innovation cases. In the case of MD the leading independent advice supplier, though it developed some intermediary activities, was confined to the traditional extension paradigm, creating awareness among farmers for a technical innovation and bridging the gap between researchers and farmers. On the contrary, the cases of avocado and stevia were characterized by the absence of provision of extension services; instead various actors (agronomists, researchers, input sellers as well as individual farmers or/and farmers' organizations) tried to support and influence, to varying degrees, farmers' decisions making processes.

The advisory landscape in the three regions varied significantly as well. In Imathia the collaboration between a cooperative and an independent advice company created conducive conditions for the adoption of MD, became an example to follow for other cooperatives and independent companies and, thus, contributed to a more structured support environment in comparison to the two other cases. In Chania the advisory landscape was muddled; various actors tried to support avocado growers and enhance knowledge with dubious results. Avocado growers relied at large on peer-to-peer exchanges throughout the innovation process. The main collective activity of the key advice suppliers was their engagement in an informal working group aiming at promoting proposals, which the regional government was called to endorse; however, this activity did not yet produce significant results. In Karditsa, the stevia cooperative was involved in experimental/experiential activities that enhanced its members' knowledge and ability to interact with each other. Nevertheless, the fact that all activities were confined within the cooperative did not allow for the creation of space for the development of interactions and synergies with other actors and, consequently, did not generate changes in the advisory landscape.

Advice suppliers in all cases identified farmers as valuable sources of knowledge; this indicates a possibility for co-creation of knowledge. Moreover, peer-to-peer interaction is a widespread practice among farmers; this also occurs among advisors in Imathia and, to some extent, in Chania. However, important structures and capabilities for co-creation and synergies seem to be lacking.

Therefore, amidst a national AKIS which is weak and fragmented, in all the innovation cases examined here it is quite obvious that the links among the local AKIS actors, despite some efforts for synergies, are also weak; this, in combination with a lack of research tailored to farmers' needs, affects all existing advisors'/supporters' ability to obtain and disseminate knowledge and advice farmers effectively and efficiently. Moreover, both farmers and advice suppliers admitted, to different degrees, dissatisfaction with the provided advice services, with advice suppliers highlighting the lack of staff, necessary data and tools facilitating advisory work.

Such findings, on the one hand, verify and, on the other hand, complement previous research concerning the provision of extension/advisory services in Greece. Especially the use of the notions of micro-AKIS and R-FAS prove extremely useful in disentangling the extension/advisory landscape at local level with reference to specific innovations. In the case of Greece examined here, the macro picture of the national AKIS as well as surveys addressing farmers' (dis)satisfaction from current extension/advisory (including training) services become now 'clearer' as we have been able to identify exactly who supports -and in what way- innovative endeavours in the Greek countryside. So the overall dysfunctional picture of the Greek AKIS is now complemented with (somewhat) positive experiences which nevertheless, due to the gaps identified at micro-level as well, also point to the urgent need for a clear, integrated and stable policy mix aiming at (a) bridging the gap owed to the fragmentation of extension providers through the setting up of networks to support learning and collaboration among diverse providers at both regional and national level and (b) the building of Innovation Platforms (see: Magala et al., 2019) and, finally, of a functional national AKIS. Policy should focus both on creating more space for potential innovators and facilitating the establishment of stable linkages among the potentially involved actors. Nevertheless, though there is abundant of international literature on the role of innovation brokers facilitating innovation processes in various fields, certain actions facilitating their emergence within a weak institutional environment are not obvious and, in particular, not easily performed. Successful innovation brokerage presupposes knowledge and competencies on the part of individuals and organizations willing to play this role (Ward et al. 2009; CHSRF, 2003; Robeson et al. 2008). Moreover, the actors engaged in innovation initiatives should understand and accept brokers' function; but such conditions are not evident in the examined cases, therefore, they should be created by a variety of measures (such as specific projects and Living Labs) aiming at building capacities and changing mindsets at national, regional and local level.

The further elaboration of the current preliminary results (possibly with the use of Social Network Analysis tools) in which additional data can be included (as for example the sources of knowledge of the advisors/innovation supporters; see Zarokosta and Koutsouris, 2019) may yield further interesting results.

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THE ROLE OF ADVISORY SERVICES IN THE UPTAKE OF SMART FARMING TECHNOLOGIES: EVIDENCE FROM FIVE EU COUNTRIES

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Abstract

Smart farming technologies (SFTs) such as variable rate precision farming, milking robots and smart sensors can lead to better productivity, yields and cost savings as well as supporting more environmentally sustainable farming practices. Despite these advantages and the growing prevalence of SFTs, patterns of adoption vary within regions and across European countries. This is in part due to characteristics of specific farms such as farm size and type, as well as changing advisory landscapes with services becoming more fragmented, and challenges for advisors and policy makers in keeping up to speed with technological developments and the changing structures of farms.

In this paper we present findings from five case studies (UK, Czech Republic, France, Portugal and Norway) exploring the role of advisors in the uptake of SFTs. We discuss the factors affecting adoption of SFTs. We focus on the role of microAKIS on decision making in innovation adoption. Finally we reflect on the implications of these findings on the future roles of advisory services in relation to supporting farmers' decision making in relation to SFTs.

Introduction

Agriculture in Europe is becoming an increasingly digitised sector. Smart farming technologies (SFTs) aimed at improving farming practices are being developed at a rapid pace. These developments are heralded as having the potential to alleviate the economic, ecological and social challenges associated with modern agriculture, resulting in more sustainable farming across Europe (Kernicker et al. 2019). Increasingly popular SFTs include variable rate precision farming, milking robots and smart sensors (e.g. the "Internet of Underground Things" - Vuran et al. 2018). These and other SFTs are argued to revolutionise agriculture, in many cases already leading to better productivity, yields and cost savings as well as more environmentally sustainable farming practices (Rose and Chilvers 2018). On the other hand, digitalisation of farming practices enables further industrialisation of agriculture (Wolf and Buttel 1996) exacerbating existing inequalities between agricultural stakeholders. Nonetheless, it can be argued that farms have much to gain by embracing the digital age and engaging with tools for more efficient and profitable food production.

Despite the promised benefits, patterns of adoption vary across European countries. This is in part due to characteristics such as farm size and type. It has been argued that SFTs are most often adopted by larger farms because these are better placed to benefit from technological advancements (Kernecker et al. 2019). In addition, advisory knowledge and innovation systems (AKIS) for farmers vary from country to country. In this paper, we conceptualise the range of individuals and organisations that farmers seek and exchange knowledge from as "microAKIS" (Labarthe et al, 2018). In Europe, advisory landscapes are becoming more fragmented, and

challenges arise for advisors in staying abreast of technological developments as well as keeping up with the changing structures of farms.

"AgriLink"[4] is a Horizon 2020 project which seeks to understand the roles of a wide range of advisory organisations (microAKIS) in farmer decision-making on the uptake of various innovations across Europe. The project works across 13 partner countries and eight innovation areas. The innovation cluster of relevance to this paper is **"Autonomous vehicles, robots, drones, intelligent sensors and precision farming", in which case studies were carried out across five European countries -** Czech Republic, France, Norway, Portugal and UK**.**

In this paper we present findings from the case studies. In Section 2 we present our literature review. We outline the changing nature of AKIS in the different EU countries (2.1), discuss the factors affecting adoption of SFTs (2.2) and consider the role of microAKIS across the various stages of decision making in SFT adoption (2.3). In Section 3 we present our research methodology. In Section 4 we present our results and discussion. Section 5 presents our concluding remarks.

Technological innovations, adoption on farms and the role of microAKIS.

Section 2 outlines the literature in terms of changing advisory landscapes, technology adoption on farms, and the role of microAKIS in supporting that adoption.

Changing advisory landscapes

Advisory landscapes are undergoing transformation across Europe (Kania et al. 2014). There exist various drivers behind these changes, for example the commercialisation and privatisation of services (Prager et al. 2016), and new technological developments (Knierim et al. 2017). Research shows that these drivers have resulted in fragmentation of advisory services in different EU states, and have impacted on the capabilities of advisory services to support farmer decision making in a number of innovation areas (Labarthe et al. 2018).

In the UK, the late 20th century marked significant changes for farm advisory services (FAS), as previously state-funded advisory organisations were commercialised and then privatised (Prager & Thomson 2014). A fragmentary sector resulted in specific challenges, namely the increase and diversity of other actors including NGOs and private commercial companies to provide advisory services. FAS is considered to be a devolved power and is contracted out to different organisations with each nation having their own rural development program and specific areas of interest to be targeted.

In France, Agricultural Chambers were the main actors of the FAS. They were created by the State after World War II with the objective of modernising French Agriculture. The Chambers oversee agricultural extension (Brives, 2008) and are organised at the local level. However, they are challenged by other advisory organisations, trade organisations and Farmer Based Organisations (FBO). With the progressive decline of public funding, the Chambers reorganised their activities towards paid advice and services (Labarthe et al, 2013). Today French FAS is dominated by large farmer cooperatives that are dealing with commercial contracts, selling inputs and offering free advice to farmers.

In Norway there has been a transformation towards privatisation and paid services in recent years (Klerkx et al. 2017). The earlier public and free advisory service does not exist anymore and the cooperatives are the main advisory actors. The only independent actor is the Norwegian

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Agricultural Extension Service (NAES); other actors are input or output cooperatives in agriculture. The transformation has resulted in more competition and less cooperation between advisory organisations (Kvam and Stræte 2018).

In the Czech Republic, during the late 20th century and the end of the communist regime, FAS, which had previously been state-funded, were commercialised and then privatised (Ksouda et al. 2016). The new advisory services helped newly privatised farms to consolidate their property bases and adapt to market management systems, offering advice on subsidies and compliance with government regulations (Pulkrábek & Pazderu, 2014). The market environment and press to modernisation have opened the door for strong players from technology and inputs suppliers as well as facilitators from FBO. The influence of suppliers is even stronger because farmers are not willing to pay for advice. Thus advice is integrated into product sales.

In Portugal, FAS builds on a large number of regional and sectoral FBOs comprising farmers' associations, cooperatives, and producer's organisations. It is overall a weak and fragmented FAS, although innovative FBOs have emerged since Portugal's entrance into the European Economic Community. These FBOs sell inputs, equipment and technical advice to farmers. Local governments are emerging as a relevant AKIS actor in some regions, by supporting the FBOs. Private independent advisors have emerged, although these are more focused on specific topics and targets, such as project development or book-keeping services.

2.2 Technology adoption on farms

Agriculture is experiencing a global technological revolution, increasingly refered to as the "Fourth Industrial Revolution", or "Agriculture 4.0" (Rose and Chilvers 2018). SFTs are lauded as transformative for the economic, environmental and social challenges of modern agriculture (Kernicker et al. 2019). New technologies are accompanied by promises of a more sustainable future for agriculture, in terms of food security and even smart responses to climate change (Long et al 2016). The role of SFTs is therefore high on the worldwide political agenda (El Bilali and Allahyari 2018).

However, the adoption and diffusion of SFTs on farms across Europe has been slow (Long et al. 2016). There are a number of reasons including complexity of SFT systems (Eastwood et al. 2017) as well as characteristics of farms which can act as barriers to adoption. SFTs are most likely to be adopted by larger farms better placed to benefit from technological advancements in agriculture (Kernecker et al. 2019). Many SFTs entail costly investments. Small farms are unlikely to have the financial resources to invest in SFTs, and the small scale of their operations means that returns on investments takes longer.

SFTs also contribute to an increasingly mechanised sector with farms operating on much larger scales. Small farms face increasing marginalisation as many SFTs are not well adapted to small scale farming practices (Wegren 2018). Hence whilst large farms enjoy the benefits of the digital economy, smaller farms are left behind and suffer competitive disadvantages and increased marginalisation (Wegren 2018). These are the elements of the *agricultural digital divide* characterised by both winners and losers in an increasingly high-tech agricultural sector (Hennessy et al. 2016).

The role of microAKIS in supporting the uptake of SFTs

Research has found that diffusion of SFTs is hindered by a lack of appropriate support, particularly where technological systems are complex, and that collaboration between different stakeholders and support organisations is required in order to support future uptake (Eastwood et al. 2017).

Unfortunately, the capabilities of advisory services to support farmer decision-making are stretched, as we outline in Section 2.1, but especially in regard to innovations and new technology (Labarthe et al. 2018). As we show in Section 4, the adoption of SFTs is not only supported by traditional advisory services in all of the five countries; instead, new players in these microAKIS are becoming more prominent. Our research explores the extent to which there is still a role for traditional advisory services in the uptake of SFTs on farms in Europe; or conversely, whether these roles are increasingly adopted by commercial companies which better understand the technological landscape of SFTs.

Methodology

Case studies were carried out in five European countries (Czech Republic, France, Norway, Portugal and UK) between 2018 and 2019. In-depth semi-structured interviews with more than 200 farmers (characterised as adopters, non-adopters and droppers of specific technologies) and with advisors and AKIS experts explored the role of advisors in supporting uptake of SFTs (see Table 1 for the range of technologies in question). We consider adopters of a technology as those who used the technology on their farm during the year of the study. Non adopters are farmers who never used the technology on their farm. Droppers are farmers who have used the technology during the past but no longer do. Some case studies also use the category of "partial droppers" to refer to farmers who drop certain applications but not the entire technology.

Farmers and AKIS experts in the study were identified through snowball sampling, and by sending letters out to farms and advisory organisations identified through local business directories and local farming fairs. Farmers were interviewed at their own farms. The in-depth interviews posed a number of questions relating to the adoption (or non adoption, or dropping) of the technology in question, and the role of various advisors and other actors in a) becoming aware of a technology, b) assessing its potential impact on the farm, and c) implementing the technology on the farm.

Data was analysed using Nvivo which allows for the coding of qualitative data into a thematic framework for analysis. Results are presented below.

Results and Discussion

Table 1 presents an overview of the contrasting findings across the five countries.

Table 1: Overview of findings in the five countries

Country	Technology	Advisors	Adopter characteristics
UK	Variable rate precision farming via soil sampling	Mostly private – chemical input companies	Larger farms more likely to adopt – arable
Czech	Variable rate precision farming via satellite and soil sampling	Mostly private – chemical input companies and machinery suppliers. Also pioneer farmers.	Larger farms are more likely to adopt – several farms owned by large corporations. Arable crops.

France	Variable rate precision farming via satellite and drones	Cooperatives (that are selling the service via a tech company). Also Fmachinery suppliers, and traditional advisors who attempt to re-enter market via precision farming.	Diversified, mixed (arable and livestock). Larger farms not more likely to adopt.
Norway	Automatic milking systems (milking robots)	Machinery advisors advise on the hardware (machines) whereas the Dairy cooperative advises on the software. The cooperative are not public but a more traditional form of advisory service.	Large farms more likely to adopt, smaller farms must rent more land, in order to produce more fodder for more cows (because it is not cost efficient to invest in the tech if not enough cows)
Portugal	Irrigation sensors (moisture probes).	Regional advisors association (cooperative). They both sell the farmers' products and also sell inputs and advice to farmers. Collaborate with hi-tech companies.	Larger farms with larger plots (and less plots) more likely to adopt.

The UK case study was focused on *variable rate precision farming technologies* (VRPF). The UK case study was carried out in North East Scotland, encompassing the Aberdeenshire and Angus regions. 31 farmers and 6 advisory suppliers were interviewed. Of the farmers, 22 were adopters, 6 were non adopters and 3 had dropped only part of the technology. The total agricultural land for all the farmers in this case study amounted to 17,512 ha, with the average farm size being 565 ha. Despite this high number, the majority of farms, nearly 75%, held agricultural land under 500 ha.

The UK findings highlight that advice on SFTs is increasingly provided outside of traditional advisory organisations. Advice on the adoption of VRPF was most commonly being provided by two private commerical companies dealing in machinery and chemical sales. One of the AKIS experts indicated the traditional advisors in the region are not considered the best source of advice regarding these types of SFTs, instead they turn to private companies who have more expertise in these technologies on farms. FAS are instead associated with support with administrative or legislative matters:

"*You want to find out about new or innovative ways of crop production, you go to [private company specialising in soil sampling] or the Internet or whatever. So, you know, and that's quite sad and it's slightly worrying for the industry."* (AKIS expert).

FAS within the region are increasingly associated with legislation compliance, and not with technological advances. This highlights a growing gap in expertise relating to FAS and new technologies.

Of the commercial companies providing advice on how (and whether) to implement SFTs, farmers tended to name trusted individuals. Many farmers reflected working relationships with individuals which span many years. These are trusted relationships, in some cases built over multiple generations on the farm. The companies themselves have in many cases evolved over decades to respond to technological advancements – hence they have developed (or brought in)

expertise in new technologies to remain competetive in terms of the provision of farming services and products.

For uptake of all VRPF technologies, farmers were typically requesting (or being offered) a soil map, produced by commercial companies specialising in soil sampling, by taking samples at regular intervals across a field. The output of this map is both visual (a colour coded map that can be printed or viewed on a screen) and a data file which is compatible with certain software (or apps) which work with precision farming equipment on the tractor (the hardware). The tractor receives information about how much inputs to apply at various places in the field. This represents a large potential cost saving on inputs, because traditional farming applies the same level of inputs across all parts of the field, whether they are needed or not.

"I knew my fields were not homogeneous but after I received the output [the soil sample maps] from the supplier I was surprised how the soil condition of some of the fields were variable" (farmer).

It is this soil map that has proved to be a very influential trigger on adoption. Farmers, on seeing this map, immediately recognise the potential cost savings (through reducing inputs) of adopting VRPF.

It is not only the initial uptake of VRPF that requires advice and support, but also the ongoing use of the technologies. As one farmer stated:

"It's what you do with that information once you've gathered it and how you then regurgitate it and then use it the following year or the following season or whatever. And I think that's probably where the challenge is." (Farmer).

In this regard, traditional FAS are again not seen as expert enough to provide support, hence farmers prefer to maintain relationships with individuals within those commercial companies providing advice on the technologies. The challenge for FAS will be to adapt to constantly advancing technologies and their applications, and the use and storing of data for benefits on the farm, when others who are closer to the technologies are better equipped to respond to these advances.

The Czech case study looked at VRPF in two regions - South Moravian and Central Bohemian region. 35 interviews with farmers and 8 interviews advisory experts were carried out. The sample was composed of 19 adopters, 15 non-adopters and 1 dropper.

The total area of farms covered in the Czech case study is 54,100 ha. The average area in the case study is 1,546 ha.

The adoption of VRPF varied according to the size of farm and farming focus. The consideration of adoption was based on several parameters such as existing use of GPS and the level of accuracy required during farming. Thanks to the post-communist (cooperative scheme) field arrangement, i.e. farms with typically big fields (more than 30 ha per plot), Czech fields have high potential to take advantage of this innovation. Larger farms access very high accuracy navigation mainly through RTK (Real Time Kinematic) correction, where stationary stations correct the inaccuracy of the moving satellites by up to 2 cm. The huge initial investment is quickly returned through cost savings on inputs used across the large scale of these farms. Besides VRFT, some innovative large farms experimented with belt sowing of two different crops targeted to the erosion-risk fields.

"The state regulation of soil protection pushes us to experiment with new ways of farming in our large fields." (Agronomist of a big farm)

The smaller farms invested in the cheaper but less accurate variation of navigation through the paid satellite service which allows accuracy up to 5 cm, or through a free satellite service which

allows accuracy up to 25 cm. This insight garnered from this approach are usually combined with soil sampling and the local field knowledge of the farmer.

"I do not need to have GPS with high accuracy, I know my fields and the soil sampling of a particular grid of the field is sufficient for suitable applications." (small-scale farmer).

Interviews in both regions illustrate the importance of informal learning. Reciprocal services between the suppliers of advice and farmers are crucial. Despite the demanding transition process, we found that trust tends to grow following a previous good experience. Machinery and input suppliers know the importance of reciprocity; therefore, they willingly support farmers with ongoing information and services. Czech farmers are not used to paying for advice, it therefore has to be covered through the cost of other items, inputs or services. Mutual knowledge sharing and cooperating are also growing between farmers. Therefore, in the last few years, well-experienced farmers have become very important providers of advice for other farmers. The role of the farmer-based organisations is also significant, mainly as a bridge between farmers and other relevant actors (researchers, specialists, policy-makers) in the awareness stage.

In summary, in the Czech Republic case, the main suppliers of advice on VRPF are private companies such as machinery and input suppliers as well as pioneer farmers – there is little role for traditional advisors in this sphere, given they have less expertise in this field.

The French case study relates to crop input modulation tools for fertilisation, with a focus on tools using drones and satellites. The study was conducted in the South West of France, in the Gers region. 33 farmers were interviewed. The sample consisted of 19 adopters, 8 non adopters and 6 droppers. We also interviewed 19 advisory experts: 6 advisors, 2 machinery dealers and 7 private companies in relation to VRPF.

All farms (except 1) are established family farms. Many farms still follow a diversification strategy with activities other than growing crops. About one third of farms (36.5%) still own animals (duck, poultry, bovine). The total agricultural land for all farmers in this case study amounted to 6,101 ha, with the average farm size being 150 ha.

The adoption of SFTs is strongly linked with the main advisory organisations already established in the region. Farmers are already aware of the existence of the technologies but their advisor has a key role in transforming awareness into the adoption. Advisors trigger the adoption of SFTs by offering farmers various technology services. The service often originates from a start-up or other external company outside the advisory organisation: advisors are reselling the service.This offer is made during one of the regular visits made by the advisor to the farm. In the French sample, all farmers who received such an offer quickly accepted it. Farmers often justify this quick decision by citing the trusted relationship they have with their advisor:

"This [name of the cooperative] I had been working with them for 10 years. It was [name of the advisor] who came, who was my technician and who told me "Would you like to start with us, it's not about using inputs, but we're going to use satellites". (Farmer).

Farmers who are already well connected with advisory organisations (typically members or former members of farmers' unions or cooperative boards) are more likely to receive the proposition to adopt SFTs. In this sample, farmers who did not adopt the technologies were farmers who had weaker connections with their advisors and therefore never received any offer from them. However, although traditional advisors are key actors in trigerring adoption, farmers implement the innovation independently and rarely discuss with their advisors the crop input modulation maps generated by the technological tool they bought, because these aspects are beyond the traditional skillsets of advisors. The main difficulties are linked with machines and connectivity:

"We solved the problem at the [name of of a local fair on farming innovations] where I had gathered [name of the advisor], the guy from [name of the start-up developing the technology], the console builder, the distributor builder, the farm contractor and me. There were six of us! I want a conclusion: why didn't it work? The device did not work. [Name of the tractor brand] couldn't read the maps. […] In fact there was a position A and B and it had to be put on B and nobody knew." (Farmer).

Thus, advisors are key actors in the dissemination of SFTs at the local level. The challenge for them will be to reassure their role and legitimacy with respect to other actors, especially the developers of SFTs (software) and machinary dealers (hardware) who are often better equipped to deal with technological challenges faced by farmers.

The Norwegian case study considered automated milking systems (AMS). The case study was carried out in the county of Trøndelag, located in the middle of Norway. Altogether 29 farmers were interviewed, including 20 adopters and 9 non-adopters. It is very rare that dairy farmers remove AMS after installation: therefore it was not possible to find any droppers. Additionally, we carried out interviews with eight AKIS experts. Sampling of these experts was based on the interviews with farmers.

Results from the study shows that size is important for implementing a milking robot both regarding number of cows and area of arable land. Most farmers had between 20 and 60 dairy cows. The non-adopters had 60 cows as a maximum, while adopters had up to 100 cows. The majority of the sample have 41-80 ha. We find that installing a milking robot increases the need for more cows, buying milk quotas and renting or buying more land – therefore illustrating structural consequences for farming in Norway.

Management of dairy farming is partly based on data and tools related to the Norwegian Dairy Herd Recording System (NDHRS) operated by the milk cooperative, Tine. Milking robots are associated with increased efficiency and productivity, and consequently profitability in dairy farming as well as more flexible working conditions for dairy farmers and their households. For farmers and advisors, it was other farmers and suppliers of AMS, rather than traditional advisors, who were most important in raising awareness of the innovation. Advisors and AKIS actors are more active in helping farmers to assess the potential benefits of implementing the innovation. At this stage, the farmer needs several kinds of information in order to make decisions for his/her future farm. The milk cooperative Tine, the Norwegian agriculture extensions service (NAES), the technology companies and their Norwegian suppliers are all important advisors. Tine and the input providers have bigger roles than traditional advisors in this phase, because they have developed specialised startup advisory services focused on technology regarding different milking robots. Tine has advisors specialised in the most common robots, in addition to specialised advisory service on feeding, milk production and breeding related to dairy production with milking robots.

Due to the extent of adoption of AMS in Trøndelag, changes in the advisory landscape have emerged. Input suppliers are primarily salespeople but are used by farmers as advisors. These salespersons have a double role, and act as advisors on the adoption and implementation of AMS because they have first-hand knowledge about the technology.

"I am not sure that the traditional advisers will manage to keep up with the future technological development. We (suppliers) are the most updated on the technology and the farmers have increasing requirements for expertise in the field". (Supplier).

Traditional advisors struggle to keep up with farmers' needs for specialised advice. The farmers have gained so much knowledge that they may have more knowledge than the advisors in some cases. The traditional advisory services acknowledge that they have challenges in keeping up with technological developments. They see the need for the different actors, including their

competitors, to collaborate in order to meet the farmers' needs for specialised advice on AMS. The suppliers also see the need for more collaboration between the different actors in order to coordinate their advice to provide farmers with the "whole package" at various stages of adoption, rather than fragmented information.

In Portugal the selected case study focused on the adoption smart irrigation sensors (moisture probes). The group of farmers comprised commercial small, medium and large growing irrigated crops in the river Tagus flatlands region, known as Lezíria do Tejo (NUTS 3). It is an agrarian predominantly rural area close to city. It comprises medium sizes cities and is nearby the Lisbon conurbation. Irrigated crops predominated in this region, mainly maize and vegetables, and tomato for industry. The interviews were administrated to a sample of 38 farmers, 21 currently adopters, 10 non-adopters and 7 droppers. Farmers in this region have a similar business model by producing and bulk selling their production to large assemblers, such as cooperatives or the industry, although some larger farmer negotiate directly with the private agro-industry and the large distribution.

The Portuguese case study took place in the Lezíria do Tejo region. The crops produced in this region are mostly vegetables (including onions, sprouts, cabbage, broccoli and pumpkins). The average farm size across the sample is 177 ha, with adopters having larger farms (average 225 ha) compared with non-adopters (average 35 ha). There were 38 farmers interviewed (21 adopters, 10 non adopters and 7 droppers) as well as 4 AKIS experts.

The regional AKIS is characterised by a strong presence of suppliers of inputs, equipment and technologies. All of these actors are involved in providing advice on the innovation, although it was first introduced to farmers by an FBO (a regional farmers' association). The association first introduced and tested the probes in the region in 1998. In 2008, once the smart probes became commercially available, they were disseminated and developed by the FBO, which has since worked closely with high technology developers developing software for the probes:

"FBO Agromais are designing differentiated actions to enhance farmers active use of the information... in partnership with the hi-tech company". (FBO advisor).

This a case where advisors (FBOs) played a key role in the introduction and development of the innovation, by working with the hi-tech sector in the design and supply of the technology. Currently, probes are supplied by a number of manufacturers but the software to operate them is developed and released by a few high-tech companies that work informally together with the FBO referred to above.

Probes are installed in the soil and monitor parameters such as humidity, temperature and salinity at different soil depths. This allows farmers to know when and how much water is needed to irrigate their fields. The data obtained from the probes can be directly used by farmers installing the app on their mobile phones or other electronic devices. However, we found that most of the adopters rely on information "ready-made" by the FBO that analyses and interprets data from the probes alongside meteorological information. Only a very few adopters are active users of all aspects of the technology. Non-adoption and dropping is mainly related to unsatisfactory returns on investment. Lots of farmers have land scattered over many small plots, making the cost of having at least one probe for each plot unfeasible. The probes are typically leased for an annual fee by the FBOs, who in turn provide farmers direct advice along with support on irrigation systems and the supply of inputs and irrigation equipment. In general farmers appear to have a positive view of the probes although their economic benefits (the energy savings) are only fully realised by a few intensive users of the probes.

This case study shows that traditional advisory services can play a role in SFT adoption if they are knowledgeable about the technology's development and use. This entails effective collaboration

with high-tech companies and working closely with farmers in order to support them in the adoption and ongoing use of the innovation.

Conclusions

The extent that traditional advisory organisations are supporting uptake of SFTs varies between countries. New entrants to the advisory landscape are taking a more prominent role. In the UK private companies (in the form of machinery and input suppliers) are favoured by farmers looking to implement SFTs. In Czech Republic, it is typically private companies that introduce farmers to these innovations. In France, traditional advisors and cooperatives play a more prominent role at the awareness stage, but are ill equipped to provide ongoing support. Likewise, in Norway, all types of advisors play a role in assesing the potential of SFTs, but some actors are more critical during the implementation stage because they have become specialised in specific technologies. In Norway, milk cooperatives have become skilled in technology, so it is not only the technology providers who are able to provide all of the necessary advice on adoption and implementation, as is the case in some other countries. The Portuguese case proves that there is a role for traditional advisors, but only if they can foster effective collaboration with hi-tech companies in implementation and ongoing support to farmers.

The extent that different actors play a role depends upon the existing advisory landscape in the region, existing relationships, trust between farmers and advisors, and the ongoing skills development of the actors and their capacity to stay abreast of technological developments. For traditional advisory services to find a place in this rapidly developing landscape, it will be increasingly important to recruit technologically skilled employees, and work with them to provide appropriate advice and support at all key stages of SFT adoption. Technology expertise is necessary, as is the understanding of how these technologies work in different agronomic situations. A combination of skills is therefore required if traditional advisory organisations are to strenghten their role in helping farmers in assessing whether specific SFTs are appropriate for individual farms.

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ADVISORY SUPPORT ON NON-TECHNOLOGICAL INNOVATIONS ON FARMS: THE CASE OF DIRECT MARKETING

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ABSTRACT

Context: The search for sustainability of EU farmers, especially from the economic point of view and particularly in the case of small and medium size farms, has led to several attempts of introducing organisational and marketing innovations, not linked to new products of new technology. Often these innovations are implemented through collective approaches – a factor that along with its positive effects also brings various challenges and requires specific skills.

Purpose: The paper addresses the question of if and how are the Farm Advisory Systems (FAS) supporting farmers in the implementation of non-technological innovations in various countries and in different social environments. It also aims to understand what skills and knowledge are required for a successful implementation of organisational and marketing innovations and who can provide this knowledge and skills to farmers.

Methodology and approach: The research is based on five case studies carried out in the H2020 AgriLink project. These cases pertain to the use of direct marketing by farmers, in collective or individual form, in Italy, Portugal, Latvia, Spain, and Romania.

Results and Implications: The paper advances our understanding of the present and prospective role of agricultural advisory services in the domain of non-technological innovations. The obtained results also address the needs of FAS in terms of training and innovative work modality in order to be supportive to farm-level innovation adoption. Furthermore, the role of new actors in the AKIS (Agriculture Knowledge and Innovation Systems) are discussed and recommendations for policy-makers and rural development agents are provided.

INTRODUCTION

Innovation is seen as one of the main drivers of productivity, profitability and competitiveness in the agricultural sector (OECD, 2013). Despite this, there is evidence that the European agricultural sector is not reaching its full potential in terms of innovation and there are considerable differences in agricultural innovation across countries (e.g., OECD, 2013). This can partly be explained by the fact that policies, institutional settings, infrastructural environments and/or knowledge transfer systems differ between countries. While agricultural innovative performance differs across countries, it is also the case that innovative activity is generally not uniformly distributed across regions: there may be regional dynamics at play that also affect innovation efforts (Läpple, Renwick, Cullinan, and Thorne, 2016). In these innovation regional dynamics agricultural advisory services are expected to play a key role.

The interest in assessing the role and effectiveness of agricultural advisory services is not new, but has been much more common in developing countries, where supporters wanted evidence that their investment was worthwhile (Swanson and Rajalahti, 2010). Evaluations of advisory

services in developed countries and in Europe are rare (OECD, 2015), and tend to focus on the farm level and specific advisory methods. Agricultural advisory services are meant to provide farmers with relevant knowledge and networks for innovation, as well as adjustments to policy and markets in agriculture. Despite substantial investment into these services, there has been little evaluation of their performance and impact, in particular at a system level (Prager, Creaney, and Lorenzo-Arribas, 2017), on the performance of small and medium size farms and with respect to non-technological innovations (incl. marketing and organisational ones).

This paper contributes to fill this gap taking into account that search for sustainability of EU farmers, especially from the economic point of view and particularly in the case of small and medium size farms, has led to several attempts of introducing organisational and marketing innovations. Often these innovations are implemented through collective approaches – a factor that along with its positive effects also brings various challenges and requires specific skills.

The paper addresses the question of if and how are the Farm Advisory Systems (FAS) supporting farmers in the implementation of non-technological innovations in various countries and in different social environments. It also aims to understand what skills and knowledge are required for a successful implementation of organisational and marketing innovations and who can provide this knowledge and skills to farmers. The paper poses the following research questions: 1) who is acting as a farm adviser regarding non-technological innovations such as direct marketing?; 2) what are knowledge and skills demanded by farmers with respect to direct marketing; and, 3) how can different knowledge domains be integrated and become useful to the farming community?

The research is based on five case studies carried out in the H2020 AgriLink project. These cases pertain to the use of direct marketing by farmers, in collective or individual form, in Italy, Portugal, Latvia, Spain, and Romania. In all cases a set of interviews with farmers and other AKIS actors provided the empirical basis for a thorough analysis of the farmers' knowledge needs, the FAS' readiness and capacity to supply the required support, the role of different formal and informal advisory actors in farmer decision-making, and the knowledge gaps inhibiting successful implementation of direct marketing solutions by farms.

The article proceeds as follows: the next section presents a brief literature review on innovation in agriculture and on farm advisor system. Methods and empirical data underlying the study are then introduced, followed by a description and discussion of the research results. The article ends with some concluding remarks.

LITERATURE REVIEW

Innovation in agriculture

Innovations are generally divided into technological (product and process) and non-technological (organisational and marketing) innovations (OECD/Eurostat, 2005; OECD, 2010). However, these general distinctions do not recognise that most firms' innovations encompass a vast range of activities. A set of innovation activities that are implemented together are often called modes of innovation (OECD, 2010). While the dominant image of innovation is the technological one (e.g., a new product or process applied in production), there is a vast array of innovations that are less tangible but still highly important, including, for example, changes in thinking and behaviour (e.g., environmental issues), new collaboration agreements between firms and between firms and others actors, establishment of a collective brand for one common product, etc. It is often the case that the terms revolutionary or radical are used in the context of innovation, though it can equally apply to smaller more incremental changes (OECD, 2013) or mimicking (e.g., where a successful technology or approach from outside agricultural industry is transferred or applied in

this industry). As some refer to innovation as a complex social process (Vanclay, Russell and Kimber, 2013), it is not surprising that there is considerable ambiguity in terms of defining innovation, which became obvious by considering the above mentioned innovation possibilities.

In this article, the authors adopt the view that innovation in agriculture is a broader set of complementary strategies (OECD, 2010) and measure innovation by three components (Läpple, Renwick and Thorne, 2015): (i) innovation adoption, which are modes of innovation relating to farm performance improvement, (ii) acquisition of knowledge, taking into account the importance of knowledge development for innovation (Spielman and Birner, 2008), and (iii) continuous innovation, underlining the need for ongoing innovation (OECD, 2013). The idea behind this innovation index is an attempt to capture and reflect the complexity of agricultural innovation.

Agricultural innovation is a process that involves the input of several actors (e.g., Klerkx, van Mierlo and Leeuwis 2012; Lamprinopoulou, Renwick, Klerkx, Hermans and Roep, 2014). That is, agricultural innovation evolves as a result of interactions among different individuals or systems. An innovation system is 'a network of organisations, enterprises, and individuals focused on bringing new products, new processes and new forms of organisations into social and economic use, together with the institutions and policies that affect their behaviour and performance' (World Bank, 2006, p. xiv). The innovation systems approach means moving away from the idea of the development and diffusion of technologies being a linear process involving public sector research and extension organisations (i.e., innovation simply being a product of science), to one with a wider focus on all of the organisations responsible for innovation. In this paper we focus our attention on the role of advisors and farmers in the agricultural innovation system at the farmers' micro-scale related to direct marketing.

It should be noted that the extent to which farmers adopt available innovations and the speed by which they do so determines the impact of innovations in terms of productivity growth. It is a common phenomenon that farmers, like any other kind of entrepreneurs, do not adopt innovations simultaneously as they appear on the market. Diffusion typically takes several years and mostly follows some sort of an S-shaped curve in time: some farmers choose to be innovators (first users) while others prefer to be early adopters, late adopters, or non-adopters (Diederen, van Meijl, Wolters and Bijak, 2003).

Farm Advisory Systems

Farm advisory services are only one component within the larger Agricultural Knowledge and Innovation System (AKIS). The AKIS concept describes the exchange of knowledge and supporting services between diverse actors from the first, second or third sector in rural areas (Prager et al., 2017).

The AKIS concept offers a multi-actor perspective designed to deal with the complexity and the diversity of information sources and channels in rural areas. The conception of an AKIS includes research and education, training, and advisory services (World Bank, 2012), with the innovation system literature broadening this conception to emphasise the role of public funding and policy, market developments, as well as systemic intermediaries in innovation support (Klerkx and Leeuwis, 2009). Although the AKIS concept is increasingly recognised as a relevant concept at the European level (EU SCAR, 2013), its use by policy makers has remained limited until recently.

Agricultural advisory services can be conceptualised as an intangible service activity (Gadrey, 2000), where the entity transformed by the services are the skills, knowledge and attitudes of the people involved in farming activities. The services can be provided by independent advisors and consultants, by organisations employing advisors such as government agencies, farmer-based

organisations (FBOs) or non-governmental organisations (NGOs). The farmer-advisor relationship is embedded in the wider institutional context and regional/national policy objectives (Labarthe and Laurent, 2013). Here, we adapt the definition of micro-AKIS (Agricultural Knowledge and Innovation Systems at the farmer micro scale) used in AgriLink that describes the micro scale knowledge-system that farmers personally assemble, including the range of individuals and organisations from whom they seek service and with whom they exchange knowledge, the processes involved, and how they translate this into innovative activities (or not). The empirical uptake of this concept entails answering two questions: a) who influences farmers (and farm households) in decision-making on adopting or choosing to not adopt innovations; and, b) how does it take place, in other words, what are the processes describing the knowledge assemblage by the farmers and role played by the different sources involved.

AgriLink defines the Regional Farm Advisory Systems (R-FAS) as the set of organisations that enable farmers to develop farm-level solutions, enhance skills and coproduce knowledge with advisors. These are viewed by AgriLink from a pluralistic point of view, including traditional advice providers (chambers of agriculture, public bodies, etc.), farmer-based organisations (unions, associations, cooperatives, etc.), independent consultants, NGOs, upstream or downstream industries, and high-tech sectors. Hence, R-FAS covers the full range of these organisations in a given region, and their connection to wider AKIS organisations, and as well as a range of services, including research, advice and brokering, meaning they can be active at different steps of the farmers' decision-making processes, and use different methods at these different steps.

METODOLOGY

The research is based on five case studies carried out in the H2020 AgriLink project, looking at the role of advisory support in adopting direct marketing as a non-technological innovation. These cases pertain to the use of direct marketing by farmers, in collective or individual form, in selected regions in Italy, Portugal, Latvia, Spain, and Romania.

The methodological framework implemented in this research consisted of a mixed-method strategy: combining a case study approach with quantitative survey-type data collection. It was implemented in two major steps: 1) the case studies selection (five case studies in five European countries); 2) the survey of farmers and of advisory service suppliers.

The farmers' survey was conducted through a questionnaire comprising both open-ended and closed-ended questions intended to gather quantitative data on 'who' and 'how' types of questions (who are the advisory service providers and how these services are provided), along with qualitative data on the why and how type of questions allowing for in-depth understanding of farmers' micro-AKIS. Quantitative data from farmers' survey were entered into a joint database, while qualitative information and narratives descriptions were recorded and analysed by individual researchers.

The advisory organisations' questionnaire built mainly on closed-ended questions and addressed formal providers of advice, excluding informal providers. Formal advisory service suppliers are organisations providing advisory services as a primary activity, eventually combined with the supply of inputs or software. In-depth information on the R-FAS was gathered through interviews with key AKIS actors within the innovation uptake context.

The farmers' survey was implemented through face-to-face interviews, conducted between June and December 2018, while the advisory supplier survey was self-administrated or conducted by phone. The interviewed farmers were selected to purposefully cover innovation adopters, (informed) non-adopters, and droppers (farmers that abandoned the innovation). The innovation at stake was direct marketing of farm products done by the farmers themselves, individually or

collectively organised. Hence the target farmers in all the involved countries were the small and medium scale family farmers that envisaged (or not) the adoption the direct marketing as a way to improve the economic sustainability of their farms. A snowball-type sampling procedure was adopted relying on the support of key-informants ('gatekeepers'). The surveyed advisory service suppliers were selected using a similar procedure, building on the farmers' identification of their advice suppliers in the given domain of activity.

The surveys allowed for the gathering of both qualitative and quantitative data from farmers and quantitative data from advisory suppliers. While using the full reports on the individual cases produced by the national teams based on the while set of data, this paper primarily focuses on the qualitative insights into the farmers' micro-AKIS to answer the research questions.

RESULTS

Table 1 shows the number of farmers and advisors that responded to the survey and identifies interviewed farmers with respect to their relationship with the innovation: adopters, non-adopters, and droppers.

Table 1. *Interviewed farmers and advisors by case study and classification of farmers according to their situation with respect to the innovation of direct marketing*

Country	Farmers			Total	Advisors
	Adopter	Non-adopter	Dropper		
Italy	24	4	4	35	3
Latvia	21	6	3	38	8
Portugal	14	9	14	40	3
Romania	18	16	3	43	6
Spain	18	18	2	44	6
Total	**95**	**53**	**26**		**26**

Table 2 provides an overview of the findings across the five case studies with respect to the innovation features, the adopters' characteristics, the advisory suppliers involved in the support of the innovation and the type of knowledge and skills demanded by farmers to implement the innovation. The cross-comparison of the five case studies evidences a number of common and contrasting patterns with respect to farmers' micro-AKIS. It evidences a small but still present role of conventional advisory service providers in some of the case studies, and the emergence of new advisory service suppliers to fill advisory gaps, which are prevalent in the case of this type of non-technological innovation.

Different approaches to direct marketing

The cross-comparison evidenced two groups of cases studies. One of them, comprising the case studies from Italy and Portugal, have focused on a particular type of direct marketing, collectively organised producers (groups of farmers) selling their produce to established groups of consumers. Hence, these cases entail both marketing and organisational (collaborative) innovation. The other three case studies, from Latvia, Romania and Spain, didn´t target a

particular type of direct marketing and focused instead on a variety of schemes of direct marketing from retro-innovation to novel ones, like online sales. The three cases encompass mostly individually led direct marketing solutions.

4.1.1 Collective direct marketing approaches:

The case studies from Italy and Portugal offer insights on how collective action can be successful in direct marketing innovation. This is particularly important when the farmers involved are small-sized and need to collaborate to be able to develop successful short supply chains. The two case studies bring in contrasting insights in this respect.

The region of Friuli Venezia Giulia (Italy) features a successful collaborative innovation as shown by the reduced number of (informed) non-adopters and droppers (see Table 1), whereas the region of Tâmega e Sousa (Portugal) evidences a collaborative innovation failure considering the number of non-adopters, but specially the substantial number of droppers (that are in the sample in line with the study population). What are the explanations for such a divergent path of the innovation?

The Italian case was launched by a volunteer action of a pioneering group of farmers and consumers. It configures a bottom-up initiative without any support both from funding policies or regional advisory services. The motivation to the creation of the collaborative groups involving both producers and consumers was not focused on the commercial success but instead on the formalisation of already pre-existing informal cooperation between organic farmers and consumers.

This informal cooperation, built on shared values and practices of collective action, created room for the development of an NGO that brought together farmers and small scale processors and enabled consumers to get a diversified set of farm products, including vegetables, fruits, fresh and processed meat, processed products, such as jams, olives and olive oil, among other. The NGO acted as an organiser and a facilitator assembling the products and preparing the packages pre-ordered by consumers. The success of the initiative allowed for hiring two independent freelancer advisors that support the producers regarding the legal and the logistical aspects. The knowledge and skills accumulated by the pioneering farmers and consumers through attending workshops, visiting other initiatives, testing and experimenting are currently potentiated by professional advisory service providers. The innovation development created its own AKIS, and the farmers' micro-AKIS reduce to the NGO support and to informal peer-to-peer advisory. The main advisory challenge in this case is how to couple its successful direct marketing scheme that attracts a growing number of producers and consumers, with the foundational values of the pioneers, comprising no-profit related values, such as mutual trust and collective well-being.

The collaborative scheme for direct marketing in Tâmega e Sousa (Portugal) was launched by a project led by a LAG from another Portuguese region. The project started with a pilot initiative encompassing a local LAG, and later expanded to the entire region by the action of a second LAG. The project was awarded a status of European Good Practice and has attracted the Portuguese media attention. Hence the LAGs were able to mobilise other actors, such as local governments and local cooperatives to support them in the awareness stage. The scheme attracted initially both small-scale family farmers and more specialised medium-sized young farmers. This happened because the innovation assessment stage was basically reduced to the observation of successful innovation on other farms outside of the region. The actual assessment only took place after the implementation stage. The implementation of the innovation rapidly pulled out the more specialised farmers that moved to other direct marketing schemes (e.g. delivering to restaurants or gourmet retail stores) or re-oriented to bulk selling to cooperatives, similar to non-adopters. The farmers' groups were made up of 4 to 6 producers that weekly organised boxes

with a diversity of fresh vegetables and fruits pre-ordered by the consumers. The groups have to organise the delivery logistics and to share the transportation costs.

With the ending of the funding for the LAG these organisations only were able to support farmers with general counselling and by providing them consumers' contacts. The self-sustainability of the initiative was part of the project design, and the LAG were supposed to step out after setting up the farmers groups. However, without the direct support of the LAGs farmers weren´t able to maintain the groups. Several difficulties accumulated along the process. The fact that all the producers produced basically the same products making difficult to diversify the offer to consumers, the transportation costs and the delivery logistics, the effort of meeting consumer demands, along with the fiscal complications (taxation is on products and not on the boxes), reduced the profitability of direct selling and the groups broke up. Some of the farmers continued doing direct marketing, but with an individually led strategy even if formally established as a farmers' group, by joining another farmer they trust, often different ones in different groups. Hence, the currently "adopters" work differently, and the initial collaborative (organisational) dimension of the innovation is largely lost.

In this case study an AKIS was also created, led by the LAGs and involving other actors, such as the local governments, the local cooperatives and NGOs, but it fell apart with the project ending. The farmers' micro-AKIS was also reduced in number and diversity of actors, with the LAGs playing a central role along with the informal ties the farmers had with cooperative advisors. Peer-to-peer advisory support was also important and basically was the only form of advisory support that continued when the individually led strategies replaced the collaborative ones. Specialised advisory support is also mobilised related to bookkeeping and ICT solutions related with issuing electronic invoices.

4.1.2 Individually-led direct marketing approaches: from retro-innovation to novel schemes

The cases from Latvia, Romania and Spain bring in insights into individually led direct marketing strategies. These are largely potentiated in the case of Latvia and Romania, due to the geographic location of the selected regions, Pierīga and Giurgiu, in the surroundings of major metropolitan areas, Riga and Bucharest.

The Pieriga case study (Latvia) highlights the revitalisation and recreation of traditional direct marketing, a retro-innovation, with the involved farmers relying pretty much on their family and social networks to directly deliver their products to permanent clients going to their residential areas or places of work. Other channels used are local and farmers' markets, on-farm sales, farm shops. On-line sales are starting to emerge. For many farmers, the knowledge and skills necessary for direct marketing are part of their experience and family history. In other words, direct marketing is part of their everyday routine. Farmers perceive this knowledge about direct marketing as experience-based knowledge. Thus advisors and advisory organisations in the narrow sense had played a peripheral role in this process. The main sources of information and learning mentioned in the interviews were personal observations made at markets, exchanges with other farmers, feedback from clients and professional literature, as well as adcice provided by organisers of specific markets. Attendance of courses was also mentioned, but these events were seldom specifically about direct marketing, though they did involve bookkeeping and rural tourism, which have a connection with direct marketing. Sales and communication skills, economic skills, the ability to respond to consumer demand and planning, as well as practical skills to do with marketing, packaging, driving and having the necessary documentation, as well as language proficiency (Latvian, Russian, English) were considered important for successful implementation of direct marketing. Farmers involved in direct marketing are not organised in cooperatives or producer groups where targeted knowledge sharing or learning would take place.

Aside from the benefits, social learning and informal peer-to-peer learning has the undesirable side effect of narrowing down the range of channels and forms for selling one's products if no one in the particular social circle has experience with novel forms and channels. Access to knowledge possessed by other groups is, therefore, very important and could be facilitated by institutional learning.

The Giurgiu case study (Romania), while comprising also a retro-innovation trend, evidences a strong emergence of more sophisticated direct marketing patterns, encompassing organisational innovation, and great involvement of the buyers, gourmet retailers and restaurants responding to growing niche market demands from a variety of sophisticated consumers, including gourmet, vegans, etc. The novel direct marketing strategies in this case encompass on-line delivery services and supermarket-led cooperatives involving networks of small-scale farmers.

Advisory support to direct marketing in the Pieriga and the Giurgiu case studies relies mostly on peer-to-peer informal networks, involving neighbours, relatives and consumers and organisers of local and farmers' markets. Buyers, such as the retailers in the Romanian case, are an important emergent advisory service supplier helping farmers to address market and consumer demands. In both cases specialised advice on fiscal and bookkeeping is provided by farmers or by NGOs. In Romania, local public advisory services appear to play a role, although residual, in supporting farmers with legal and food safety issues and by promoting the awareness on the innovation.

Advisory landscape in organisational and marketing innovation

The common pattern evidenced by the five cases, in spite of different strategies of direct marketing involved is the absence of a farm advisory system able to respond to the farmers' advice needs. The innovation emerges and develops aside the respective R-FAS, the role of which varies from none to residual support to this type of innovation. Additional shared features by all the case studies are: 1) the growing importance of clients and market actors, new players in advisory landscape with respect to this innovation; 2) the key role of informal peer-to-peer advisory support; 3) the diversity of knowledge and skills needed and demanded by farmers involved with direct marketing, and 4) the absence of specialised advisory services to respond to them.

4.2.1 Growing role for new players in advisory support: clients and buyers

The role of clients and buyers as informal advice suppliers in direct marketing innovations is not surprising. It derives from the nature of the innovation that aims at bringing closer primary producers and consumers. The insights from the case studies suggest that the greater their involvement the more successful the innovation. The Italian case of collective-led direct marketing shows the importance of joining in farmers and consumers sharing similar values to the success of the initiative. By contrast, the Portuguese case where the buyers (consumers) had a more passive role appear to have contributed to the failure of the initiative.

The Romanian case also highlights the role of buyers and clients as players in advice provision supporting farmers with the development of sales channels, product selection and production-orientation, introducing new crops, converting to organic farming, etc., packaging and logistics decisions.

However, the role of these market-led players tends to be informal, with the exception of the Italian case, where they were also founders of the NGOs that led the innovation development. Hence the involvement of consumers and buyers as co-producers of the innovation appears to be a critical factor for the success and sustainability of the direct marketing approaches.

4.2.2 Peer-to-peer informal advisory networks and tradition in direct sales

In all the case studies, with the exception of the Navarra case study where direct marketing is an emergent innovation not relying on tradition, traditional direct marketing approaches were present with larger or smaller extent. Individually led direct marketing strategies in the cases of Latvia and Romania evidence an evolution from intense tradition of direct selling in the respective regions. The innovation configures a more incremental evolution in the Latvia case, and more radical change in the Romanian case study. Nevertheless, both cases highlight the importance of peer-to-peer informal advisory support involving family and social networks.

The Italian and Portuguese cases highlight a different trend that is the creation of disruptive forms of approaching farmers and consumers that weren´t traditionally connected. In fact, some of the innovation droppers in the Portuguese case recovered their traditional direct marketing channels, like local markets and on-farm sales, the limited profitability of which have led them to adopt the innovation. In both cases peer-to-peer advice appears as an important source of advisory support across all stages of innovation adoption, and in particular during implementation. The main difference is that the Italian peer-to-peer advisory network comprised the pioneering producers and consumers that had accumulated knowledge and experience to share with newcomers, whereas in the Portuguese case there wasn´t a role for pioneers, and adopters had to learn from and with each other. In both cases, maybe with more evidence in the Portuguese case, due to shortage of advisory services, farmers relied on their informal relationships to obtain more specialised support on topics like ICT use related to fiscal matters.

4.2.3 Organisational and marketing innovation demand for holistic multi-topic advisory

Table 2 underlines that in all case studies farmers need advisory support on many topics that should be offered in a holistic manner. In addition to the agronomic advisory support, which is particularly important for new entrants, such as young farmers or rural entrepreneurs, there is a need for advisory support in a series of non-conventional topics in farm advice, such as information on legal and fiscal requirements, food safety and packaging, knowledge on logistics and marketing, along with digital, communication and soft skills related with interaction with the consumers. This diversity of advisory topics it’s currently provided only separately and at a prohibitive cost. Hence, in all cases, farmers rely on their informal networks and assemble themselves pieces of this knowledge and skills that results in multiple gaps in their micro-AKIS.

Table 2. Overview of findings in the five direct marketing (DMAR) case studies

Case study	Description of innovation	Adopter profile	Advisory support supplier	Knowledge and skills demanded by farmers
DMAR in Friuli Venezia Giulia (Italy)	Initiative of a group of pioneering farmers and consumers that together with an NGO created a DMAR group; The group is growing with the entrance of farmers and consumers attracted by the success of the initiative	Small and medium organic farmers and processors, producing a variety of products	No role for conventional advisory services; Advisory support supplied by an NGO focused on local advisory supply to organic farming (NGO hires freelance independent advisors)	Multidisciplinary: Agronomic, Legal, Logistics, ICT tools, Communication (soft skills to interact with consumers)
DMAR in Pierīga (Latvia) (a peri-urban area nearby the capital city Riga	A variety of direct marketing forms was observed: Local and farmers' markets, on-farm sales, farm shops, permanent clients, sales in market towns, delivery to residential areas and places of work, and online sales.	Small and medium farmers and processors, producing a variety of products; Includes both young and experienced farmers	Informal advice is predominant, building on peer-to-peer networks involving neighbours, relatives, fellow practitioners and organisers of specific markets.	Multidisciplinary: Agronomic, Legal, Fiscal, Communication (soft skills to interact with consumers), Business planning and marketing, Languages
DMAR in Tâmega e Sousa (Portugal), a countryside area (relatively close to Porto conurbation)	Groups of farmers (4-6) join to deliver weekly pre-ordered boxes of fresh vegetables and fruits directly to consumers in pre-established pick-up spots	Small-scale family farmers, with polyculture farming systems; More females and more educated than non-adopters	Residual role for conventional advisory services; Advisory support supplied by Local Development Action Groups (LAG) associated to a project frame that ended with the implementation of the innovation	Multidisciplinary: Agronomic, Legal, Logistics, ICT tools, Communication (soft skills to interact with consumers)

Table 2. Overview of findings in the five direct marketing (DMAR) case studies (Continuation)

Case study	Description of innovation	Adopter profile	Advisory support supplier	Knowledge and skills demanded by farmers
DMAR in Giurgiu (Romania) is a consumption countryside area nearby Bucharest (The major conurbation of Romania)	Variety of novel direct marketing approaches, including farm shops, on-line delivery services, supermarket-led cooperatives involving networks of small-scale farmers	Small-scale family farmers, farming systems varying from polyculture to more specialised in niche gourmet crops; More educated than non-adopters.	Some role for conventional advisory services, in particular to public advisory services at the awareness stage; Important role for new advisory suppliers, the business partners of the farmers (ranging from clients, traders to business partners and farm contractors); informal peer-to-peer advice is a key system to exchange knowledge related to the innovation.	Multidisciplinary: Agronomic, Legal, Logistics, ICT tools, Communication (soft skills to interact with consumers), business planning and marketing.
DMAR in Navarra (Spain)	Direct marketing forms are emergent, with the exception of direct selling of DOP cheese. Fresh vegetables and beef producers are starting to adopt direct selling (local markets, direct deliveries to consumers or to restaurants)	Small to medium specialised farmers	There is a role for conventional advisory services, Navarra applied research and extension institute launched a line to support direct marketing, although currently only offers advisory support on a limited number of issues beyond conventional agronomic knowledge, such as food safety regulation and business planning and marketing in partnership with local cooperatives	Multidisciplinary: Agronomic, Legal, Logistics, business planning and marketing.

CONCLUDING REMARKS

What can be learned from the insights brought in by these different five case studies across Europe regarding how advisory services can be organised to encompass advice provision on non-technological innovation, such as direct marketing?

Firstly, only a holistic advisory system could provide an integrated supply of the multi-topical, mostly outside the agricultural domain, set of knowledge and skills needed by marketing and organisational innovations involved by direct marketing approaches. Individually-led approaches can benefit from already exiting organisations, namely NGOs, specialised offices of local governments, R&D sector related incubators, focused on supporting business planning, marketing, fiscal and digital competences of micro-entrepreneurs. However, this needs to be articulated with advisory support on agronomic and other production aspects that could be provided by the conventional advisory system when available, such as FBOs, local public advisory systems (still present in Latvia and in Romania, for instance) or independent farm advisors. An obstacle to the integration of different advisory organisations from different sectors in the support provision is the lack of tradition in this type of cooperation along with its costs. In addition, specialised knowledge related to the legal aspects of food safety, as well as to logistics and design (e.g. for packaging and branding), along with a set of soft skills related to communication, customer service, conflict resolution etc. is also needed to implement sustainable direct marketing schemes, both collectively or individually-led. The formal involvement of consumers or buyers in the development of direct marketing schemes as shown by the Italian and the Romanian cases is a good advisory practice, in particular if the schemes have the scale to recruit external advisors.

However, to make direct marketing a feasible alternative for small to medium-sized farmers, with different models for polyculture and specialised farmers, regional AKIS need to be created. The case studies show a diversity of fragmented solutions that might work better if used in a complementary manner. Devoted organisations, such as the NGO created in the case of Friuli Venezia Giullia (Italy) seem to be indispensable to act as facilitators enabling the coordination of the available cross-sector advisory support providers on the regional level and enhancing a strong involvement of consumers and buyers in the development of the innovation.

This study contributed to a deeper understanding of what kind of support is demanded for direct marketing.

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ENABLING ENVIRONMENTAL INNOVATIONS ON FARMS: WHAT IS THE ROLE OF FARM ADVISORY SERVICES?

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Introduction

Growing concerns over the environmental impact of food production have given rise to a range of environmental innovations[5] in agriculture (Sayer and Cassman, 2013). Among them, biological and integrated pest control (B/IPC) are seen as tools to reduce pesticide use, enhance biodiversity, improve water quality, limit adverse health impacts on human health, and mitigate climate change caused by agriculture (Geiger et al., 2010; Crowder and Jabbour, 2014; Dhananjayan and Ravichandran, 2018). Despite these benefits and policy incentives to reduce pesticide use and support environmentally friendly farming practices (Lee et al., 2019; Lefebvre et al., 2014), farmers' perceived values and adoption of B/IPC techniques remain low (Zhang et al., 2018).

There are complex personal and structural reasons behind farmers' reluctance to adopt environmental innovations, such as disapproving attitudes, characteristics of the innovation that make it too complicated or costly to introduce, low demand, poor institutional support and others (Vanclay and Lawrence, 1994; Wensing et al., 2019; Clausen and Fichter, 2019; Long et al., 2016). Farmers' knowledge and understanding of the innovation guide his/her innovation decision-making. Therefore, to encourage a more widespread use of B/IPC on farms, farmers' access to knowledge and advice about these methods is of key importance.

This paper aims to explore the role of the farm advisory system in enabling implementation of environmental innovations on farms. By farm advisory system we understand the set of actors - both formal and informal, individuals and organisations - who provide farmers with the advice necessary to operate a farm, develop farm-level solutions and enhance farmer skills and knowledge. We use the *triggering change cycle model* of innovation uptake developed as part of the EU Horizon 2020 project AgriLink, and apply it to five cases of B/IPC in five European countries to examine B/IPC advisory landscape and interplay of various sources of knowledge in farmer decision making in different contexts.

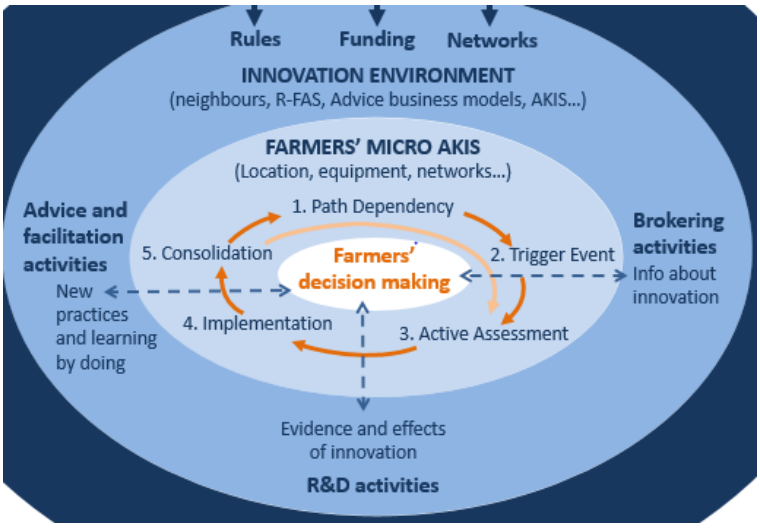
Conceptual framework: Triggering change cycle[6]

This paper approaches farmers' environmental innovation adoption behaviour from a multi-level, relational and dynamic perspective. It assumes a farmer's embeddedness in a broader innovation environment and posits that a farmers' decision to adopt and maintain an innovation depends on a set of personal and institutional settings (see Figure 1). Farmers operate within their personally assembled micro scale knowledge and innovation system

[5] By environmental innovations we understand innovation that contributes to sustainable development by reducing environmental impact, increasing resilience to environmental pressures or allowing for an efficient and responsible use of natural resources (Clausen and Fichter 2019).
[6] More information available here: https://www.agrilink2020.eu/our-work/conceptual-framework/

(*micro-AKIS)* that includes the range of individuals and organisations from whom they seek advice and exchange knowledge with (Sutherland et al., 2018). Farmer's micro-AKIS is linked to a broader innovation environment that consists of a range of agricultural knowledge and innovation institutions.

Figure 1: Multi-level model of the cycle



Source: AgriLink

The 'triggering change' cycle model (Sutherland et al., 2012) puts forward that farmer's decision-making regarding innovation uptake is initiated and driven by a trigger event that disrupts path-dependency and introduces new options. This breaking with the path-dependency and entering the change cycle is constituted by three phases, that can be distinguished in order to account for the advisors' role.

The first is the awareness stage that primarily refers to the farmers becoming aware of the innovation, but it also encompasses brokering activities developed by advisors to disseminate the innovation and to (co-)create trigger events influencing farmers' decision-making processes. The second is the active assessment stage, in which farmers assess the innovation. Advisors are engaged to (i) assemble information on the costs, benefits, and side-effects of an innovation, and (ii) develop and involve farmers in R&D activities. Finally, we have the implementation stage, in which advisors support farmers in their attempts to implement the innovation on their farm by delivering advice and carrying out facilitation activities. This, ultimately, lead to path dependency until a new trigger event re-initiates the cycle.

Methodology and cases

The paper is based on five case studies of farm advice in the field of B/IPC carried out as part of the ongoing Horizon 2020 project AgriLink. These case studies include the method of sexual confusion of insects in Imathia (Greece), biological plant protection methods in Vidzeme (Latvia), tagetes cultivation for nematode control in the Netherlands, biological control of grapevine pests in Douro (Portugal), and integrated pest management in Navarra (Spain) (see Box 1). Data were gathered through semi-structured interviews with farmers, advisors and experts (see Table 1) and analysed according to mixed quantitative and qualitative methods.

Box 1. Cases of the studied environmental innovations

Imathia, Greece: The case study concerns the method of mating disruption (MD) of insects implemented in the framework of the Integrated Pest Management by peach producers' groups. The method was introduced in this highly intensive cultivated area at the initiative of a local leading cooperative and a private advisory company, following export markets' demand for healthier fruits. The method includes the installation of a network of dispensers releasing pheromones across the fields. The implementation process is monitored by experts based on an annual implementation plan, therefore the establishment of collaboration relationships between the producers adopting MD and the experts is an important factor of success. Overall, the effectiveness of the method at a large scale depends on the extent of its adoption in the wider area, which is a difficult process, given the highly fragmented landscape of numerous smallholders in the area.

Vidzeme, Latvia: Given the low adoption rate of individual B/IPC techniques, the study considered various biological plant protection methods. Some notable examples among other include the targeted use of natural predators of pests (e.g. ladybirds and parasitic wasps to control greenflies) and proving special shelters for useful animals (insect houses). The underlying knowledge that farmers base upon is a mix of both traditional /local knowledge passed on from earlier generations of farmers and new research-based knowledge provided by contemporary science, which is imparted by various advisors. Vidzeme was selected due to the prominence of organic farming in this region. The assumption was that organic farmers were the most likely to use biological plant protection methods.

The Netherlands: The use of soil disinfestation pesticides is under pressure in the Netherlands, due to environmental concerns from consumers and regulations by government. These chemical products are also harmful for the environment. The pesticides are used to control nematodes which can cause damage to the crops. An alternative to chemical soil disinfection is the cultivation of Tagetus patula, which is currently used in fruit, strawberries, potatoes, roses and lily cultivation to control the nematode species Pratylenchus Penetrans. The cultivation of Tagetes is considered as an innovation, since it uses biological principles to control nematodes. Adopters of this innovation do not have to use pesticides anymore to protect their crops for the nematode species Pratylenchus Penetrans, because comparable control effectiveness levels are reached.

Douro, Portugal: The case study focused on a set of farming practices for enhancing the vineyards ecological infrastructure (EI). These comprise the vineyards green cover (seeded or spontaneous) along with the implementing and /or restoring of live hedgerows, schist walls, and maintenance of Mediterranean bushes and the remains of the oldest vines destroyed by the Phylloxera. Together these practices configure an eco-functional vineyards landscape more resilient to plagues driven by insects and other agents. The vine growers implementing the EI build on scientific knowledge and on the new empirical knowledge they acquire by testing, experimenting and monitoring the innovation outcomes. This is a time and knowledge intensive consuming innovation and their benefits on the quality of the landscape and of the grapes and the wines are only captured by medium and large vine growers which are simultaneously winemakers, and this explains why the vast majority of small and medium grape growers are non-adopters.

Navarra, Spain: This case study explored the use of Integrated Pest Management techniques in Navarra. These included the use of mating disruption, the introduction of natural enemies to control pests and the use of alternative zero-residue products in vineyards, fruit trees and

horticultural crops. Some of the techniques have been used for many years but policy changes and consumer demand have led to an increase in the use of these innovations. Historically, the public advisory service has been a key actor in the dissemination of these techniques, but in recent years more and more organisations have become part of the advisory landscape, resulting in changes in knowledge flows.

The methodological framework consisted of a mixed-method strategy, combining a case study approach with survey data collection. In the selected case study regions two surveys were carried out: (1) a farmer survey on the micro-AKIS and the role of the advisory service providers during the three stages of innovation adoption (awareness, active assessment and implementation); and, (2) a survey of advisory service providers to explore farm advisory system in the region in relation with the B/IPC (see Table 1). Both surveys adopted a snowball-type sampling procedure with different information sources used and cross-checked. The farmer survey targeted both adopters and non-adopters of the innovation. The farmers were selected so that the innovation in question was relevant for their farming practices (for instance, in the Netherlands, farmers were selected on the base of their farm and soil characteristics (e.g. are their crops vulnerable for the nematodes, are the nematodes present on the specific soil type etc.), in Navarra, those farmers were targeted who cultivated crops for which the studied techniques were used in the region (fruit trees, horticultural crops and vineyards), etc.). The advisory services providers survey aimed to capture the complete spectrum of advisory organisations supplying advisory or related services on the innovation.

Table 1. Samples of farmer and advisor surveys

Innovation case study	Farmers				Advisors
	Adopters	Non-adopters	Droppers	Total	
Sexual confusion of insects, Imathia, Greece	25	17	0	42	10
Biological plant protection, Vidzeme, Latvia	22	15	3	40	5
Cultivation of Tagetes, the Netherlands	14	1	0	15	5
Biological control of grapevine pests, Portugal	23	17	2	42	3
Integrated pest management, Navarra, Spain	17	12	3	32	10
Total	101	62	8	171	33

Source: AgriLink

The sample represents the socio-economic diversity of farmers in the studied regions and innovations. The interviewed farms varied greatly in terms of their size: from 1 ha to 1200 ha. The farmers had various educational profiles (including those with only compulsory education, a high-school diploma, vocational training and a university degree), age, farming experience, and farm's management and commercial strategies.

The interviews were structured around both open and closed questions. Quantitative data from the surveys were entered in databases, while qualitative information and narrative descriptions were recorded and analysed in order to provide the descriptive and analytical insights. The data were analysed and synthesised according to predefined themes: farmer and farm socio-economic profile, attitude towards the innovation and change, farm's innovation path, farmer's micro-AKIS, advisory landscape in the innovation area.

Even though the cases present a variety of insights, the sample is not random and, therefore, has limitations. Our findings cannot claim to be representative of the complexities attendant to implementing B/IPC. Nonetheless, cross-comparison between the cases and interviews has identified several issues in farm advisory systems that are of common relevance to many farmers in different regions. Consequently, while not exhaustive, our findings are indicative of common issues, experiences and obstacles that affect farmers who are engaged with the environmental innovations in question.

Results

In this section we present the societal and knowledge contexts of the studied environmental innovations, the principal sources of advice on B/IPC that farmers consult and interlinks of different sources. We identify good practices in providing knowledge and advice to farmers, as well as gaps in the provision of advice.

4.1. Environmental innovations in dynamic contexts

The studied environmental innovations differ in terms of their scope of implementation and history in each of the regions. Some of the innovations have been developed and implemented recently, like mating disruption in Greece and biological control in fruit trees in Spain. In these cases, the innovations are based on recent scientific research. However, many of the environmental innovations considered in this paper - like, tagetes in the Netherlands, and some B/IPC methods in Latvia and Spain - are more akin to retro-innovations. These methods have been known in the agricultural community for several decades but have been abandoned in place of more intensive chemical methods or have been continuously practised by a minority of farmers with specific profiles, like organic, small-scale or semi-subsistence farmers. Knowledge of these 'older' methods has been maintained among a comparatively small number of farmers, and recent scientific research has provided evidence on their efficacy and helped to inform a broader farming community.

The variety of contexts that we consider in the study regions illustrates that the (re)integration of these environmental methods in farming practices has been stimulated by different developments and contextual triggers. Altogether they reflect the growing societal concerns over negative impact of farming practices on the environment that result in growing demand for environmentally friendlier agricultural products, and pro-environmental policy frameworks (see Chapter 4.5).

4.2. Advisory landscapes in the field of B/IPC

The results show that farmers engage with a wide range of information, knowledge and advice sources in the regions when implementing the studied environmental innovations. Often the same advisors are consulted during all the phases of the triggering change cycle. Moreover, in farmers' experiences, the phases often are not sequential and linear, but overlapping and iterative. (Therefore, we do not distinguish between the phases in the analysis that follows and refer to individual stages of the cycle only when distinguishing elements appear.) Still a specific advisors' role can be identified for each phase. In the awareness phase, advisors inform farmers

on the innovation. During the assessment phase, advisors support farmers in their evaluation of the possibilities, requirements and consequences of implementing the method on the specific farm. During the implementation stage, the role of advisors consists of facilitating the farmer in making the best decisions to make the innovation a success.

The central sources of advice on B/IPC for farmers in the study regions were "traditional" agricultural advisors, peers, ie, other farmers, and farmers' organisations. When traditional agricultural advisory organisations with experts in the field are present, they play an important role in supporting the adoption of the studied environmental innovations. For example, among Dutch farmers it is a common practice to regularly consult agricultural advisors, who are key persons in introducing novelties to farmers and assisting them with implementation. Advisors visit the farms often, they know many farmers with similar problems, and play an important role in getting farmers acquainted with innovations. However, not all farmers systematically use the advice from an agricultural advisor in the decision-making process. In Greece, private advisory companies collaborate with local farmer-based organisations, influencing decisively farmers' decisions: *My respect and trust for the advisor [who informed me about the innovation] made me adopt the innovation,"* (farmer 34, Greece). Similarly, Spanish farmers also indicated that the public advisory service is ever present during the advisory cycle. To a lesser extent they were present in the Latvian case.

The importance of peers, i.e. other farmers, was evident in all cases, as farmers receive from them information and advice. Just over a third of the interviewed Spanish farmers became aware of the innovation from conversations with other farmers who were already applying or evaluating it. When Dutch farmers consider cultivating tagetes, they often visit neighbouring or experimental farms that have already started cultivating and promote tagetes. Exchange of experiences, learning and advising each other, joint learning among farmers continue to be very important in the implementation stage and the assessment stages of the innovation. A Greek farmer confirms: "*we discuss together and learn from our mistakes," (*farmer 38). Similarly, Latvian farmers indicated that many plant protection methods are simply "in circulation" among farmers, and farmers talk about the proper ways to implement them. For instance, when a Latvian farmer was asked when she first came across biological methods, she said: "*..Well, I've used folk methods since I was a child,"* (farmer 6, Latvia). This points also to the role of farming family background, and family members were listed among key advice providers, especially in the Latvian case.

When farmers are organised in production cooperatives, these collective organisations appear to be among the key drivers of environmental innovations and a source of knowledge and advice for their members. In Portugal, farmers - wine growers' organisation is simultaneously the key advisory organisation that holds the leading role in the region's transition path towards a more eco-functional farming landscape. (However, the traditional wine cooperatives are not so far playing any role in the diffusion of the innovation.) In Spain, the demand of the cooperative stimulated its members to use the technique of the mating disruption: the cooperative proposed to apply the technique in a big area, to guarantee the efficacy of the technique and reduce the costs. Similarly, in Greece, the first adopters of mating disruption were members of a leading cooperative's board.

In addition to these three key groups of advisors, other actors appear important in providing advice depending on the organisation of production and dissemination stage of the innovation. Research is an intrinsic part of the innovation generation and diffusion process as it provides scientific evidence to support innovation, and this was also the case in the countries covered in this paper. In the Netherlands, public funded research on alternative disinfestation methods and researchers' dissemination activities played a key role in the innovation process of tagetes. Researchers executed field trials to verify the effects on the nematode population and

demonstrate it to farmers. Researchers were also deemed important by Portuguese farmers, as the innovation builds on scientific knowledge and requires on-site experimentation and active learning by the farmers. Multi-actor R&D projects funded by EU and national funds have shown key to the spread and deepening of the environmental innovation in Douro.

Input suppliers were also cited by farmers as their providers of advice. However, in Spain it was indicated that, because of the commercial motivation driving these companies, their advice is not as highly appreciated as the impartial advice provided by public organisations. Similar concerns were noted by AKIS experts in Latvia. The expertise of the input suppliers was not questioned, but there were doubts as to their impartiality.

As the innovations gain popularity among farmers, there is an increasing diversity in the advisory landscape. Over the years, more advisors - such as input suppliers, cooperatives and the agri-food industry - have been entering the innovation area of B/IPC methods in Spain. Also, in Greece, retailers, traders, input machinery companies and others supplement the picture of farm advice providers, albeit their advisory role remains marginal in comparison to the local cooperatives and the advisors collaborating with them. In Portugal, we note the presence of environmental NGOs and traders, which highlights the interest of consumers and the markets in dissemination of environmental innovations.

4.3. Advisory networks

All the studies cases point to the role of networking between various actors to support innovation adoption on farms. Joint and coordinated efforts of key actors have facilitated dissemination of innovations, while a lack of joint actions seems to be a hampering factor in other cases.

In some cases, more formal and institutional collaboration between key actors was established. In Greece, the shared interest to reduce the use of pesticides and developed collaboration between an advisory company and a leading cooperative led them to the initiation of pilot fields in the framework of a research program. The cooperatives and the collaborating advisory companies were often engaged in common advisory activities in order to support farmers to meet integrated pest management standards. Similarly, in the Netherlands, communication and collaboration between researchers, advisors and farmers has supported innovation diffusion. Advisors have cooperated closely with researchers to deliver information to farmers, and researchers have been actively involved to convince and assist farmers to implement tagetes cultivation on their farm. In Portugal, pioneering farmers cooperated and developed an effective farmer-based advisory organisation with strong local roots and simultaneously well-networked with other key AKIS actors at the meso-regional and the global scale. In Navarra, INTIA as the only public applied research and advisory centre in the region, played a central role acting as an innovation broker and facilitator for the transfer of knowledge.

In addition to these formal forms of collaboration, there are more informal ones. For example, the Latvian farmers indicated the significance of learning through informal networks that bring together people with common practical or commercial interests. Such formal organisations as the Association of Latvian Organic Agriculture and The Community of Environmental Health function as informal forums of advice as their members interact and assist one another on various technical issues, including pest control. In the Netherlands, many farmers are involved in 'study groups' – groups of farmers that regularly meet to discuss the problems they are facing and exchange solutions and new developments. Often these groups are facilitated by an advisor or researcher, and they are an important source of information and support, as experiences and best practices are shared. In addition, much like in Spain, several farmers

indicated that they have formed their own informal network of farmers with mutual interests. In the Portuguese case informal collaboration is emerging between the large wine makers and their suppliers small-scale vine growers. Small-scale growers' interest in the innovation of ecological infrastructures and knowledge about it is gained in these informal interactions.

Even in cases where no formal networking has been established between the key advisory actors, their activities in innovation diffusion is complementary. For instance, in Spain the public advisory service played a fundamental role in raising awareness of the innovation, but so did the input suppliers who supported the practical implementation of innovation.

Finally, cooperation between different actors in the advisory landscape can provide benefits that go beyond innovation diffusion. For example, in Greece, cooperation between independent advisors and local cooperatives has induced actions aimed at influencing agricultural policies and practices at a broader scale. The advisors have facilitated connecting the local cooperatives and oriented their common actions for the innovation by supporting them with technical and advocacy services to influence policy makers for the inclusion of mating disruption in the public agri-environmental measures. In Portugal, the cooperation between the wine growers, through their association, and the researchers has shown determinant for the emergency and for the consolidation of the innovation.

4.4. Advisory gaps and challenges

The studied environmental innovations have been relatively successfully (re)introduced, but in most cases, there are still knowledge and advisory gaps that constrain their broader diffusion.

There is a lack of specialised experts on biological pest control, even though many organisations provide advice. In Greece AKIS actors pointed to the urgent need for qualified advisors in order to boost development in the farming sector and allow for the continuous improvement of quality systems. Overall, farmers' lack of knowledge and interest to participate in information and training activities hinders the diffusion of the innovation. In Portugal, the small-scale regional farm advisory system is dominated by cooperatives and farm associations that so far have not involved with the innovation of ecological infrastructures due to lack of direct benefits for their associates. Most of the advice providers on B/IPC that Latvian farmers consult, including certification and controlling bodies, are without a specific advisory function, as there are few experts on B/IPC at the farm advisory organisation.

A cross-cutting issue is the lack of impartial advice or the growing influence of commercially motivated advisory actors. In Spain and Latvia, the need for impartial advice on B/IPC methods was noted, as not all farmers have the necessary knowledge to competently and critically assess the biological method in question. The growing significance of input suppliers as providers of advice makes this need for impartial advice more acute. While the quality of advice is not disputed, it is reasonable to assume a certain bias towards the products in the portfolio of the company the advisor represents. The growing influence of input suppliers was noted in other countries as well, though it remains to be seen whether this will become a serious issue.

A common challenge for innovation pioneers and advisory providers is to transmit knowledge about alternative methods due to path-dependency in the agricultural community. For example, in Spain, B/IPC are generally perceived to be more complex than conventional techniques because they require greater monitoring commitments and products that are not harmful to the auxiliary fauna can be more expensive. *"When I decided to start using biological control techniques, I had to learn a lot about insects, their life cycles, etc. I spent a lot of time observing the crop and monitoring the evolution of pests and natural enemies during the implementation of the technique,"* (farmer x, Spain). Therefore, many farmers do not even

consider these techniques. Nonetheless, all the advisory organisations interviewed acknowledged that the topic is increasingly important and that they are investing in this topic, for instance, by trials, developing decision support tools, etc.

Cooperation of different actors involved with the innovation might be needed to improve the transfer of knowledge about alternative methods and to enable their uptake in farms. For this purpose, in the Greek case, farmers' cooperatives joined efforts with private advisors. The private advisors based on agreements with the farmers' cooperatives carried out information seminars and individual discussions with growers, disseminating valuable information about the innovation, motivating and helping producers' first assessment by providing evidence about its effectiveness and guiding them during the implementation stage.

In the Netherlands, no specific problems were reported in advisory services in link to the tagetes method. However, it is mentioned that farmers need complex knowledge about the innovation that involves not only technical information about the practice and the feasibility in different farming systems, but also information about the economical results and ecological effects.

4.5. Multifactor decision-making in environmental innovations

Overall, we note that availability and access to advice on environmental innovations is a key, but only one factor among many that influence farmers' decision-making vis-a-vis the adoption of these innovation. Farmers consider various, sometimes conflicting aspects, when considering adoption of innovations, as it is illustrated by a Dutch farmer's reflections over adoption of Tagetes cultivation: *"Firstly, while the farmer recognises that Tagetes cultivation improves the soil after a few years, he is unsure whether or not it is worth the investment on rented land. What if the owner of the land decides to sell the land? The farmer feels like he would have wasted his money and not benefited from improved soil quality himself. Secondly, the farmer explained that it goes against his 'farmer instincts' to dedicate time, energy and money to cultivate a crop that is not harvested. Thirdly, the farmer thinks cultivating Tagetes is not a good fit on his farm. The farmer explained that because of the type of crops he grows, he would have to cultivate Tagetes instead of cultivating a profitable crop that he can harvest. He is still debating between either investing in the long-term benefits of Tagetes cultivation or investing in the short-term benefits of harvesting crops that are profitable right now."* (Verstand et al., 2019) Those diverse factors also suggest that the field of farm advisors' expertise might need to be enlarged beyond the technical aspects of innovative methods.

The characteristics of an innovation and farmer's estimations of the innovation's feasibility on his/her farm and of its economic benefit are the principle factors whether farmers decide or not to adopt it. For instance, the interviewed non-adopters in Spain explained their decision to not adopt an environmental method for economic reasons, their farm conditions (plot size, crop diversity, etc.) which are not suitable for the method, lesser effectiveness of B/IPC and no demand from their buyers (cooperative, winery or freezer) to apply the methods in their fields. Overall, it was believed that advisory service providers need to further demonstrate the viability of the techniques and to provide a better access to the necessary knowledge. In Greece, the basic differentiation between adopters and non-adopters was largely related to the perceived effectiveness and the implementation cost of the innovation: *"My neighbours do not adopt [the innovation], this increases my cost too much since I had to install too many dispensers in my field,"* (farmer 2, Greece). This sentiment was echoed in the interviews with Portuguese farmers that in addition to perceived direct benefits must entail into more costly practices and processes. In Latvia, some farmers suggested that the cost/benefit ratio of many BPC methods

meant that they are more suited to small and medium-sized farms or farms specialising in niche products.

Farmers' environmental values and commitment play a decisive role in selection of farming methods. In Latvia, having a '"love of nature", familiarity with "ancestral methods" and an interest in organic farming were also considered important motivational factors, underlining the complex mix of practical skills, habitual knowledge and philosophical considerations involved in choosing to implement the innovation. In Spain, of similar importance was the willingness of farmers to reduce the use of pesticides in crop production and increase biodiversity. In Greece, the differences in the interpretation of human intervention in the natural balance influenced farmers' willingness to adopt the innovation. As a farmer said: *"MD is another human intervention that disturbs further the ecological balance,"* (farmer 41, Greece).

A support network and the presence of successful examples in the surrounding area can address and assuage concerns and uncertainties. In the Greek case, the existence of strong cooperatives has been the critical factor of the whole innovation process at all stages, providing farmers with advice and support. In Portugal, the dynamic created by the large winegrowers in supplying advice to their suppliers (small-scale farmers) might stimulate the adoption of environmental innovations among the more dynamic advisory organisations. The interviews in Latvia suggest that familiarity with successful examples of implementation and familiarity with the innovation as such are also important factors for stimulating the uptake of innovations that can contribute to the sustainability of agricultural practices.

As stated above, growing societal environmental awareness and demand for environmentally friendly farming practices and healthy food in general is a considerable driving force for farmers and other food system actors to consider environmental innovations. In the Greek case, a cluster of cooperatives adopted the method of mating disruption of insects to demonstrate their environmentally friendly profile in response to the growing demand for safe and healthy products. Similarly, in Spain, the growing demand of zero residue products that are more respectful of the environment stimulate farmers' interest about innovative environmental techniques in fruit and horticultural production. In the Netherlands, in some occasions health issues have supported considering alternatives to the conventional practice as people got ill as a result of being exposed to the pesticide for soil disinfestation. Also the Portuguese case illustrates the indirect impact of societal expectations as the transition to a more eco-functional farming approach was stimulated by farmers' growing awareness of future market trends, societal demands and funding opportunities.

Taking policy measures ~~a~~nd structuring a legal framework play a crucial role in turning societal concerns into concrete action. The societal demand for the environment and health protection has a considerable effect on the diffusion of environmental innovations when it is enforced by legislation. In the Netherlands, growing societal concern over agricultural has resulted in stricter regulations of chemical disinfestation. These, in turn, have been the key triggering factor for farmers and advisors to consider more environmentally sustainable alternatives. Together with the resulting increased costs of chemical disinfestation, the regulations have made tagetes as the only effective alternative in controlling the specific nematode species. Similarly, in Spain, the Directive on the Sustainable Use of Pesticides has encouraged the use of mating disruption methods, which started in the early 2000s in vineyards and has recently expanded to fruit production due to its high efficacy. Agri-environmental measures in public agricultural policies and related economic incentives of public subsidies have considerably reinforced also Greek farmers' motivation to adopt integrated pest management. The inclusion of mating disruption in the agri-environmental measures and the availability of subsidies are strong incentives for adoption alleviating some of the fear associated with the implementation

of this method. In Latvia, many farmers made the switch to organic farming in view of the generous subsidies. In addition, the restrictions placed on the use of chemical pesticides may yet encourage farmers to make the switch to biological pest control methods. The role of the EU and national policies are critical to enhance advisory services on environmental innovations, as they require that the implementation of an agri-environmental measure ensures the provision of advice.

Discussion

The role of advisory services in facilitating environmental innovations in farms has to be regarded in a broader context of innovation environment. The history and scope of implementation of each innovation in the region matters as there is more knowledge accumulated and validated in practice about 'older' innovations with a certain adoption rate. This increases farmers' familiarity with successful examples of implementation that is encouraging for their own decision-making on innovation adoption. Advisors can play a key role in collecting and delivering knowledge on innovations in the regional contexts, as they accumulate their clients' on-farm experiences (Lowe et al., 2019). However, familiarity with the effectiveness of environmental innovations and appropriate conditions for their implementation on farms does not lead straightforward to their wide adoption.

It was apparent that some characteristics of the farm and/or farmer determined farmers' perception of the innovation in question and its applicability on their farm. Appropriate agro-environmental, ownership and infrastructural conditions of a farm are important factors for stimulating the uptake of innovations. Farm advisors can assist farmers with estimations and best-fit farm solutions. Farmers' personal values, attitudes and outlooks play a substantial role in the adoption process. In line with previous studies, farmers' intrinsic environmental awareness motivates them to gather information about environmental innovations and adopt pro-environmental behaviour (Wensing et al., 2019; Bopp et al., 2019). Raising environmental awareness and attitude change is a long-term process, where informing, training, educating and demonstrating - key functions of farm advisory services - are crucial elements (Despotovič et al., 2019).

In the studied cases the (re)integration of the environmental methods in farming practices were often stimulated by contextual triggers. These triggers reveal societal concerns over negative impact of agricultural activities on the environment and the growing consumer demand for environmentally friendly products. However, as environmental innovations can bring about limited commercial benefits (Cullen et al., 2013; Forbes et al., 2013), policy incentives, like restrictions of the use of chemical inputs and the availability of subsidies for environmentally friendly practices, are confirmed to be important driving forces. These point to the potential functions of farm advisors of channelling up-to-date societal demand and policies to farmers.

Previous research points to the positive impact of encouraging knowledge environment and advisors on farmers' innovation perceptions and behaviours (Sneddon et al., 2011). In the studied cases, farmers' professional social networks, including other peers in their neighbourhood and in farmer organisations (associations, cooperatives, farmer groups), and professional agricultural advisors, appeared to be key social reference groups that encourage to consider innovation adoption. These three groups - traditional agricultural advisors, other farmers and farmers' organisations - stand out also as the primary sources of advice during the implementation phase. While traditional advisors and formal organisations provide with professional advice originating in formal knowledge, farmers highly value the experience-based

advice provided by other farmers in the practical implementation of innovations (Šūmane et al., 2018).

Altogether, in the studied cases farmers combine and rely upon a wide range of knowledge sources, as also other actors, like researchers, input suppliers, controlling bodies etc., play an important role of farm advisors, depending on the country and the innovations. Our research suggests that often the same advisors are consulted during all phases of the innovation cycle, starting from awareness, through active assessment and implementation; however, these phases often are not sequential and linear, but overlapping and iterative.

We note some gaps in the farm advisory system regarded the studied environmental innovations. Lack of advice and advisors in some cases indicates that some environmental innovations are not well addressed within the agricultural advisory system, and therefore the pace of their dissemination is hindered. The growing role of input suppliers raises the question of the impartiality of their provided advice and its impact on the innovation's path. Collaborative education programs involving input suppliers could help to address agro-environmental issues more effectively (Stuart et al., 2018).

More generally, there is a necessity for improvements in agricultural education and the formal advisory support provided to farmers implementing environmental innovations. Environmental aspects of farming might need more systematic approach in agricultural education and advice. Furthermore, in the landscape of (increasing) diversity of advisory providers, a joint challenge is to develop formal and informal cooperation fora that allow different actors to interact and transmit a unified message, to improve collective knowledge about alternative environmental methods, and increase successful implementation, including in economic terms, of environmental innovations on farms. Networking has approved to bring positive effects on diffusion and adoption of B/IPC, and further reinforcing of multi-actor and cross-border sectoral networks would help to address common challenges (Lamichhane et al., 2016). Better cooperation between farmers, researchers and advisors is needed also to co-create locally specific knowledge.

Conclusions

In this paper we have looked at the role of advisory system in enabling different environmental innovations on farms. Widespread adoption of environmental innovations depends on a combination of different factors, and the availability of advice is only one, still crucial and transversal element of the innovation process. Societal demand for environmentally sound farming practices and agricultural products, supported by pro-environmental public policy measures, creates often a triggering effect on farmers to consider adoption of environmental innovations. Positive attitudes vis-a-vis these innovations in farmers' key reference groups, including advisory service providers, have a pushing effect towards adoption. Farmers pay attention to various aspects of the innovation and its feasibility with the farm when deciding on its adoption. To address the wide scope of farmers' inquiries and knowledge needs in this process, it is important that advisors have a broader expertise themselves on innovation and adoption process that goes beyond the technical aspects or that they can bridge farmers to other experts. The importance of this bridging or brokering function of advisors is even more important given that the farmers tend to consult the same advisors during the several phases of the innovation process, and the growing number of advisors with commercial interests. Cooperation among knowledge actors, advisory providers and opinion leaders can promote environmental innovations in the farming community and provide full support to farmers in adoption process more effectively. Reinforced environmental education, advice and networking for practical implementation of environmental innovations will facilitate a wider

uptake and better-informed use of the B/IPC methods, enhancing farmers' ability to distinguish valuable knowledge from information and taking better advantage of peer to peer learning opportunities. Further exploration of the relations between different farm advisors and their provided advice on environmental innovations, and the effect of these on farmers' innovation behaviours would help to improve innovation support system in agriculture.

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STRENGTHENING THE ROLE OF INNOVATION BROKERS IN LIVESTOCK ADVISORY SERVICES OF PAKISTAN

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ABSTRACT

Innovation brokers are an important component of agricultural advisory systems worldwide and have potential to impact household livelihoods in developing countries. Innovation brokers play a crucial role as systemic intermediaries that facilitate information flows, connect partners, articulate demands, communicate needs, facilitate linkages and other functions related to innovation processes (Klerkx and Leeuwis 2009; Van Lente, et al. 2003). In developing sectors, such as in Pakistan, linear and top-down models of change continue to be the major components of the farm advisory systems. Transforming the role of farm advisors in these systems to innovation brokers presents major challenges (Kilelu, et al. 2013). This paper aims to investigate the knowledge and skills required to transform individuals in linear-style farm advisory roles to play the role of innovation brokers within the livestock advisory services of Pakistan. The Whole Family Extension Approach (WFEA) was developed (Warriach, et al. 2018), and is considered an Agricultural Innovation Systems (AIS) intervention in the livestock extension system of Pakistan. This research project is building the capacity of the AIS by scaling up (Hermans, et al. 2013) the WFEA intervention through collaborative efforts with local extension partners. A network of 22 organisations (research, government, NGOs, private sector and international research organisations) with the common goal to improve smallholder livelihoods has been established. As part of the intervention, each organisation has designated up to four farm advisors to be part of a training program and a community of practice meeting (three days) after every six months about their roles in the farm advisory system. This includes training on various technical farming system modules and the opportunity to engage in a collaborative learning environment where individuals reflect on their own field experiences and the challenges they face. Data regarding the capacity building process from 50 farm advisors has been collected using two approaches; (1) through two reflective focus groups, July 2018 and December 2018, at the community of practice sessions and (2) during field follow-up visits for mentoring, monitoring and evaluation of the program. The results of this study conclude that regular capacity building trainings of farm advisors on the whole farming system, integrating female farm advisor, establishing trust and feedback mechanism among various actors involved in process, training on social mobilisation and communication skills of farm advisors are the key components to integrate the WFEA within the current farm advisory services in Pakistan. The framework proposed by Prager, et al. (2017) for the evaluation of farm advisory services could therefore be expanded for developing country contexts, including criteria on: capacity building of farm advisors; advisors meeting the diverse needs of farmers; support beyond technology transfer and support to streamline organisational extension programs.

INTRODUCTION

Farm advisory services play a vital role in the improvement of the dairy sector in low-income countries. The goal of advisory services is to provide research-based knowledge to rural communities to improve their farm productivity, leading to poverty reduction, rural development and more sustainable rural livelihoods (Swanson 2008; Zwane 2012). The role, function and structure of advisory services in any country depend on farmer education level, availability and use of technologies, level of commercialisation and value of the product (Swanson, 2008).

Innovation brokers are persons or organisations that catalyse innovation through bringing together actors and facilitating their interaction (Klerkx, 2012). They play a crucial role as systemic intermediaries that facilitate information flows, connect and innovate partners, articulate demands, communicate needs, facilitate linkages and other functions related to innovation processes (Van Lente, et al. 2003; Klerkx and Leeuwis 2009; Winch and Courtney 2007). In low-income countries, intermediary organisations connect different agents involved in innovation trajectories (Szogs, 2008), are important as they fulfil boundary work (Patti, et al. 2009) and play a role in bridging, bonding and linking social capital (Heemskerk and Wennink 2004). These, third-party catalysing agents are necessary to bring partners together, motivate them, provide information, and organise space for negotiations (Hartwich, et al. 2007). The type of intermediary that is becoming increasingly important is 'systemic' in a many-to-many relationship (Van Lente, et al. 2003; Howells, 2006). In other words, a role that is neither involved in the creation of knowledge nor in its use in innovation, but one that binds together the various elements of an innovation system and ensures that demands are articulated to suppliers, that partners connect, and that information flows and learning occurs (Klerkx, et al. 2009).

The strategies and methods to support innovation remain a challenge (Toillier et al. 2018). Innovation Support Services (ISS) depends on the phase of the innovation. During the initial phases, there is a need for innovative support services (e.g. network building, support for the innovator). In the latter phases, there is a need for more conventional services (e.g. training, credit) at farm, value chain and territory level. Brokering functions and new services are key to supporting actors to innovate by facilitating interactions for the co-production of knowledge, co-design of technologies, and identification of new institutional arrangements (Guy Faure et al. 2019). The required services are diverse (Albert, 2000; Leeuwis, Van den Ban, 2004) in terms of content (technical, economic, social, legal, etc.), and they can be provided by diverse methods (transfer of knowledge, co-con- struction, participatory development, etc.), as well as by a variety of providers (public, private, NGO, etc.). The role of agricultural advisory service (AAS) providers has changed. Over the past few decades, international efforts have been made to revitalize AAS through institutional reforms (decentralization, public-private partnerships, privatization, contract- ing-outsourcing, etc.) (Birner et al., 2009). New actors have emerged (NGOs, the private sector, including private firms and farmers' organizations), pro- moting and enhancing innovation processes by providing new services and new methods to deliver these services (Labarthe et al., 2013; Leeuwis, Van den Ban, 2004).

Agricultural Innovation System (AIS), is promulgated to undertake reforms in the knowledge and innovation support structures. In many low-income South Asian countries such as Bangladesh and India (Chowdhury, et al. 2014); (Rivera and Sulaiman 2009) they have taken initiatives to transform roles of the agricultural extension to support innovation as a collective process of putting knowledge into practice, and achieving multi-stakeholder social, economic and environmental goals. Despite this, AIS tends to be an academic window into agricultural development and requires operational concepts and tools if we want to make a real change (Spielman, et al. 2009) (World Bank, 2012). In these low-income countries, public-sector extension agencies and extension workers are finding it difficult to translate their roles from the classical model of agricultural extension to the AIS perspective (Rivera and Sulaiman 2009). Agricultural innovation studies have urged policy-makers and rural development professionals to adopt different innovative approaches to build social capital among farmers, pay greater attention to the needs of women and youth, and facilitate better links to markets for performing agricultural extension services (World Bank, 2012).

In Pakistan, farm advisory services are based on the linear top-down transfer of technology, in which technology was developed and validated by researchers, communicated by extension

agents and transferred to the farmers (Ashraf, et al. 2018). However, this approach has been subjected to various criticisms, such as failure to account for the context and complexity of the agricultural sector (Pretty and Chambers 2003). This implies challenging top-down and hierarchical approaches as well as changing routines and practices to ensure learning between one-to-one, one-to-many, and many-to-many innovation actors (Hall, et al. 2004). Therefore, there is a need to transform this approach so that farmers play a more central or 'participatory' role in the acquisition of knowledge and change of practice (Cristóvão, et al. 2012). In these 'participatory' extension programmes, researchers and extension agents fulfil a facilitating role, while farmers actively set the agenda and engage with their peers (Black, 2000).

Improving human capacity to play the role of innovation broker is the first and foremost step in AIS. It requires skills related to process facilitation: leadership, multistakeholder facilitation, trust building, and communication; it also requires tools for managing group processes (Anandajayasekeram, Puskur et al. 2009). This skill set cannot be obtained through formal education alone but must be developed through a combination of formal education and practical experience (Klerkx, 2012). In Pakistan, a recent study has demonstrated the impact of improving farm advisor capacity and using a 'whole-family extension approach' (WFEA). The WFEA involves interdisciplinary training to the men, women and children of the farming household on the whole dairy-farming system. This resulted in on-farm practice change of recommended interventions and overall productivity increases up to 25-30% of smallholder dairy farming families (Warriach, et al. 2018). This study provided some foundation to establish AIS in the country. To integrate the successes of this approach within the wider livestock extension system of Pakistan, there is limited information available to understand the capacity building needs of farm advisors from the various organisations who play a role in this system. Therefore, this research aims to address the question; what are the skills, knowledge and learning required to integrate the WFEA within the current farm advisory services in Pakistan?

Methodology

2.1. The 'whole-family extension approach'

The present study builds on the WFEA which was previously developed with collaborating partners in Pakistan (Warriach, et al. 2018). This approach was based on the rationale that different family members are responsible for different aspects of the farm operations and, thus, would require different information. Females are most often responsible for milking, oestrus detection and calf rearing, males for agricultural farming operations, while children play a major role with calf rearing. Providing information to all family members stimulates informal discussion among family members over meals and during non-working hours. By stimulating awareness and discussion among family members, it was expected that an increase in on-going implementation of improved farm practices would be achieved. The role of female farm advisors is highly important in order to implement the WFEA because it is not appropriate for male farm advisors to interact with female farmers due to cultural norms in many communities.

This project used an action research (Carr and Kemmis 1986) approach and participatory methods to engage a multi-disciplinary research team, smallholder dairy-beef farming families, fam advisory service providers and policy makers in identifying opportunities for improvement and implementing participatory activities to achieve this integration.

2.2. Network of farm advisory services organisations

The project has engaged twenty-two organisations who are part of the pluralistic advisory system of Pakistan to support this innovation (including research, government, NGOs and

private sector organisations) (Table 1). The project is supporting these organisations to establish the links, information flows and shared visions to ensure it will function as AIS as outlined by the World Bank (2006) .

2.3. Farm advisors training workshops

Each organisation designated up to four farm advisors to be part of a training program and community of practice workshop (three days) after every six months (from Jan 2018 until Dec 2020). Farm advisors technical background varies greatly depending upon the scope of their respective organisation including researchers from the University sector, veterinarians, veterinary assistants and agriculture graduates from the government and private sector, social mobilizers from the the NGO sector and various technical diploma holders. Organisations having both men and women as part of their farm advisory teams nominated at least one male and one female to participate in this collaboration. The remaining organisations have designated the available option either male or female to attend these training workshops. This includes training on various technical extension modules (Table 2), social mobilisation, gender mainstreaming, participatory communication skills and the opportunity to engage in a collaborative learning environment where individuals reflect on their own field experiences and the challenges they face. During each training workshop the project team covered two of the technical modules outlined in Table 1.

2.4. Field follow-up visits

Field follow-up visits were conducted by the trained project team members consisting of both males and females in both provinces the project was working in (Punjab and Sindh). These field visits occurred every six months. During these follow-up visits project team members are providing one-to-one mentoring to the farm advisors, monitoring and evaluation of the implemented activities. The project team also collected the data from each field follow-up visit from the farmers and farm advisors.

2.5. Conceptual framework

The framework by Prager, et al. (2017) was used for assessing advisory services based on a conceptual framework for analysing characteristics of advisory services as a component of the wider AKIS. This framework could therefore be expanded for developing country contexts, including criteria on: capacity building of farm advisors; advisors meeting the diverse needs of farmers; support beyond technology transfer and support to streamline organisational extension programs.

2.6. Data collection strategy

Qualitative data regarding capacity, management, advisory methods and quality of services provided was collected from 50 farm advisors using two approaches; (1) through two reflective focus groups where participants were divided into four subgroups including (research, government, NGOs and private sector organisations) having representation of each category of organisations during July 2018 and December 2018, at the community of practice sessions and (2) during field follow-up and mentoring visits after every six months. Data was collected by the project team based on the framework proposed by Prager, et al. (2017) for the evaluation of farm advisory services.

FINDINGS

The present study demonstrated that regular capacity building trainings of farm advisors on whole farming system is one of the key components to integrate the WFEA within the current

farm advisory services in Pakistan. The overview of criteria for assessing advisory services of various farm advisory service providing organisations after the integration of WFEA have been presented in (Table 2) derived from Prager, et al. (2017). Findings related to the experiences of farm advisors with pluralistic extension in the study are presented under the following sections: capacity building of farm advisors, farm advisors meet the diverse needs of farmers, support beyond technology transfer and support to streamline organisational extension programs. The sections were derived from the theoretical framework by Prager, et al. (2017) and analysis of the qualitative data.

Capacity building of farm advisors

In the present study, evidence from reflection sessions showed that regular training of farm advisors is one of the key factors to strengthen the current farm advisory system of Pakistan. Most of the farm advisors mentioned that regular training programs helped them gain skills to build trust with communities and helped them to achieve their organisation's goals. Majority of the farm advisors mentioned that after participating in the farm advisor training workshops, they feel more technically sound, confident, resourceful and able to tackle extension challenges more effectively. Farm advisors from the private sector and NGOs found that the technical information provided was simple and highly applicable to smallholder farming communities; previously this type of material has not been readily available to them. Farm advisors from the private sector and NGOs actively participated because provision of farm advisory services is the part of main role of their job. During the second reflection session, majority of the farm advisors found that training component of social mobilisation and communication skills remained highly useful for building trust in developing relationships with farming communities and within their organisations. The results of present study align with a previous study where system-level farm advisory services were evaluated and 87% organisations found that regular training of farm advisors is an important component of a successful advisory service (Prager, et al. 2017).

Farm advisors meet the diverse needs of farmers

In the present study, evidence from reflection sessions showed that training on 'whole farming system' meet the diverse needs of smallholder farmers. Majority of the farm advisors from private sector and NGOs mentioned that they always have very limited knowledge and extension material to share with the farmers. Majority of the farm advisors that are part of this training program don't have technical background and furthermore, there was no mechanism to obtain the trainings opportunities during their routine job. Farm advisors have to consult with their senior management regarding various technical questions asked by the farming communities. "After getting these regular trainings now feeling much technical sound and confident and, in a position, to respond any question from the farming community that is why farmers start calling me Dr" (Farm advisor from private sector). Which mean the community has established their confidence on my technical advices.

In the present study, evidence from field follow-up visits with NGOs demonstrated that after practicing various innovative advisory methods (focus groups, participatory extension approach, farmer-to-farmer exchanges, demonstrations, individual farm visits) the WFEA helped to establish trust and a feedback mechanism with the farming communities. Due to this mechanism now, farmers can openly share their issues and looking for the solution from their organisation. The farmers working with one local NGO provided "the feedback to the higher management that they should be taught about the technology of local seed production of Rhodes grass because it is very expensive" (Farm advisor from local NGO). That organisation communicate to the project team regarding this technology of local production of Rhode grass seed. Project has now initiated one research trial to develop that technology.

Support beyond technology transfer

Based on the qualitative data captured during the reflection sessions, the farm advisors from private sector and local NGOs shared that the WFEA helped to strengthen their linkages with the communities. Previously, farm advisors only interacted with the communities regarding their organisational mandatory targets which were primarily transactional, like milk collection, seed sale or credit provision. After receiving social mobilisation and communication training we have "started to spend more time with communities to provide them support beyond our routine job targets" (Farm advisor from private sector). Previously we have "limited topic to discuss with communities" (Farm advisor from private sector). After getting these trainings we started "discussing to establish community based various entrepreneurs' models" (Farm advisor from local NGO). Based on the qualitative data captured during the second reflection session, the farm advisors from local NGOs shared that their organisations are utilizing "WFEA as an effective tool for the poverty alleviation" (Farm advisor from local NGO).

Support to streamline organisational extension programs

Based on the qualitative data captured during the reflection sessions, farm advisors shared that overall the relationship between (1) their organisation and farming communities and (2) their immediate supervisors and farm advisors have been significantly improved after adopting the WFEA. Many farm advisors from private companies shared that previously they were providing extension services to the farmers with limited scope as they were not aware about the significance of various components of an effective extension program. During the reflection sessions, few farm advisors shared that "now they realize the significance of female extension staff in order to implement WFEA and to achieve the on-farm practice change goals" (Farm advisor from private sector). Farm advisors from International research organisation mentioned that "their higher management realized the significance of female extension staff and they would like to involve two female extension staff in future training workshops" (Farm advisor from International research organisation). Farm advisors from government department mentioned that "previously their focus was always on the treatment of animals now they have initiated regular extension activities like farmers discussion groups and school program to educate children regarding the best farming practices" (Farm advisor from government).

Few farm advisors from the NGOs having non-technical background shared that they have "established good working relationship among the other farm advisors involved in this program so that they can consult the most relevant person within the network whenever they have any particular issues" (Farm advisor from local NGO). For example, veterinarians are specifically contacted for animal disease outbreak/treatment or when farmers are requiring technical information. In this way, the project has connected these various organisations with multiple objectives and enabled them to work towards achieving the common goal of improving the livelihood of smallholder farmers.

DISCUSSION

The present study identified the key components to strengthen the farm advisory services in Pakistan. Improving farm advisor's capacity to play the role of innovation broker is the most critical step to establish innovation system in developing countries. Data from this study identify that the diverse educational backgrounds and field roles along with a lack of regular capacity building trainings of farm advisors on whole farming system are the key constraints to integrate the WFEA within the current farm advisory services in Pakistan. Many other South Asian countries, like India and Bangladesh have taken initiatives to transform roles of the agricultural extension to support innovation as a collective process of putting knowledge into practice, and achieving multistakeholder social, economic and environmental goals. Public-sector extension agencies and extension workers are finding it difficult to translate their roles

from the classical model of agricultural extension to the AIS perspective (Rivera and Sulaiman 2009). This implies that more empirical research is needed to understand the capacity challenges of a farm advisor to effective partner and facilitator of innovation.

Pakistan's agricultural industries are evolving rapidly to service the needs of millions of the smallholder farmers. The Government invests in infrastructure and human resources in their departments of agriculture, livestock and research institutions as a high priority. The current high-priority projects focus is on short-term goals with limited scope. There is need to establish country wide Agricultural Innovation System (AIS) which is a process of co-production of new knowledge, products and processes applied to provide benefits in society and requiring technological, social, economic and institutional change (Hall, et al. 2004). A systemic understanding of innovation within an agricultural innovation systems perspective considers research and extension actors (the research, development & extension system or RD&E) as part of a broader network of actors that include practitioners like farmers and community members, processing sector groups, agricultural traders, retailers, policymakers, consumers and civic advocacy groups as sources of innovation (Knickel, et al. 2009). A program of this nature has great potential to significantly increase on-farm efficiency and livelihoods of millions of smallholder farming households across Pakistan.

CONCLUSION AND RECOMMENDATION

The results of this study conclude that regular capacity building trainings of farm advisors on the whole farming system, integrating female farm advisor, establishing trust and feedback mechanism among various actors involved in process, training on social mobilisation and communication skills of farm advisors are the key components to integrate the WFEA within the current farm advisory services in Pakistan. A program of this nature has great potential to significantly increase on-farm efficiency and livelihoods of millions of smallholder farming households across Pakistan.

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ANNEXES

Table 1. List of the extension organisations engaged with the dairy-beef project of Pakistan

Organisations	Type/Mandate
University of Veterinary & Animal Sciences, Lahore	Academia, Research, Extension
Sindh Agriculture University, Tandojam	Academia, Research, Extension
University of Sargodha	Academia, Research, Extension
Centre for Agriculture and Bioscience International	Research, Development, Extension
National Agricultural Research Centre	Research
Farm Dynamic Pakistan	Private sector, Extension
Shakarganj Foods Products Limited	Private sector, Extension
Fauji Foods Limited	Private sector, Extension
Engro Foods	Private sector, Extension
Haleeb Foods Limited	Private sector, Extension

Matra Asia (Pvt) Ltd	Private sector, Extension
Nestle Pakistan	Private sector, Extension
Livestock & Dairy Development, Punjab	Government, Extension, Research
Livestock & Fisheries Department, Sindh	Government, Extension, Research
National Rural Support Program	NGO, Development, Extension
Lodhran Pilot Project	NGO, Development, Extension
Management & Development Foundation	NGO, Development, Extension
Rural Education and Economic Development Society	NGO, Development, Extension
World Wide Federation	NGO, Development, Extension
Potohar Organization for Development Advocacy	NGO, Development, Extension
Sindh Agricultural and Forestry Workers Coordinating	NGO, Development, Extension
Akhuwat Foundation	NGO, Development, Extension

Table 2. List of the extension material developed by ASLP dairy project for smallholder dairy farmers

Modules	Fact sheets
Animal husbandry	Basic husbandry principles
Basics of animal nutrition	Basics of animal requirements
	Nutritional requirement according to age, weight and production
	Ration formulation
Calf rearing	Calf management
	Calf diseases
	Calf fattening
Animal reproduction	Principles of animal reproduction
	Reproductive disorders
	Importance of feed for reproduction
Dairy breeds and their selection	Different breeds of dairy animals
	Recommendations for the purchase of milking animal
	Selection of better productive animals

Ration formulation	Balanced feed for animals
	Total mixed ration (TMR)
	Urea molasses block (UMB) and mycotoxicosis
Improved fodder agronomy	Strategies to overcome fodder shortage
	Seed selection and preparation
	Summer and winter fodders
	Mixed cropping
Milk marketing and value chain	Cost of milk production
	Milk marketing options
	Milk value addition
Animal health	Deworming of animals
	Infectious diseases of animals and their prevention
	Mastitis prevention
Extension and mobilization	Communication skills
	Relationship building
	Community mobilization

Table 3. Overview of criteria for assessing advisory services providing organisations

Criteria	Type of organisation	Assessment (+ is being met, – is not being met)
Advisory organisations involved draw on diverse knowledge sources	Research	-
	Government	-
	NGOs	+
	Private sector	+
Advisory organisations cooperate to bridge potential knowledge gaps	Research	+
	Government	+

	NGOs	+
	Private sector	+
There is a stable or growing workforce of advisors	Research	-
	Government	+
	NGOs	-/+
	Private sector	+
Advisors receive regular training	Research	-
	Government	-
	NGOs	+
	Private sector	+
All relevant advisory topics are covered	Research	-
	Government	-
	NGOs	+
	Private sector	+
All client groups are covered	Research	-
	Government	+
	NGOs	-
	Private sector	-/+
A range of advisory methods are used	Research	-
	Government	-
	NGOs	+
	Private sector	-/+

DETERMINANTS OF FARMER'S DECISION TO JOIN A PARTICIPATORY EXTENSION PROGRAMME: A MIXED METHOD ANALYSIS OF NORTHERN IRELAND BUSINESS DEVELOPMENT GROUPS

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Abstract

Innovation, in terms of product, process and practice is now at the core of the global agricultural policy agenda. There is an increased need for farmers to become more innovative in what has become a changing agricultural environment requiring the increased adoption of advanced technologies and sustainable management practices in order to improve productivity. The purpose of this paper is to examine and analyse farmers' decisions in relation to joining and participating in a new approach to farm extension learning and advisory service provision; namely the Business Development Groups (BDG) scheme in Northern Ireland. The BDG programme focuses on facilitating 'peer-to-peer' learning at the farm level. The approach provides farmers the opportunity to discuss farm business challenges with other farmers and to draw on knowledge and experience within the group. Making use of data from both primary and secondary sources, this study employs a mixed method approach which involve an empirical analysis of quantitative and qualitative data to examine the factors influencing membership of the BDG programme. The results of our analyses show that larger, more intensive farmers who are keen to access information from other farmers to improve their business performance are most likely to participate in the BDG programme. The study contributes to the empirical literature as it provides a comprehensive analysis of factors influencing the decision to join participatory extension programmes using a mixed method approach. The results of the analysis will provide evidence to inform future policy development in the area of participatory extension programmes.

1.0 Introduction

Innovation at the farm-level, in terms of product, processes and practice, is now emerging as a core theme in the global agricultural policy agenda (Hooks et al. 2017, Singh and Bhowmick 2015). As farmers operate more and more in a competitive global markets, farm-level profitability increasingly depends on their recognition of the need to adopt new management practices and advanced technologies that will underpin sustainable farming systems. Central to increasing the innovative capacity at farm level are existing extension service providers who have an important role in facilitating effective extension services that encourage farmers to augment their skills and knowledge and embrace new technologies and best practices (Hennessy and Heanue 2012). Alongside this, effective extension programmes should provide an avenue for better communication of relevant research findings as well as innovations in order to bring about improved diffusion and adoption at farm-level (King et al. 2019, Läpple, Hennessy, and Newman 2013, Tamini 2011).

The international literature commonly identifies four major strands of agricultural extension methods namely: linear technology transfer, one-to-one advice, structured education and training and participatory extension methods (Black 2000, King et al. 2019, Esparcia 2014). National advisory programmes around the world have tended to adopt a range and combination of these methods in order to fulfil their farm- level extension remit.

The linear one-to-one basis using a top down approach has been the most dominant extension method for many years (Black, 2000). However, this approach has limitations firstly in terms

of the extent of its coverage to farmers and secondly in its ability to take account of and be responsive to the current, more complex agricultural production environment which requires more innovative approaches. In a bid to overcoming these challenges, a new participatory advisory service provision for farmers namely the Northern Ireland Farm Business Development Groups (BDGs) was established in March 2016. The overarching goal of the programme is to increase farmers' access to agricultural extension services that will foster sustainable agricultural practices, improve farm-level productivity and ultimately increase economic performance at farm-level. The scheme focuses on facilitated 'peer-to-peer' learning, bringing farmers together to share knowledge and skills, help them improve their technical efficiency and business management skills and introduce them to new technologies and innovative ways of working. Previous research has shown that interactions and exchanges of knowledge from multiple sources especially from actors within the production value chain promotes the adoption of best production practices and new technologies which consequently improve farmers' productivity and income (King et al. 2019, Woodhill 2014)

The BDG scheme is a part of a wider programme, the Farm Business Improvement Scheme (FBIS), part funded by the EU through Pillar II of the Northern Ireland Rural Development Programme 2014 – 2020 (Department of Agriculture 2016). It employs a group approach to improve farm businesses performance; (allocation to groups is by main farm enterprise and farm location). Farmers participating in the scheme have their farm key performance indicators recorded and benchmarked to identify areas for potential improvement in performance. They also maintain an active business development plan, attend training events, and share benchmarking information with other group members. Each farmer hosts a group training event on their farm during the lifetime of the scheme and interactions are held under the guidance of a facilitator who bring in new ideas and foster innovation, particularly around the use of new technologies. Participatory extension approaches have previously been shown to give farmers improved access to local and expert knowledge, as well as developing well-functioning social networks which promote rural innovations (Esparcia 2014, Swan and Newell 2000, Klerkx, Aarts, and Leeuwis 2010). The implementation of the BDG programme in Northern Ireland emphasises relational processes including co-learning and reflexivity. It provides group members with the opportunity to discuss farm business challenges, and to be actively involved in a shared problem-solving process. The farmers meet formally at least eight times a year, providing them with an opportunity to talk about issues relating to their own farm business, including responses to wider market, policy and technology drivers. The participants are eligible to claim for costs associated with analytical services and an allowance of £600 for hosting a training event. The total government investment in the FBIS scheme as a whole is worth over £40 million (Department of Agriculture 2016).

The objective of this study is to explore and analyse the reasons around farmers' decisions to join and participate in the BDG programme in Northern Ireland using a mixed method approach (empirical analysis of quantitative and qualitative data). This research makes a unique contribution to the existing literature by providing a comprehensive analysis of the factors influencing the decision to join participatory extension scheme in a Northern Ireland context. The study examines the reasons why farmers chose to join or not join the BDG programme and identify ways in which the programme might be improved. We are not aware of any previous study that have employed the mixed method approach to analyse the factors influencing the decision to join participatory extension programmes. While a few studies on participatory extension programmes have been undertaken in the Republic of Ireland (Läpple and Hennessy 2015, Hennessy and Heanue 2012, Läpple, Hennessy, and Newman 2013) these studies focused mainly on the measuring the impact of the participatory extension programme. Only Hennessy and Heanue (2012) have analysed factors associated with membership of participatory extension programme but this research focused on just one enterprise group; dairy discussion

groups. Our study cut across different enterprise groups and uses a mixed method approach (empirical analysis of quantitative and qualitative data) to provide a balanced analysis around the decision of different groups of farmers to join a BDG by creating additional insights into the perceptions and motivations of the members in the context of the programme being newly initiated. The mixed method approach is fast gaining popularity in the literature to provide answers to research questions focussing on personal, social and psychological variables (Triste et al. 2018, Wauters and Mathijs 2013). For example, Triste et al. (2018) employed the mixed method approach to explore the influence a sustainable farming initiatives (SFI) design characteristics may have on farmer motivation to participate in *Veldleeuwerik*,(a Dutch SFI programme). Also, Charatsari, Lioutas, and Koutsouris (2016) employed the mixed method approach to investigate farmers' motivational orientations towards competence development projects (CDP) and the needs that drive them to participate in such activities.

The exploratory analysis of the BDG programme which is a novel approach to participatory extension practices can also serve as a template of participatory extension programmes in other regions both nationally and internationally.

The remaining sections of this paper are organised as follows: Section 2 describes the methodology while section 3 explains data available. The results and discussion are presented in section 4 and finally, section 5 concludes.

2.0 Methods

2.1 Data

Data for this study was obtained from both primary and secondary sources. The primary data is obtained through an "entry level" survey which was undertaken for BDG participants and non-participants at the initial establishment of the programme. The survey questionnaire captured those factors which might influence a farmer's decision to join or not join a group and include close and open ended questions. The options from which the farmers were to choose from were carefully selected based on literature review and experience of the authors. In total 719 farmers completed the questionnaire over a 3 month period with a response rate of ~24% for the members of the BDG programme while 52 responses were obtained for farmers who are not members of BDG group. The primary data from the entry level survey was analysed to provide more insight into why farmers chose to join or not to join the BDG programme.

The secondary data were obtained from the Northern Ireland Farm Business Survey and the College of Agriculture, Food and Rural Enterprise (CAFRE) benchmarking data for the year 2015. While data for the members of the BDG group was obtained from the CAFRE benchmarking data collected annually from the members of the BDG programme (treatment group), data for non-members was obtained from the FBS data collected by DAERA Statistics and Analytical Services Branch. The CAFRE benchmarking and FBS data contains detailed information regarding the financial position of the farm business. Variables captured in both data sources and used for analysis are directly comparable.

These secondary data sets were modelled using Logistic regressions model, followed by a detailed analysis of the primary data aimed at providing insights around the decision to participate or not to participate in the BDG programmes. This include an analysis of sources of information about the BDG Scheme, attendance rate and ways of improving the programme.

2.1 Logistic Regression Model

The logistic regression is used to develop a regression model when the dependent variable is categorical (Cox 1958). It possess a dichotomous dependent (left-hand-side) variables coded

as 0/1 (Adenuga et al. 2013). For this study, the dependent variable is coded 1 if the farmer is a member of a BDG group and coded 0 otherwise. The explanatory variables hypothesized to influence membership of the BDG group include: the utilised agricultural area measured in hectares, age of the farmers measured in years, herd size measured in cow equivalent and herd size squared also measured in cow equivalents. These variables were selected taking into account previous literature (Hennessy and Heanue, 2012) Due to data limitation we were unable to include more variables in the model. The empirical specification of the logistic regression model is presented in equation (1).

$$logit\ (p) = ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_i X_i \qquad (1)$$

Where p is the indicates the probability of joining the BDG programme, β_i are the regression coefficients associated with the membership of the BDG programme and x_i represents the explanatory variables hypothesized o influence membership of the BDG programme.

3.0 Data and Descriptive Statistics

An overview of the farm characteristics of the members and non-members of the BDG programme is presented in Table 1. The analysis was undertaken using Stata 15.0. The results of the analyses showed a significant difference in farm characteristics between farmers participating in the BDG programme and non-participants. For example, considering the combined sample of farmers for members and non-members of the BDG group, it can be observed that farmers in the BDG groups have larger land areas (54.8 hectares versus 31.2 hectares), larger herd size (108.6 versus 50.5), are younger (47.7 years versus 54.6 years) and are the more profitable farmers (£901.4. versus £456 per hectare). The higher profitability of the BDG farmers may be associated with the fact that farmers who join participatory extension programmes are more motivated to improve farm-level profitability and therefore are more likely to adopt new technologies and best farm management practices (Hennessy and Heanue, 2012). This observation supports previous studies in the literature, for example Davis et al. (2012) and (Läpple, Hennessy, and Newman 2013) also found initial differences between participants and non-participants of participatory extension programmes.

Table 1: Descriptive statistics on characteristics of the BDG and Non BDG Farmers, 2015

Variables		BDG Farmers		Non BDG Farmers	
All Enterprises	Description and unit	Mean	SD	Mean	SD
Allocated Land area	Hectares of area	54.8	44.4	31.2	24.2
Age of farmer	Years	47.7	13.6	54.6	12.1
Size of herd	Cow equivalent	108.6	81.3	50.5	48.2
Gross margin	£/hectare	901.4	688.9	456.51	415.80

4.0 Results and Discussion

The result and discussion section is reported in the two following subsections. The first subsection focuses on the result of the logistic regression model presented in Table 2. The result explains the factors influencing farmers' decision to join BDG groups. This is followed by a discussion of the results of the qualitative analysis of the membership of the BDG programme.

4.1 Determinants of farmer's decision to join the BDG programme

The results of the logistic regression analysis showing the parameter estimates and their respective marginal effect (the effect of a unit change in each explanatory variable on the probability of participation in the BDG programme) is presented in Table 2. The likelihood ratio statistic suggests that the model is significant ($p<0.01$). We found the herd size and its squared term were statistically significant ($p<0.01$) with positive and negative signs respectively. Variables with a positive coefficient increase the probability of participation while those with a negative coefficient decrease the probability of participation. Specifically, the results implies that farmers with larger herd sizes are more likely to participate in the BDG programme although at a declining rate given the negative sign and the statistical significance of the herd size squared term. The increase of herd size by one unit will increase the probability of participation in the BDG programme by 0.7 per cent. We also found land area to be positively associated ($p<0.1$) with participation, indicating that farmers with larger land area are more likely to join the BDG group. An increase in land area by one hectare increases the probability of participation by 0.2 per cent. On the other hand, we found a negative and statistically significant relationship between the age of the farmer and the decision participate in the BDG programme. This indicates that the younger farmers have a higher probability of joining the BDG group compared to the older farmers. A one year increase in the age of the farmer will decrease the probability of participation in the BDG programme by 0.6 per cent. Similar results were obtained by (Hennessy and Heanue 2012) in which they found both land and herd size to be statistically significant determinants of the decision to join a dairy discussion group.

Table 2: Logit regression model results

Variable (N= 703)	Coefficient	Std. Err.	Z-Statistic	Marginal effect
Constant	0.28602	0.40326	0.71	
Herd Size	0.03078***	0.0039	7.99	0.0071
Age	-0.0278***	0.0069	-4.04	-0.0064
Land Area	-0.01*	0.0057	-1.72	-0.0023
Herd Size^2	-0.00004***	7.72e-06	-5.08	-9.10e-06
Log likelihood	-386.2046			
LR chi2(4)	178.35			
Prob > chi2	0.0000			
Pseudo R2	0.1876			

***, **, * Significant at the 1%, 5%, 10% level, respectively

4.2 Results of Qualitative Analysis of the Decision to join or not to join the BDG Groups

The results of the primary data analysis in respect of reasons why farmers decide to join or not to join the BDG programme is presented in Table 3 and 4 respectively.

4.2.1 Reasons for Joining the BDG Programme

In the entry level survey, farmers who are participating in the BDG programme were asked to rank the factors that influence their decisions to join the BDG programme based on degree of importance. The results of the analysis presented in Table 3 showed that the most important reason why farmers decided to join the BDG programme was because they wanted to learn from other farmers. This result confirms that farmers place value on the opportunity to draw on the knowledge and experience of other farmers. Another important reason why farmers decided to join the BDG programme was to access other schemes. This may probably be connected with the initial perception at the start of the programme that BDG membership would be a pre-requisite for accessing other government funded schemes and supports. This is understandable as participation in the scheme gives the farmers greater access to information through the facilitators and other farmers which enables them to easily access other schemes such as the "capital grant" scheme compared to farmers that are non-members of the BDG programme. This buttresses the results of the quantitative analysis which shows that farmers with larger farm sizes and probably more commercially oriented are more likely to join the BDG programme. Another interesting result is the ranking of 'access to annual payment' as the least important. This might indicate that the majority of the farmers that join the BDG programme do so to be able to improve their farm performance rather than the motivation of obtaining the payment they will receive when they join the programme.

Table 3: Reasons for Joining the BDG Programme

Reasons	Degree of Importance	Rank
Accessing CAFRE advice/information	4.15	4th
Opportunity to engage socially with like-minded farmers	4.24	3rd
The annual payment	3.85	5th
To access other schemes/future schemes	4.29	2nd
To learn from other farmers	4.55	1st

Key: 1 = not important 2 = Less important, and 3 = important 4 = Very important

4.2.2 Reasons for not joining the BDG Programme

The results presented in Table 4 gives a summary of the reasons provided by non-members of the BDG programme as to why they did not join a BDG group. Almost 27 percent of the surveyed respondents said they did not participate in the BDG programme because they were not aware of it at the time it was introduced. This highlights a need for improved communication of the existence and potential benefits of the programme to raise awareness among the farming population. Our analysis of the sources of information regarding the programme showed that Newspapers/Press/Media were the most popular means of communicating the programme to farmers (Table 5). Twenty-five per cent of respondents

indicated that they did not participate in the programme because they never saw it as relevant to their farm business. This result corroborates the results of the quantitative analysis where it is found that farmers with larger herd size and land area and who a more commercially oriented have a higher probability of participating in the BDG programme. The findings highlight that the method of communication to promote the BDG programme and its membership requires careful consideration to establish a good level of uptake.

Table 4: Reasons for not Joining BDG

Reason	Frequency	Percentage
I thought it would involve too much work	3	5.77
Did not see it as relevant to my farm	13	25
I am already involved in the Farm Business Survey	4	7.69
I did not apply on time	2	3.85
I didn't like the idea of sharing farm business/financial information with other farmers	7	13.46
I was not aware of it at the time	14	26.92
Would not have been able to take time away from the farm	6	11.54
Other	3	5.77
Total	52	100

Table 5: Sources of Information about the BDG Scheme

	Frequency	Percentage
CAFRE advisors	210	29.17
DAERA website	89	12.36
Family member	14	1.94
Newspapers/Press/Media	294	40.83
Through involvement in another scheme	24	3.33
Through the farming unions	19	2.64
Other farmers	62	8.61
Others	8	1.11

4.2.3 Average Attendance at BDG Meetings

The farmers participating in the BDG programmes are expected to attend at least 8 meetings within a year. The results presented in Table 6 showed that the average attendance of farmers at meetings for the first and second year of BDG membership. The results show that attendance at the meetings was relatively high.

Table 6: Attendance rate

BDG groups	2016/2017 (%)	2017/2018 (%)
Dairy	86.9	82.0
Sheep	89.6	85.0
Cattle	91.9	84.0
Beef	90.0	84.1

For the dairy business development group for the year 2017/2018 about 82 per cent of the participant have more than 75 per cent attendance and about 30 percent has 100 percent attendance. For sheep, 88 percent have at least 75 percent attendance and as much as 32 percent has 100 percent attendance. For the beef BDG group, 87 per cent has at least 75 per cent attendance and as much as 34 per cent has 100 percent attendance. For the cattle group, about 86 percent of the participants have more than 75 percent attendance and as much as 28 percent has 100 percent attendance.

4.2.4 Areas of Improvement for the BDG programme

As part of the entry survey, respondents were asked to identify areas of improvement for the BDG programme. Given that it was an open ended question, different responses were obtained from the farmers in the BDG programme. The responses were analysed and grouped into 15 headings as presented in Table 7. From our analysis, we found that 24 per cent of the farmers believe that no change is required as they are satisfied with the current operation of the programme. However, close to 20 per cent of group members believe more in-depth diverse and technical information should be provided at BDG meetings. About 9 per cent of the farmers also indicated that more meetings and farm visits per year will enhance the benefits gained from BDG membership.

Table 7: Identified Areas of Improvement of the BDG programme

Areas of improvement	Frequency	Percentage
Flexibility in group rules	21	2.91
More outside speakers and workshops	19	2.61

Improved diversity in group composition and meeting schedule	31	4.3
No change is needed	173	23.99
Get qualification for attendance	8	1.11
More Farm Visits and Meetings per year	65	9.02
Improved social interaction among members and between groups	57	7.91
Review progress made by members/Revisit issues raised on farm visits	26	3.61
Link membership to grants	6	0.83
More members	18	2.49
More in-depth , diverse and technical information	142	19.69
Continue attendance payment	37	5.13
UK/Ireland trips	20	2.77
Group winter meetings off farm	26	3.61
N/A	72	9.99

5.0 Conclusion

In this study, we employed a mixed method approach to elucidate the key drivers of farmer participation in the Northern Ireland BDG programme. The approach provides a comprehensive evidence of farmers' decisions to join or not to join a specific peer-to peer learning extension service, namely the BDG programme. From the results of the analysis, it can be concluded that herd size, land area and age of the farmer are significant factors influencing the decision of the farmers to join the BDG programme. Those farmers with larger farms (land area farmed) and who are younger demonstrate a greater willingness to join and participate in the BDG programme with the aim of raising the level of their farm performance. The results also show that farmers value the opportunity to obtain and share relevant information and discuss their farm business with other farmers; this ranks first among their reasons for joining the BDG programme. Although farmers were being paid for participating in the BDG programme, for most of the farmers, being paid was less important compared to the opportunity to share farming information with other farmers. This is in line with those of previous studies, for example Charatsari, Lioutas, and Koutsouris (2016) who stated that participation in competence development projects (CDP) is influenced by farmers' Willingness to cover their needs for autonomy and competence, rather than external factors. This might however require further research as a study by (Läpple and Hennessy 2015) has shown that farmers perform better when they did not receive incentives to join participatory extension group compared to when they were given incentives. In line with the results of the study, suggested improvements that could be made to BDG programme would be to explore a wider range of technical information in a more in depth way. There was also interest in increasing the number of meetings, in particular farm visits.

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ENABLING FARMERS' CONTINUOUS LEARNING THROUGH SOCIAL LEARNING PRACTICES - THE ROLE OF INNOVATION SUPPORT SERVICES

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Abstract

Agricultural innovation policy increasingly emphasises farmers' continuous learning in multi-actor settings for knowledge development and innovation. The aim of this paper is to critically analyse the structural conditions for farmers' involvement in lifelong learning, and the role of innovation support services in supporting this. Within an exploratory case study approach, interviews with key stakeholders were analysed using a practice-based approach. The findings show that the overall structures and incentives enabling multi-actor learning opportunities of farmers and other actors are too weak. The practical implications are that there is a need to form working approaches that systematically build and uphold multi-actor networks, and innovation support services have a key role in this. The theoretical implications include the use of a practice-based approach, where the concept of practice offers a bridge between the structural conditions and the learning processes among involved actors.

Introduction

Contemporary agricultural innovation policies promote farmers' continuous learning in multi-actor settings for knowledge development and innovation (EU 2020; OECD 2019). It has been claimed by both the scientific community and policymakers that farmers' continuous learning and innovation is principal to the productivity and sustainability of agriculture and rural areas (EU SCAR 2019).

This claim is supported by several arguments. Firstly, the pace of current societal development is so fast that an on-going analysis of the surrounding world is required (Klerkx 2020). At the same time, the personal learning environment has changed dramatically due to new technological opportunities (Dabbagh and Castaneda 2020).

Secondly, the types of knowledge needed to solve the complex issues of agriculture are diverse and local (Leeuwis 2000). This requires transdisciplinary cooperation between farmers, advisers, researchers and other experts, working interactively through experiential learning, learning in groups and on-farm research (ibid).

Thirdly, the focus of continuous learning has shifted from subject specific skills towards more generic skills, i.e., the capacities needed to continue learning (Tilbury 2011). A recent literature review found the vital skills for life-long learning in agriculture to be; systems perspective, knowledge integration, building and maintaining networks and learning communities, and subject-specific skills (Sørensen et al. under review).

Policymakers and researchers have responded to these needs. Several approaches fostering multi-actor learning, and co-innovation have been developed and implemented (Cerf et al. 2000; Fieldsend et al. 2021). However, it still seems difficult to find a robust and generic model proven to be effectively scaled up and out (cf. Wigboldus and Leeuwis 2013). Despite the substantial scientific evidence and policy efforts, there are still challenges to farmers'

involvement in continuous social learning at a general scale. According to Moschitz et al. (2015), many agricultural knowledge organisations are still locked into a science-driven linear paradigm of technology transfer. Oreszczyn et al. (2010) claim that the gap between scientific research and the support available to farmers is increasing, as research focuses on the scientific community and policymakers, rather than farmers.

These challenges call for a deeper understanding of the enablers and disablers of farmers' involvement in learning processes. In order to do this, we aim to critically investigate the structural conditions of farmers' involvement in continuous learning, and the role of innovation support services, such as advisers, in this. Advisers are being challenged by new expectations of handling interactions between heterogeneous actors, implying a paradigm shift from the transfer of knowledge to facilitators of knowledge development (Blackmore 2010; EU SCAR AKIS 2019).

To address this aim, we use the case of the horticultural industry in Sweden. Its focus on market competitiveness and the scarce resources for research and innovation make it an interesting case to employ for the investigation of the study's main premise. The study applies a practice based approach, focusing on people's recurrent activities that constitute their every-day social practices (Nicolini 2012). The concept of social practices offers a bridge between the structural conditions and the learning processes among involved actors.

The remainder of the paper is structured as follows. First, we frame the study with a brief overview of existing literature on the social dimensions of learning in an agricultural context. Secondly, the choice of case study is explained, and the methods for data collection and data analysis are introduced. The results of the empirical study are presented in the third section, followed by an analysis and discussion. Finally, we conclude our main results and provide suggestions for implications for practice and policy makers.

Social learning in an agricultural context

Learning - a social and participatory process

Collaborative, community-based and transdisciplinary learning, dialogue, and deliberation have long been described as desirable, even necessary, approaches to managing socio-ecological challenges (cf., Wondolleck and Yaffee 2000:23; Chang et al. 2020). This notion is based on findings in many fields; ideas about deliberation and participatory democracy (Dryzek 2010), the importance of local and tacit knowledge in sustainable natural resource management (McDonagh and Tuulentie 2020), the processes of experiential learning, adaptive management and institutional change (Rist et al. 2013), as well as interactive innovation and co-innovation (EIP-Agri 2015).

The practical arguments for farmers' involvement in knowledge development are many (Ljung 2001). Firstly, when developing management strategies adapted to site and cultivation-specific conditions, farmers' experiences are needed. Secondly, farmers have to be motivated, perceiving knowledge development as meaningful for them to participate in, learn and change their practices, and thirdly; one can argue that it is the farmers' democratic right to be able to participate in future policies and decisions that will affect their livelihoods. Collaborative processes might also be important for strengthening the individual farmer's social conditions, recognition and entrepreneurial skills (Nordström Källström and Ljung 2005; Ljung 2021a). Involving farmers and other stakeholders in social learning activities will contribute to the above-mentioned societal ambitions, but only if this involvement has certain qualities.

Farmers' experiential and social learning

To create the right preconditions for social learning, the basic principles for adult learning need to be considered. According to Vella (1994) there are 12 fundamental principles for adult learning, for instance, understanding the participants needs, a sense of safety, focus on praxis (action with reflection), immediacy of the learning outcomes, working with smaller groups, and accountability. It is the cumulative effect of all these principles that will allow dialogue to flourish and concrete measures to be implemented (cf. Daniels and Walker 2000). The creation of new knowledge is a continuous, spiralling conversation between explicit and tacit forms of knowledge (Nonaka 1994). Such learning hasthe ability to nurture and is necessary to facilitate new spaces organised for social learning (Wals 2007).

More specifically, five critical factors for learning in farmers' groups have been identified (Millar and Curtis 1997):

group autonomy,

effective facilitation,

the integration of information,

experiential learning and

ongoing relationships.

These factors are as valid and equally important when supporting social learning groups involving a broader range of stakeholders, such as farmers, advisors and researchers. Clearly, there is a strong foundation for approaches focusing on broad participation, systemic thinking and action, and critical assessment of existing social order; not least how scientists, advisors and farmers organize themselves and interact within the agri-food system.

It is important to keep in mind the fact that there is no one-size-fits-all approach to farmers' and other stakeholders' involvement. Different methods and tools must be prudently combined. In fact, learning and decision-making processes on complex issues will span different activities at different points in time (Ljung 2021b). Although adhering to some guiding principles (Brouwer and Woodhill 2016), the actual choices made regarding process design depend on the phase and goals of the anticipated work and the unique context.

Social learning for knowledge development and innovation

Raymond et al (2010) argue that many of the new approaches suggested aim to:

integrate knowledge held by academic researchers across disciplinary boundaries, and non-academic participants,

promote common understandings of shared problems and challenges,

utilise participatory research methods to enhance the validity of knowledge elicited in research and to increase the inclusion of stakeholders in decision-making,

implement iterative processes of knowledge creation and feedback to science or decision-making, and

integrate knowledge across a variety of spatial and temporal scales.

Successfully integrating different knowledge traditions, such as scientific and local knowledge, means putting research findings in a whole-farm context, along with integrating codified and tacit knowledge (Ingram 2008; Schneider et al. 2009; Sumane et al. 2018). Enabling experiential learning is supported by practical experiments, such as field trials, as they serve as a basis for discussion and learning (Hamunen et al. 2015; Prager and Creaney 2017). Finally, building and withholding strong relations among the actors is necessary for the sense of belonging and

commitment among both farmers, advisors and scientists (Röling and Wagemakers, 2000). Together, these factors enable the emergence of new communities of practice (Blackmore et al. 2010) with a focus on developing new knowledge and innovations.

Social learning resulting in co-production of knowledge between farmers, advisors and scientists is essential for jointly moving towards more sustainable agriculture (Schneider et al 2009). Farmers are empowered in groups, rather than individually (Dolinska and d'Aquino, 2016), as these groups provide motivation and a structural base for farmers to identify and deal with their own needs for new knowledge and innovation (Coutts et al. 2005). Hence, such groups can provide a basis for researchers' engagement with farmers around meaningful research projects, contributing to continuous learning as well as sustainable innovations.

Method

Case selection

Swedish horticulture is a small industry in an international context, its share in 2018 of European production being 0.8% of vegetables and horticultural products, and 0.3% of fruit (EU 2019). International pressure has caused horticultural farms to become larger, fewer, and more specialised (Statistics Sweden, 2020). There is, however, rising interest in small scale vegetable farming vying for consumer preferences for local produce (Drottberger et al. 2021).

Over the last few decades, the number of people working in horticultural advisory services and field trials in Sweden has shrunk significantly. Advisory services are currently private and restricted to a few regions and plant cultures. Supplier firms have increasingly taken a role as the knowledge partners of farmers (Yngwe 2013). At the same time, horticultural research has changed from being state funded to a partly industry financed knowledge market of fewer resources (von Bothmer et al. 2018). Only a few researchers still work with applied horticulture, as the incentives for researchers to engage with applied projects are insufficient (Glynn et al. 2018). The communication between advisory services and research organisations is generally low within the domestic agri-food system (OECD 2018).

In summary, the Swedish horticultural industry has an emphasis on market competitiveness and, at the same time, scarce resources for applied research and advisory services. This implies a high demand for new knowledge and innovation, yet with few resources to deploy, making it an interesting case for investigating this study's main premise.

Research approach

This study sets out from the claim that structures form human actions, as both physical and social structures influence human daily practices (Giddens, 1984; Nicolini, 2012). Reciprocally, these structures are shaped by the recurring activities of people, as human actions in turn affect structures (ibid). For example, farmers have both physical structures, e.g., farm size and soil types, and social structures, e.g., family members and employees, embedded in the make-up of their farm business. These structures influence the daily operations and practices performed at the farm, and vice versa.

The study employs a practice based approach, focusing on what people do on a daily basis, their recurrent activities that constitute their social practices. Social practices are seen as reappearing activities that are meaning-making, identity-forming and order-producing (Nicolini 2012). The study of practices reveal the meanings, motivations and implicit knowledge underlying human actions (Bueger 2014). However, as people carry out their daily social practices, space is always left for creativity and initiatives. Social practices constitute the

background against which people can take initiative and create new things, ideas and actions (Feldman and Worline, 2016).

To guide the collection of data, we used the concept of functions as a means of structuring the inquiry into the social practices connected to social learning and innovation. Functions can be defined as key sub-processes of the overall innovation process (Bergek et al. 2008). Several sets of functions have been assigned to agricultural knowledge and innovation systems, see Bachmann (2000:19) for an overview. In addition, several studies set in agricultural contexts have used the functional dynamics concept developed for technological innovation systems, by Hekkert et al. (2007) and Bergek et al. (2008). As a function can be carried out in many ways, it opens up the opportunity for the respondents to define it for themselves and thereby revealing the underlying meanings and motives of their practices.

Block no	Description	Questions	Sources informing the questions
1	Identification and articulation of possibilities or problems	How it usually happens, who is involved, incentives for doing this, etc.	Nagel 1980; Bachmann 2000; Hekkert et al. 2007; Bergek et al. 2008
2	Generation of new knowledge	Motives for doing this, how this is done, who is involved, etc.	Nagel 1980; Bachmann 2000; Hekkert et al. 2007; Bergek et al. 2008
3	Operationalisation of new knowledge	Motives for doing this, how is this done, who is involved, etc.	Nagel 1980; Bachmann 2000; Nonaka 1994
4	Knowledge exchange and dissemination	How this is done, what sources, if respondents share their knowledge, how, to whom, and why.	Nagel 1980; Bachmann 2000; Hekkert et al. 2007; Bergek et al. 2008; Rogers 2003
5	Creation of necessary resources for developing and testing new knowledge	How this is done, who is involved, and why.	Hekkert et al. 2007; Bergek et al. 2008
6	Guidance of the search	How do you know the direction in which you should develop your operations, what influences the direction of your attention. How this is done, who is involved, and why.	Hekkert et al. 2007; Bergek et al. 2008
7	Evaluation, monitoring of the work	Motive for doing this, how this is done, by whom, when.	Nagel 1980; Bachmann 2000; van Mierlo et al. 2010

Table 1. Overview of interview guide.

Data collection and analysis

The mapping of the focal practices was guided by the case study and approached through:

desk research of databases and documents, and identification of involved actors as a base for making an informed selection of actors for interviews.

The initial desk research included a thorough search in databases and revealed that vegetable production on arable land and fruit orchards accounted for nearly 75% of the total horticultural production area (Statistics Sweden, 2018), and constituted substantial parts of the research projects carried out in horticulture. The gathering of relevant reports and documents primarily gave an insight into the historical conditions leading up to the current situation. It served as a basis for creating a detailed picture of actors, networks, institutions and technologies prevalent in the fruit and vegetable sectors.

The actors selected for interview were identified on the basis of the initial desk research. The goal was to create a representative sample. The fruit and vegetable farmers where distributed in the south and west parts of the country, and were a range of experience levels, from newcomers to experienced growers. The following actors were interviewed in 2019-2021, see table 2.

Actor	Number of respondents	Main orientation	Regional/National
Farmer	12	Fruit (n=3) Vegetables (n=9)	South region (n=6) West region (n=6)
Advisor	5	Vegetables (n=5) (No domestic fruit advisor at the time)	South region (n=3) West region (n=2)
Producers' organisation/ farmers' customer	4	Fruit (n=2) Vegetables (n=2)	South region (n=3) West region (n=1)
Innovation coordinator	2	Both fruit and vegetables	South region (n=1) West region (n=1)
Researcher	7	Fruit (n=4) Vegetables (n=3)	National
Policymakers, national agricultural authority	4	Both fruit and vegetables	National
Farmers' supplier	1	Both fruit and vegetables	National
Farmers' union	2	Both fruit and vegetables	National

Table 2. Specification of interviewed actors (n=37)

All interviews were transcribed, read carefully, and fed into a computer based analytical tool. In the first round, the data were sorted according to an actor analysis. The actors' sources of

and practices related to learning and innovation were analysed in detail. This analysis was discussed in depth between the authors, and resulted in a second round of sorting of interview excerpts, cutting across the actor analysis and responding to some of the functions described in table 1.

Results

Identification and articulation of possibility or problem

The horticultural farmers were interested in new knowledge mainly concerning their production, such as plant protection, weeds, fertilising, precision farming and technology in general, new varieties, storing and packaging. Many of the farmers' needs emanate from market requirements, as customers and market actors had demands concerning what to grow, the quality and other properties of their products, delivery requirements and pricing.

The farmers articulated their ideas, problems and needs when appropriate, in contact with other actors such as their advisors and suppliers. In addition, a farmers' organisation developed a research strategy based on the ideas and opinions of their members, in order to clarify their research needs and hoping to influence research funding priorities. They also collect plant protection needs from their members yearly and communicate these to suppliers and advisers. Advisers and researchers referred to a general analysis of their surroundings for new ideas.

Generation and acquisition of knowledge

When farmers spoke about their search for new knowledge to develop their operations, neighbours and colleagues were often mentioned as important sources of knowledge and inspiration. Support from colleagues was especially pronounced when starting with horticultural crops (e.g., from those with previous experience of the agricultural crops), and when adding new crops or new production methods.

The farmers' experience of research contacts varied greatly. On the one hand, respondents voiced a perception that farmers do not have the time to think about research, as they are already fully occupied running their operations, and there is not much domestic research on horticultural production anyway. On the other hand, farmers who had their own experience of involvement in research studies or hosted research trials, were more positive towards such contacts. Although it was perceived as burdensome at times, they enjoyed the dialogue with the researchers and felt that useful results were gained.

The responding researchers reported that research grants were generally directed towards understanding the basic mechanisms of certain phenomena, rather than practice-oriented issues. In addition, working with research built on field trials is time-consuming and comes with several sources of uncertainty. Therefore, it was generally regarded as easier and safer to stay in the laboratory.

The use of research approaches that involve stakeholders, were regarded as interesting by the researchers, albeit time-consuming. Participatory approaches were said to work best if researchers could work in teams in order to maintain continuity and trust with the participating farmers. However, it was seen as difficult to find the funding needed for long-term team-work of practice-oriented research. Nevertheless, this quote illustrates the interest from the respondent in involving stakeholders in research projects.

"When you work with growers and advisers, and you see them all fired up by the joy of discovery /…/ that's probably why I´m still working with this." (Researcher 2)

One of the respondents had worked as a facilitator of several research projects with a participatory approach. While researchers usually look at a question in depth in order to

understand underlying factors, the farmer has the holistic role of putting the findings into the farm context. To include both views is a pivotal point, the respondent argued, for designing studies in a way that make concrete changes in farm practices possible. Furthermore, the adviser has an important role in participatory research approaches, as they have usually seen many farms and have a broad picture of how various things relate to different farm types. Moreover, advisers can play a key role in passing on new knowledge.

Operationalisation of knowledge

The researchers note that to operationalise research knowledge of basic mechanisms generally requires other types of funding sources than the traditional ones. This makes funding of practice-oriented research valuable in contributing to bridging the gap between research and practice. In addition, funding for practice-oriented studies can also be used for pilot testing or screenings that may constitute the basis for conventional research applications. However, the overall funding of horticultural production research is scarce.

Some advisers reported having good contact with researchers and good cooperation in specific projects. However, even those with good connections with researchers, reported a general lack of applied research. Much of their new knowledge was obtained from abroad, as domestic research is limited. Domestic field experiments are valuable as they provide regionally adapted knowledge as well as providing opportunities for the exchange of results with international advisory colleagues. Trial results from abroad cannot be directly translated to domestic situations, as the conditions may differ considerably.

The farmers' collegial relations were often referred to as cautious exchanges, where they were generally careful about sharing their knowledge with peers, due to market reasons. Despite this, organised peer-learning groups were seen as interesting. It was noted that peer-learning groups work best when someone knowledgeable, such as an advisor, leads the dialogue and facilitates learning.

"They [the facilitators] were important because they were very committed. Without them, it would not have worked /…/ In order for farmers to communicate well with others, they need learning groups like these because that is when everyone is tuned in to talking, exchanging and networking." (Farmer 4)

The quote illustrates the vital role of facilitators - in this case two advisers - of farmers' peer-learning groups, in order to create an open, sharing environment.

However, peer-learning groups were reported to be less common than previously. The reasons mentioned were fewer horticultural farmers, a perception of competition between farmers, or just the lack of anyone initiating a peer-group. The existing peer-learning groups were initiated mainly by farmer and producer organisations, or advisers.

Farmers who were members of the same producer organisation reported a more open attitude towards sharing experiences with each other, and that producer organisations encourage exchange between growers with similar cultivations, organise field excursions and study visits abroad. Generally, producer organisations do not provide their own advisory services, but there are some exceptions to this.

Knowledge exchange and dissemination

The previous state funded extension service with 40 horticultural specialists deployed across geographical regions and areas of expertise, was terminated in the 1990s. Private horticultural advisory services have been built up gradually over the last few years and are now available in the southern and western region for a few cultivations. The development towards larger and more specialised horticultural farms places higher demands on advisors. While domestic

advisors are well acquainted with national conditions, legislation and regulatory compliance, international advisory services bring in comparisons to other countries.

The responding farmers reported talking to suppliers of seed, fertilisers, plant protection and equipment on advice related to the use of their products. The dialogue with suppliers was more pronounced in connection to large investments, or when the relationship was long-term. The supplier reported seeing their role as helping farmers to solve problems, rather than just selling.

Small-scale horticultural farmers, such as market gardeners, lacked advisory services altogether. They use informal peer networks, social media and the internet as important knowledge resources. A responding small scale farmer stated that he had set a clear intention from the start to foster a sharing attitude in his networks. He reasoned that farming at this very small scale is often an ideologically driven business, which makes people more open to sharing their knowledge freely. He also described growing demand as positively influencing attitudes towards knowledge sharing.

Analysis and discussion

This study uses a practice-based approach to investigate the structural conditions of farmers' involvement in continuous social learning and the role of innovation support services in this. To start with, while farmers continuously search for ways to improve their production, they were only ad hoc involved in social learning settings. The social learning opportunities were mainly represented by advisory and supplier contacts, and there was limited availability of peer-learning groups or involvement in research projects or field trials.

Advisers worked hard to keep up and develop their knowledge, with the aim of building and providing knowledge and advice on a commercial basis. They recognised the potential in multi-actor approaches. However, the existing advisory services were limited to certain regions and cultivations, and the resources for multi-actor modes of working were scarce.

While several of the responding researchers prioritized or would like to prioritize practice-oriented and participatory research approaches, they found themselves restricted by funding opportunities and incentives that push for scientific publications. There were structures that promote practice-oriented and multi-actor research and development efforts, such as intermediary organisations and advisors that work to link research and practice. Nonetheless, these structures have neither the resources nor the mandate to engage horticultural farmers in continuous social learning, at a general scale. Hence, the organisational division and differing incentives restrained the fostering of social learning and collaboration between actors more broadly.

While the social practices of the involved actors diverge, they also contain areas where interests aligned, or could be made to align. One such area is issues concerning improved field production, and this is where social learning and collaboration can be developed. Collaboration efforts need to start from the social practices of those involved. There is a need for building on existing practices, and implementing new ones where necessary, hence forming social learning practices.

The first step would be for actors to meet, as joint exploratory dialogues lay the foundations of collaboration between diverse actors. As peer-learning groups were perceived as having considerable learning potential, and the need for useful field trials has been emphasised, these can be part of a possible pathway forward. The role of innovation support services, such as advisors, is vital as they could carry the role of actively and purposefully facilitating such groups. Researchers and suppliers could be connected to the groups as resources.

Conclusions

The aim of this paper was to critically investigate the structural conditions of farmers' involvement in continuous social learning, and the role of innovation support services in this. Based on database searches, documents and interviews, the results illustrate the social practices of actors with differing motives and incentives, where multi-actor meetings rarely seem to happen. The results indicate a need for new approaches to farmers' continuous learning in multi-actor settings, and the vital role of advisory services in enabling this.

Using social learning processes as a means to not only manage complex issues and knowledge development but also to improve possibilities for continuous and lifelong learning among farmers has great potential. We suggest the creation of learning communities where farmers have a leading role, facilitated by advisors, supported by researchers, and including other relevant actors, such as suppliers. Field trials and practical experiments are suggested to act as organising devices, around which dialogues of joint learning and meaning making can be centred. Such groups can provide a basis for researchers' engagement with farmers around meaningful research projects.

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TRANSDISCIPLINARITY IN AGRO-ECOLOGICAL RESEARCH: AN EVALUATION FRAMEWORK

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Abstract

Acknowledging that sustainability issues demand new ways of knowledge production, the UNISECO H2020 project employs a transdisciplinary research approach in order to strengthen the sustainability of agro-ecological European farming systems. Transdisciplinarity is mainly performed through the Multi-Actor Platforms (MAPs), which are seen as the mechanism that brings together the project team and non-academic actors to encourage knowledge sharing and co-learning through participatory processes carried out in project's duration. The MAPs are established at the EU and the local (case study) levels aiming at co-constructing practice-validated strategies and incentives for the promotion of improved agro-ecological approaches. This paper is an attempt to review existing literature on the evaluation of transdisciplinary and participatory approaches in order to develop a monitoring and evaluation framework for assessing the process and outcome of interactions with the MAP members.

1. Introduction

The concept of sustainability demands an integrated and holistic way to address the interconnection between the biological systems and their physical environment, taking into consideration the social and economic factors that influence them (Blackstock et al., 2007). For this purpose, sustainability science uses practices, such as transdisciplinary and participatory research approaches that enable researchers of various disciplines to work together and collaborate with non-academic actors in order to solve complex sustainability problems (Lang et al., 2012). In a recent literature review (Holzer et al., 2018), focusing on how transdisciplinarity is defined in the context of socio-ecological research, transdisciplinary research is summarized as follows:

addresses real-world problems recognized at the same time by science and society (Hirsch Hadorn et al., 2008),

goes beyond distinct disciplinary concepts and theories (Klein, 2010),

incorporates academics and non-academics knowledge and experiences using usually participatory methods (Lang et al. 2012),

is critical and reflexive (Jahn & Keil, 2015).

As the most important characteristic of transdisciplinary research is the active involvement of the non-academic actors, Blackstock et al. (2007) describe participatory research as "participants collaborating to problem solve and produce new knowledge in an ongoing learning and reflective process". Such research approaches facilitate mutual learning processes among all actors involved, encouraging thus the co-creation of knowledge (Lang et al., 2012).

Focusing on agricultural research in the European Union (EU), sustainable management of natural resources, food security and economic viability of the farming sector are considered as important societal issues. In the policy context, the European Commission (EC) aims to address these major challenges faced by the agrifood system through the contribution of the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI), which has been established as a new way to foster innovation in agriculture and enhance the

competitiveness and sustainability of European agriculture (EC, 2012). In this regard, it follows an interactive innovation approach which links science and practice, encouraging the co-creation of knowledge via meaningful collaborations between researchers and concerned actors, e.g. farmers, advisors, businesses, NGOs, etc. (EC, 2016). The Horizon 2020 research framework programme (H2020)[7] supports this interactive innovation model through the implementation of the Multi-Actor Approach (MAA) research projects in which various end-users and practitioners are truly engaged throughout the project's lifetime (EIP-AGRI, 2017). Furthermore, several calls of H2020 stimulate transdisciplinarity in projects which brings together knowledge from different disciplines and integrate it considering societal experiences as well (EC, 2017).

Nevertheless, participants' involvement and interaction in research processes may vary. Thus, Brandt et al. (2013) point out that one of the challenges transdisciplinary research has to address is the engagement of practitioners from outside academia. They acknowledge four different increasing levels of practitioners' involvement, from information through consultation and collaboration towards empowerment, in which practitioners have the power and control to influence decision making. Accordingly, the knowledge generated through the interaction between the various scientists and societal actors in transdisciplinary research can be differentiated into four levels, "one-way information" when information is transferred only by one side; "mutual one-way information" when information is transferred by both sides at the same time; "collaborative research" when shared new knowledge is generated through knowledge exchange; "joint decision-making" when scientists and actors interact also with policy and decision makers (Wiek, 2007). Based on the Arnstein's (1969) Ladder of Participation and OECD (2004) typology of public involvement, Blackstock et al. (2007) deem participatory research as the processes throughout which stakeholders have the capacity to shape what affects them and develop solutions (upper categories in the ladder, i.e. delegation and support).

Taking into account the benefits of genuine actors' engagement, the EU research project "UNderstanding and Improving the Sustainability of agro-ECOlogical farming systems in the EU" (UNISECO) uses transdisciplinary processes fostering collaboration work with various non-academic actors during the course of the project in order to better understand the socio-economic and policy factors that hinder or enhance the transition towards agro-ecological farming systems in EU. UNISECO aims to strengthen the sustainability of EU farming systems, through co-constructing practice-validated strategies and incentives for the promotion of improved agro-ecological approaches, as such approaches may contribute to sustainable agri-food system ensuring sufficient and safe food production as well as the provision of vital public goods (FAO, 2018).

A specific Work Package in UNISECO dedicated to multi-actor engagement aims mainly to develop and test new transdisciplinary methodological approaches in policy research and analysis as well as to interpret societal expectations using participatory processes with stakeholders and end users. The collaborative learning between science and stakeholders is facilitated through the Multi-Actor Platforms (MAPs) or in other words the pools of relevant actors who are engaged in the various scientific activities of UNISECO.

The establishment of a monitoring and evaluation framework that guide the steps for assessing the performance of MAPs and the efforts made through the participatory approaches for knowledge co-construction and co-learning are explored in this work-in-progress paper. The paper consists of the following: starting with a review of literature on evaluation of the

[7] Horizon 2020 is the Framework Programme for Research and Innovation for 2014-2020 funded by the European Commission https://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020

transdisciplinary and participatory approaches; the transdisciplinarity approach in UNISECO along with the selection of relevant evaluation criteria to project's objectives are then presented; the results of the first pilot application to a project activity associated with the MAP members at the EU level are provided. The paper concludes by identifying future steps of the framework in order to ensure that dialogue and collaborative learning within MAPs are promoted.

2. Transdisciplinarity in UNISECO

The ambition of the UNISECO project is to co-construct with stakeholders and end-users improved, practice validated strategies and incentives for the promotion of agro-ecological farming systems (AEFS) in the case studies in the 15 partner countries.

UNISECO employs a transdisciplinary research approach which is performed through three key mechanisms: 1) the consortium composition, 2) setting up networking and knowledge sharing platforms and 3) the inclusion of participatory methods in all project phases. In particular, the composition of the consortium includes researchers who come from different backgrounds and scientific disciplines (humanities, social and natural science) as well as partners from non-research organisations. The most fundamental element of the transdisciplinary character of the UNISECO project is the inclusion of individuals external to the consortium who are drawn from multiple non-academic organisations (such as farmers, advisors, processors, environmental stakeholders and policy makers). This ongoing involvement is performed through the MAPs, i.e. one EU level and 15 local (at each case study area) pools of key actors associated with AEFS. The aim of the MAPs is to open two-way exchange of ideas for co-learning and co-creation of knowledge through participatory processes in various intersection points throughout the project's duration.

Besides the MAPs, two other mechanisms facilitate knowledge exchange within UNISECO: 1) the Project Advisory Group (PAG), consisting of external experts who provide guidance and advice on the central scientific scope, and 2) the Stakeholder Reference Group (SRG) formed by representatives from case study MAPs expressing local stakeholder's views on overall project activities.

The UNISECO project attempts to ensure that through engagement processes, the real needs on the ground are met, as well as that the different types of knowledge are incorporated into all stages of research and dissemination. Subsequently, the multi-actor approach is driven by specific guidelines and criteria in order to increase project's impact and co-develop innovative practical solutions. Firstly, all project partners identify and select potential individuals for joining in the MAPs according to a set of predetermined criteria that assess them against their interest, availability, relevance, appropriateness, representativeness and willingness (Budniok et al., 2018). Furthermore, project partners are guided and advised on how to meaningfully interact with MAP members as well as how to design and carry out participatory activities that may support exchange of knowledge and experiences among the various actors (Irvine et al., 2019).

All the aforementioned illustrate the structures of UNISECO to facilitate engagement and collaborate with various actors, so that project results are co-generated and practically utilised by the relevant societal actors. For this reason, the transdisciplinary approach of the UNISECO project is completed with the monitoring and assessment of mechanisms and approaches used throughout the course of the project.

3. Monitoring and evaluation framework

3.1 Literature review

The overarching objective of the multi-actor engagement in UNISECO is to develop a monitoring and evaluation framework for assessing the project activities in which non project actors are involved. For this purpose, it was considered necessary to review the literature on evaluation of the transdisciplinary research and participatory approaches relevant to sustainability and socio-ecological systems in order to identify and select appropriate evaluation criteria and methods for measuring project activities which engage non project actors with respect to achieving their purposes and giving constructive feedback for improvement.

Although the transdisciplinary approach is advocated by funders as well as researchers, the literature doesn't provide guidance on how to design, implement and measure research that use transdisciplinary and participatory approaches (Blackstock et al., 2007; Lang et al., 2012; Holzer et al., 2018). Additionally, the evaluation of transdisciplinary research is considered complex (Klein, 2008), since it has to integrate knowledge from various disciplines, develop dynamic methodologies that are context and problem-specific and involve non-academic actors (Carew & Wickson, 2010). It is argued that these challenges have delayed the progress in developing widely approved criteria for judging the quality of transdisciplinary research and define when transdisciplinary research is successful (Jahn & Keil, 2015). Since the specific characteristics of the transdisciplinary research and how it is implemented determine the criteria for its evaluation, many papers first define transdisciplinary research (e.g. Jahn & Keil, 2015; Holzer et al., 2018; Bergman et al., 2005; Lang et al., 2012).

Based on the literature review, some scholars are interested in developing frameworks for evaluating transdisciplinary or participatory research (e.g. Blackstock et al., 2007; Hassenforder et al., 2016), while others deal with the quality of transdisciplinary research proposing guidelines and specific quality criteria (e.g. Lang et al., 2012; Bergman et al., 2005; Jahn & Keil, 2015).

Blackstock et al. (2005) have developed an elaborate framework that illustrates the significant characteristics of the evaluation concept. The framework emphasises that the timing, purpose and focus determine the different types of evaluations, providing a comprehensive list of suitable evaluation criteria compiled from literature in order to measure the research process, outcome and context. The evaluation methods (interviews, surveys, document analysis, media analysis, observation, field notes, cost benefit analysis, impact assessment) should be context-sensitive and their choice depends on the objectives and focus of the research project, but also on the timing, purpose and focus of the evaluation. The framework was applied to a post summative evaluation of a regional sustainability project in Australia, involving a broad spectrum of participants aiming to reflect on the outcome and the learning aspects.

In line with Blackstock et al. (2005), the study of Hassenforder et al. (2016) deals with the challenges faced, when selecting and implementing methods, in order to monitor and evaluate participatory processes in the field of environmental or natural resource management. It is argued that a plethora of qualitative and quantitative methods should be considered for use (baseline studies, stakeholder analysis, attendance lists, questionnaires, semi-structured interviews, participants' expectations before and after the workshops, participants' observations by the evaluators, etc.) in order to ensure a wide range of data collection and data triangulation. The authors develop a framework for the monitoring and evaluation of a participatory process in Uganda, suggesting how to combine methods that are mixed,

qualitative and quantitative, static and adaptive, theory-based and participant-based, process and outcome-oriented.

Nevertheless, among evaluation methods, the written questionnaires and interview-based surveys seem that are commonly applied due to clarity, flexibility and easiness of their use (Holzer et al., 2018).

To fill the gaps in literature, Walter et al. (2007) focused only on the evaluation of the societal effects of transdisciplinary research projects, which are related to the knowledge and decision making capacity that stakeholders may gain through their involvement in the transdisciplinary process and their collaboration with the scientists. Authors proposed a model which was applied in an ex-post evaluation of a transdisciplinary project (two years after its completion) taking a quantitative statistical approach to test the relation between the three types of social effects, i.e. outputs, impacts and outcomes. The correlation between project's involvement and the social outcome of increased decision making capacity of stakeholders was found to be statistically significant and is especially mediated through the social impacts of the network building and the use of transformation knowledge.

The benefits of stakeholder participation in environmental decision-making are discussed in a comprehensive review paper by Reed (2008). It is claimed that the decisions made by stakeholders are influenced by their engagement process, highlighting thus practice principles and key criteria that may lead to effective stakeholder participation.

On the other hand, Lang et al. (2012) presented a set of design guidelines for transdisciplinary research in sustainability science, presenting a conceptual model of how an ideal–typical transdisciplinary research process can be planned and carried out. Based on the conceptual model, they distinguish three different phases in transdisciplinary research process: (A) recognition and structure of the problem as well as the composition of the research team that should develop a common understanding of the problem addressed, (B) joint creation of knowledge which is transferrable and solution-oriented through synergistic research work, and last, (C) implementation, review and adjustment of the project results taking into account their practical use for the society and science. For each of the three phases, they formulate a set of design principles for transdisciplinary research along with relevant guiding questions that could be subject to evaluation, providing thus support to the research team and practitioners for successful research. They put emphasis on the necessity for a continuous formative evaluation, i.e. evaluate the process of operating and progressing a project in a reflexive way providing useful information and ongoing feedback in order to revise and improve learning and research quality. In this concept, Bergman et al. (2005) developed a long list of specific and detailed evaluation criteria which are arranged according to the project timeline for assuring the quality and examining the success throughout the course of a project.

Additionally, the study by Jahn & Keil (2015) is concerned with the quality assurance of transdisciplinary research that deals with policy making for sustainable development. Since the quality of transdisciplinary research is dependent on the collaboration and shared learning between the scientists and non-scientific actors, transdisciplinary research processes should pay attention to the integration of knowledge, perspectives, needs and values of the different actors involved, i.e. researchers, program managers or donors, and policymakers.

In general, evaluation methods and criteria should be tailor-made to project's aims and context, as well as all individual objectives, expectations and interests. When evaluating transdisciplinary approaches, emphasis should be put on the various opportunities for knowledge creation and the involvement of the external actors in the research process, the conditions of building trust, collaboration and mutual understanding, as well as the practical applicability of the outcome.

3.2 Towards an evaluation framework

The findings from the literature review have been synthesised and adjusted to the UNISECO purposes in order to develop a monitoring and evaluation framework primarily aiming to assess the performance of the MAPs in promoting co-learning and capacity building of key stakeholders at EU and local levels. In addition, there is a need to evaluate the process per se on the one hand and reflect on project teams' performance during this process, on the other hand. Consequently, the framework focuses on the project activities in which MAPs are involved, aiming to assess the process and outcome of the various transdisciplinary and participatory activities carried out during the project. Thus, the overall objective is to conduct an ongoing evaluation that critically analyses and examines the quality of the activities and point to the positive and negative aspects of their implementation, so as to adjust and improve both the approach and the team's performance for the research activities to follow.

The monitoring and evaluation framework addressed the following aspects:

assess the effectiveness of the project activity in which the MAPs' members were involved by examining whether it succeeded to engage the participants and accomplish its intended objectives and outcomes;

check whether the method of engagement used was appropriate and successful, whether the phases of preparation and execution process of the research activity were well organised;

appraise the degree to which the activity promoted transdisciplinarity and increased mutual learning.

Consequently, the evaluation procedure attempts to answer the following key questions:

Did the research activity reach its target groups?

Did the MAP engagement meet its objectives and achieve the intended outcome?

What worked well and what constraints/difficulties occurred through planning and implementation processes?

Did it promote mutual learning among different participants and co-construct knowledge?

What were the lessons learnt, for the project team and participants involved?

What should be changed for future activities?

For the purposes of the project, relevant evaluation criteria drawn from the literature review are compiled and grouped into three sets applying to the different phases of the research activities: preparation, implementation, post-implementation. The criteria are mainly adapted from Blackstock et al. (2007), who present a detailed list of criteria used for the evaluation of participatory approaches (e.g. relevant papers focused on stakeholder participation are Rowe & Frewer, 2000; Richards et al, 2004; Grant & Curtis, 2004), and combined with similar criteria other scholars have proposed (Walter et al., 2007; Hassenforder et al., 2016; Holzer et al., 2018; Reed, 2008).

Concerning methods, a combination of qualitative and quantitative methods is used in order to ensure that information from multiple perspectives, i.e. project and non-project partners, is gathered. Methods include observation and reporting/debriefing sheet filled by project partners and feedback questionnaire requested from participants.

Given that the MAPs' members are continuously engaged in all project phases, the UNISECO team was cautious and avoided engaging external participants also in designing the evaluation

process, particularly in the initial stages, i.e. for selecting evaluation criteria, as this activity would increase the risk of stakeholder fatigue.

3.3. Operationalisation of the evaluation framework

The evaluation criteria cover the steps of preparing and conducting the research activities in which the MAPs members have been involved as well as the MAP members' feedback on the effectiveness of the outcomes. The sets of evaluation criteria suggested to be applied to the UNISECO evaluation are summarised in the following table (Table 1).

Evaluation Criteria Set		
Operational	Process	Outcome
Participants' profile	Representativeness	Network building
Design of the process	Access to resources	Capacity building
Level of involvement	Group dynamics	

Table 4. Suggested evaluation criteria for the UNISECO project

3.3.1 Operational criteria set

A debriefing/reporting sheet to be completed by project partners was designed to provide quantitative and qualitative information about:

Participants' profile: number of stakeholders engaged in the activity, categorized by gender, age, professional background, geographic location, etc.

Design of the process: Description of the activity's preparation and participants' identification and selection establishing transparent and objective justification of who is involved in the research activity and how the activity was planned and executed.

Level of stakeholder involvement: The consistency and loyalty in participation for each MAP member, in case of multiple project activities.

3.3.2 Process criteria set

At the end of group project activities (i.e. focus groups, workshops), questionnaires are distributed, detailing the feedback and perceptions of participants involved about the activity process in relation to representativeness, access to resources and group dynamics.

Representativeness: When a participatory process takes place, it is crucial to ensure that representatives of the key stakeholder groups are involved in the activity and viewed as legitimate, so that diverse viewpoints, interests and values are considered.

Access to resources: Access to relevant and appropriate to the research context information allows participants to effectively participate in the research activity. In addition to adequate information, enough time for interaction should be given ensuring effective facilitation.

Group dynamics: Referring to participants' ability and opportunity to participate and influence the process, outcome and others, thus effectively collaborate and learn from their involvement in the research activities. Participants should follow the principles for involvement in the MAPs including aspects related to respect, sharing, listening, attention and teamwork.

3.3.3 Outcome criteria set

Questionnaires are completed by participants who are actively and continuously involved in group research activities (focus groups, workshops), providing their feedback on the effectiveness of their engagement and their satisfaction. Questions of this criteria set are usually relevant at the latter stages of the project, since they focus more on the influence of the overall project activities on participants' capacity.

Network building: Referring to size and strength of networks and relationships that improve professional opportunities. When existing social networks are strengthened, new ones and collaborations are developed as a result of the involvement in the project.

Capacity building: Referring to change in knowledge, skills, relationships, understanding, trust that enable participants to take part in future processes and projects. When participants experience some transformation in their knowledge, skills, viewpoint due to their involvement. When project results meet the needs of stakeholders and can be used by them in everyday context, leading to a sense of ownership of project results.

4. Pilot application of the monitoring and evaluation framework

The proposed monitoring and evaluation framework was first applied in the stakeholder workshop carried out in May 2019, in the framework of the 1st annual meeting of the UNISECO project in Helsinki, Finland. The specific workshop has served as a pilot in order to get feedback from non-project attendees testing the evaluation questionnaire for participants (work in progress). The evaluation questionnaire (see Appendix) is mainly divided into three parts, trying to elicit information from attendees on issues related to the access to resources, representativeness and group dynamics. The questionnaire comprises 16 questions asked in a five-point Likert scale format ranging from 'strongly disagree', to 'strongly agree', encouraging respondents to add their comments against each question so that further information is provided.

The workshop was mainly composed of three different sections having presentations, discussions in small groups and plenary sessions, aiming (a) to validate the typology for agro-ecological farming systems and the case study selection; (b) to review the modelling framework for assessing the sustainability of agro-ecological farming systems at territorial level; and (c) consult with the external actors the key themes for the first set of policy briefs.

Apart from the UNISECO consortium partners, 14 members of the different groups, PAG, EUMAP and SRG that complement the project team, attended the workshop. After the end of the workshop, evaluation questionnaires were sent by email to all external attendees.

5. Evaluation results

5.1 Profile of the respondents

Out of the 11 external stakeholders who completed the questionnaires, four were grouped as EUMAP members, four as PAG members and three as SRG members. The stakeholders included representatives of local and EU-level farming and producer organisations, environmental NGOs, ministries, EU-level networks commissioned by DG Agri as well as social and natural scientists covering different disciplines. Among them, there were six males and five females coming from across Europe, thus having a good balance concerning the gender and geographical distribution. In relation to the professional background, most of them identified themselves as researchers/professors in various faculties of agronomy and environmental

science (six respondents), while all of them seem to be knowledgeable about sustainable agriculture.

5.2 Access to resources before the meeting

Attendees were asked to rate the level of agreement or disagreement with statements about the clarity, relevance and helpfulness of background information provided before the workshop (Figure 1). The majority of the respondents strongly agreed that when they were invited, they were informed about the objectives of the workshop in a clear way (7 respondents), while information was relevant to the issues raised during the workshop (6 respondents). Nevertheless, three respondents commented that they received the agenda just a few days before the meeting, thus they didn't have adequate time to prepare themselves. Moreover, although the information corresponded well with the workshop's agenda, some respondents found that it was not complete, as it didn't cover all issues raised at the meeting, while earlier involvement of some attendees helped them to become more familiar with project's issues.

5.3 Access to resources during the workshop

Almost all participants responded positively that the objectives of the meeting and their role were clearly explained to them at the beginning of the workshop (Figure1). Nevertheless, one SRG member expressed that their role during the workshop was not specified so one didn't know exactly what to do, "*to give opinions or be silent and learn*".

Concerning the workshop content, the outcome of the analysis suggests that it fulfilled the needs and interests of the majority of attendees (9 positive responses). Although two respondents remarked that the workshop topics were not close to their work, the respondents perceived that their contribution was useful.

Although there was a tight agenda and a large group of attendees, almost all of them responded that there was enough time allowed to express views and pose questions (9 positive responses). Nevertheless one EUMAP member felt that the workshop's duration should have been for half a day more, and one SRG member argues that it is more important "*to offer quality time and comfort*".

Finally, concerning the role of facilitators, nearly all respondents (10 out of 11) agreed that facilitators were active in ensuring a good flow of the discussion expressing positive comments about them.

5.4 Representation of interests and interest groups

Three of the respondents indicated that the representation of stakeholders was not ideal, while five of the respondents expressed that some groups of relevant stakeholders should have been also present at the workshop (Figure 1). Comments received focused on the absence of farmers' representation as well as of any policymaker and on the other hand on the dominance of some male researchers and academics, thus there was overrepresentation of opinions and interests. Moreover it is stressed that people feel more comfortable to express themselves in small group discussions rather than plenary sessions.

5.5 Group dynamics during the workshop

With very few exceptions, all respondents fully agreed that they could trust the team members, they had been always given opportunities to express their viewpoints and felt comfortable in sharing them, while everybody was open to constructive criticism (Figure 1). Nevertheless, it

should be stressed that one SRG member mentioned that the lack of expertise in technical issues inhibit active participation.

Figure 1 depicts the answers given by the 11 respondents to the 16 Likert scale questions (Q1-Q16).

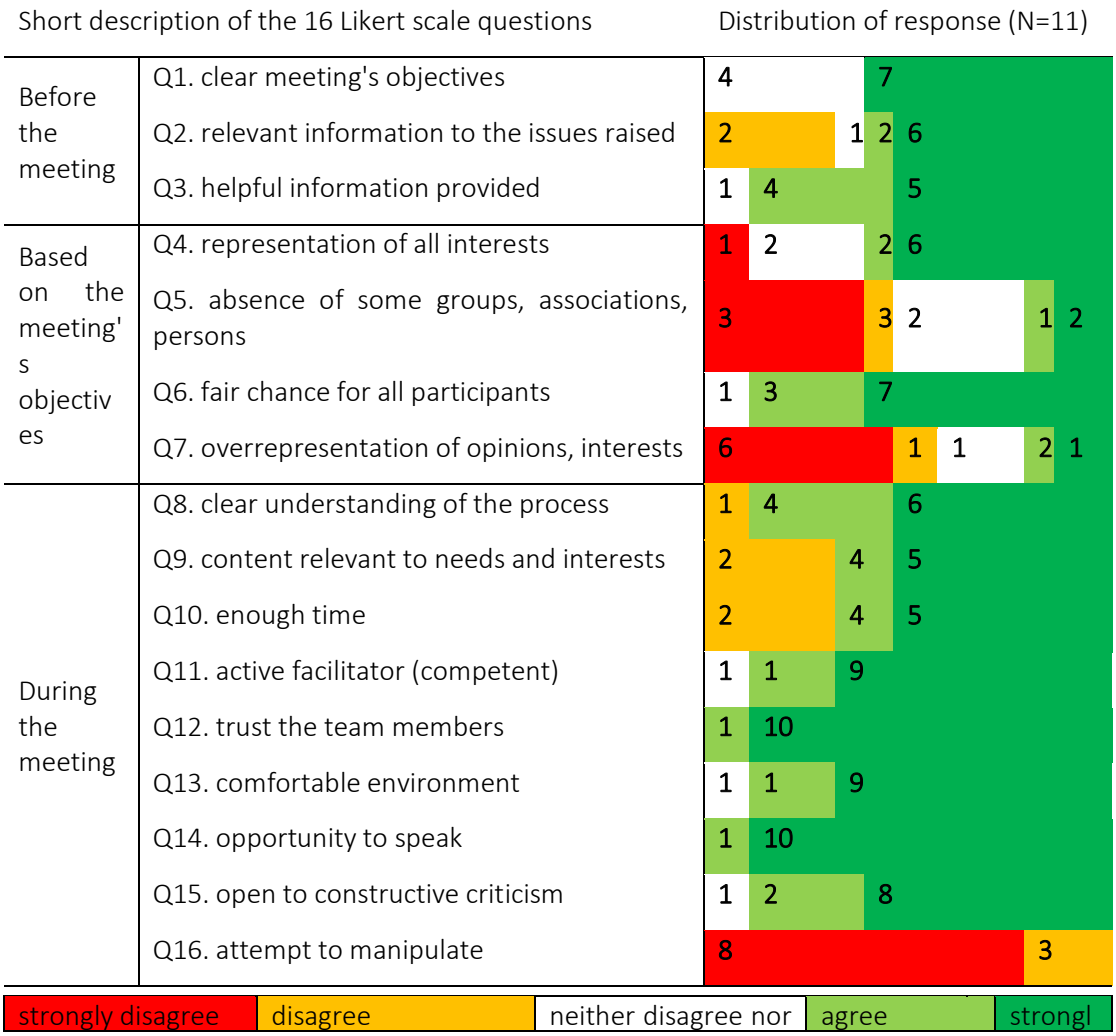

Figure 4. An overview of the distribution of the respondents' answers[8].

5.6 Contribution of the MAA to the workshop objectives

The specific objectives of the workshop were to discuss the coverage of the UNISECO case studies of agro-ecological transitions and to demonstrate and consult on the assessment tools at farm and territorial levels.

Detailed demonstrations of the different assessment tools took place in small groups during the workshop. Participants were actively discussing the functionality and strengths and weaknesses of the different tools, jointly identified key aspects that are covered by the tool as well as suggested additional aspects (e.g. in relation to quality of life and well-being of farmers) that could be assessed. Replies to the questions 8 – 15 covering aspects of active involvement, trust, listening and learning indicate that some level of co-learning and co-construction was

[8] Numbers in the cells indicate the number of respondents, whereas the different colours represents the range from strongly disagree to strongly agree.

achieved (Figure 1). This is supported by individual feedback of participants (e.g. "*There was clearly on-going co-construction of approaches in several areas and this seemed very welcomed*"; PAG member). However, the feedback from the participants also suggests that the involvement of missing types of key actors and more time for preparation would have further enhanced successful co-learning and co-construction during the workshop.

6. Conclusions

Although the H2020 MAA projects are highly welcome and increasingly funded by the EC, literature doesn't provide adequate guidance on how to design, implement and measure projects that use transdisciplinary and participatory approaches. Based on a literature search, although not exhaustive, a set of methods and criteria can be derived in order to develop a monitoring and evaluation framework that will aim to assess activities in which various stakeholders are involved. For this purpose, relevant evaluation criteria based on the literature review were compiled and grouped into three sets that describe the different phases of the research activities: preparation, implementation, post-implementation. This work-in-progress paper presented some initial results based on the pilot evaluation conducted through a participants' questionnaire which was tested in the framework of the 1st stakeholder workshop of the UNISECO project.

Taking into account the evaluation feedback, the following key points seem to be essential in order to actively involve non project partners in a two way knowledge transfer process:

External actors need to be aware of their role during the meetings, having beforehand background information in order to be well prepared.

Apart from academics and researchers, other interest groups, especially farmers' representatives should be engaged in the meetings.

The presentations and discussions during the meetings should be adjusted according to the audience's level of expertise and knowledge.

Plenary sessions and small group discussions seem to be a preferred combination of methods for the workshops, trying to ensure a balance of conditions in terms of gender, profession and expertise.

Overall, the experience confirms that a well prepared and animated participatory workshop approach leads to better workshop results and lessons learnt have been derived for future project workshops.

The questionnaire will be further tested and the proposed monitoring and evaluation framework should be seen as a learning exercise. The feedback from the workshops participants' along with experience gained from designing and implementing participatory activities will help the project team to revise and make improvements.

7. Acknowledgements

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9. Annex: Participants' Questionnaire

Activity/Task:

Code: [……]

Gender: Female Male

Professional background:

Origin:

Please indicate the level of agreement or disagreement with the following statements, we would really appreciate a brief explanatory text with your evaluation.

	Strongly disagree	Disagree	Neither agree nor	Agree	Strongly agree	Comments
Based on the information that was given when I was invited…						
1. The objective(s) of the meeting was/were clear to me.	①	②	③	④	⑤	
2. The information was relevant to the issues raised during the	①	②	③	④	⑤	
3. The information helped me understand the issues at stake	①	②	③	④	⑤	
Considering that the [theme, objectives, ….] of the meeting was/were [……..]						
4. I think that all interests have been represented in today's	①	②	③	④	⑤	
5. I think that there were groups, associations, persons	①	②	③	④	⑤	
6. I think that all participants had a fair chance to express their	①	②	③	④	⑤	
7. I think that there was overrepresentation of opinions, interests	①	②	③	④	⑤	
During the meeting						
8. When today's meeting started, the objectives of the	①	②	③	④	⑤	
9. The content of the meeting was relevant and consistent to my	①	②	③	④	⑤	
10. There was enough time allowed to express views and pose	①	②	③	④	⑤	
11. The facilitator was active in ensuring a good flow of the	①	②	③	④	⑤	

12. I felt that I could trust the team members with whom I	①	②	③	④	⑤
13. I felt comfortable in sharing my viewpoint.	①	②	③	④	⑤
14. I had always the opportunity to express my point of view	①	②	③	④	⑤
15. I felt that all participants were open to constructive	①	②	③	④	⑤
16. I felt being manipulated by powerful participants	①	②	③	④	⑤

Other comments, issues you would like to mention

IMPROVING FARMING ADVISORY SERVICES TO STIMULATE DEVELOPMENT OF SUSTAINABLE AGRICULTURE

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Abstract

European agriculture faces several sustainability issues that require various types of innovations (technological and social). Farming advice and farming advisors play in important role in this innovation process. This paper is based on the ongoing EU funded AgriLink project that develops new insights in how farming advisory systems (FAS) can operate to assist farmers in addressing the new challenges that they are facing. This also raises new challenges for advisory services that target the farm level, including the governance of advisory services at regional and national levels, the overall coordination of the system and the types of innovation that are at stake.

The research is based on an analytical framework that integrates concepts that operate at different levels, including the farm level, the wider agricultural system (the innovation environment), and policy and institutional environments. For each of these levels, the project analyses its role in the innovation process with a specific focus on sustainability issues in a set of eight domains of agriculture ('innovation areas'). An integrated assessment of all these factors is facilitated by the use of several frameworks, including the triggering change model, the multilevel perspective (MLP), and insights from organisational learning. The analysis is based on case studies from thirteen countries across Europe which allows the analysis at each of the indicated levels for various agricultural domains in different innovation contexts.

Introduction

Farming advisory systems

European agriculture faces several sustainability issues that require various types of innovations (technological and social). The development and further uptake of innovations takes place in a situation of increasing plurality within Agricultural Knowledge and Innovation Systems (AKIS) and Farm Advisory Systems (FAS). This raises new challenges for advisory services that target the farm level, including the governance of advisory services at regional and national levels, the overall coordination of the system and the types of innovation that are at stake.

This paper develops new insights in how FAS can operate in the changing AKIS to assist farmers in addressing the new challenges that they are facing. The paper is based on research within the EU-funded AgriLink project that runs from June 2017 to May 2021. It presents the initial findings of the integrated assessment of the results of various work packages that will be further developed in the coming years and also describes methods to increase understanding of the role of the FAS in the agricultural innovation processes.

The sustainability challenge

Increasing the sustainability of agricultural systems is an important, longstanding societal and policy objective (Pretty 2002). The Brundtland Report (World Commission on Environment and Development, 1987), 'Our Common Future', defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The pursuit of sustainable agriculture is embedded in European agricultural policies (see Council Regulation (EC) No 1257/1999, Marsden, 2003, Wilson, 2007). However, the definition of sustainable agriculture is highly contested (Robinson 2008).

Sustainability is widely conceptualised as comprising three facets: environmental, economic and social (Velten et al. 2015, Kuhlman and Farrington 2010). Early work on sustainable agriculture emphasised environmental sustainability, particularly the benefits of organic farming and low input agriculture. The Commission of the European Communities' (1999) communication "Directions towards sustainable agriculture" has a strong focus on environmental sustainability, suggesting that sustainability is about balancing the use of natural resources for long-term agricultural production with the protection of the environmental and cultural heritage in line with society's values.

In AgriLink, we use the three-fold definition of sustainability. For agricultural practices to be sustainable, they must be economically viable, environmentally beneficial, and yield appreciable benefits to society (e.g. local employment, access to common pool resources), while not compromising the potential of future generations to meet their own needs. This 'triple bottom line' model of including environmental, economic and social aspects of sustainability has been widely used in the sustainable agriculture literature (e.g. Rasul and Thapa 2004, Van Calker et al. 2005) and provides an imperfect but practical option for conceptualising sustainability.

The AgriLink Approach

Research questions and key concepts

In the integrated assessment of the AgriLink project results we seek to answer the following three research questions:

What is the contribution of advisory services to farmers' decision-making regarding innovation to make farming more sustainable?

Can new forms of co-production of services (interactive innovation, Living Labs) contribute to better linking actors within a regional FAS with both farmers' needs and research and innovation of the advice provision itself?

How can transformations of the advisory system contribute to sustainable transitions of European agricultures?

The answer to the third question should lead to the identification of opportunities to design a more effective FAS which supports the uptake of innovations for agricultural sustainability. This last question builds on the answers and some particular findings related to the two first questions.

Because the project is not yet finalised, these questions cannot yet be answered in full. Therefore, the paper presents preliminary results, along with the approach to finalise the synthesis of the project findings.

AgriLink uses several concepts for which different definitions are used. These are first of all AKIS (Agricultural Knowledge and Innovations System) and FAS (Farm Advisory System). To assess the

FAS role in innovation process it was necessary to adopt particular definitions in order to distinguish FAS actors from the other AKIS actors.

The current usage of the term AKIS (where "I" is short for Innovation) more accurately represents the literature on AIS (Agricultural Innovation Systems), a concept which emphasises a broader network of organisations and the focus on new products, processes and forms of innovation (Birner et al. 2009). In AgriLink we will define AKIS simply as: "the collection of agricultural information providers, the flows of information between them, and the institutions regulating these relations"

Based on the definition initially presented by Birner et al. (2009) we define FAS as part of AKIS: "Agricultural advisory services are the entire set of organizations that will enable the farmers to co-produce farm-level solutions by establishing service relationships with advisors so as to produce knowledge and enhance skills" (Labarthe et al. 2013, 10). Based on Birner et al. (2009) we recognise organizations providing independent professional advice as FAS: Private/public/semi-Public advisory organisation, Advisors of farming organisations, individual/independent advisors, NGOs providing advice.

The FAS plays a key role in the knowledge and innovation transfer within a (national or regional) AKIS, alongside other sources of information (e.g. universities, input suppliers) as it is illustrated in the example Figure 1. FAS frequently plays an intermediate role between sources of knowledge (e.g. universities, research institutes), and usually also provides advice on public goods (in contrast to input providers). As a matter of distinction, we recognise FAS as organisations/individuals for whom providing advice defines their major role (e.g. advisory organisations, individual advisors) to distinguish them from actors for whom providing advice comes secondary (e.g. universities, input suppliers).

The figure below pictures the Danish AKIS as an example. Within this image, the FAS is represented by three entities, i.e. the Knowledge Centre for Agriculture, Local advisory centres (DAAS centres) and Private advisory companies.

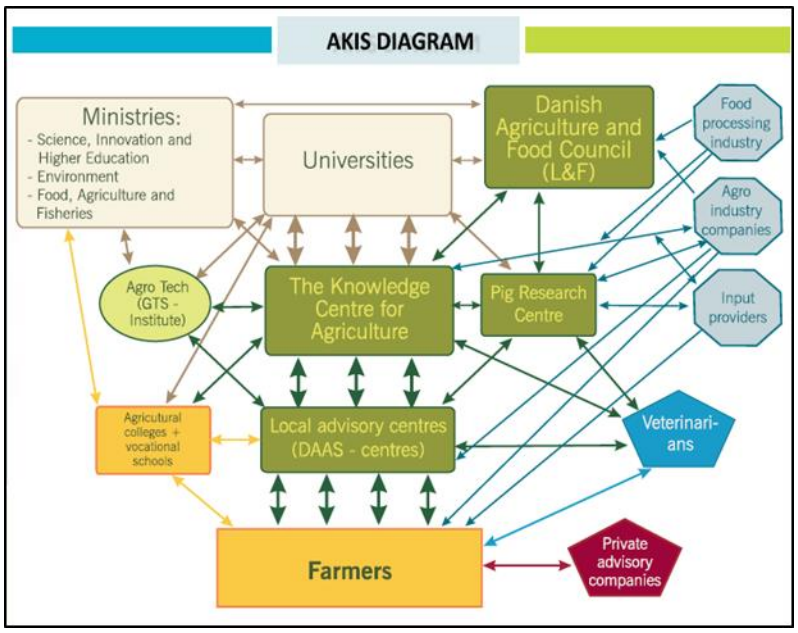

Figure 1: Example of AKIS Diagram from PROAKIS - Denmark case (Source: http://www.proakis.eu/inventory)

Methodology

Answering the first research question above builds on findings from a quantitative and qualitative survey at the farm level, the regional FAS level and a FAS governance assessment, also including a qualitative survey. The surveys were carried out in the form of one-to-one interviews.

Answering the second question is based on results from collaborative actions (in the form of Living Labs) that addressed several innovation types (described below), together with insights from farm level surveys (collecting evidence on types of innovation requiring specific types of advisors' assistance). Findings on FAS governance provides evidence on the extent to which these types of activity (Living Labs) are supported directly or by back-office activities (e.g. training of advisers). The Living Labs approach has been used as an advisory tool to explore and facilitate collective actions by actors, for instance in the case of social innovation. In AgriLink, the approach is used to design new advisory tools (e.g. in Netherlands to facilitate farmers' learning about how to reduce nutrients loss in arable farming). The project also analysis the conditions under which Living Labs can be a useful and effective tool for advice provision or for advisory tools design.

The answers to the research questions are intended to help design improvements to the existing FAS. Preliminary answers will be validated with agricultural stakeholders by exploring how such an improved FAS might actually stimulate the future development of a more sustainable agriculture in various EU regions. For this a so-called "Socio-Technical Scenario" (STSc) method will be used, which takes into account the potential barriers and drivers that play a role in shaping the future.

In AgriLink, we address agricultural sustainability by focusing on a set of innovation areas that combine (positively or negatively, with synergies or trade-offs) different dimensions of sustainable development (see Table 1 below). The innovation areas were chosen to represent the challenges identified in the Strategic Approach to EU Agricultural Research & Innovation (EC, 2016a). Each innovation area illustrates the difficulties of combining different dimensions of sustainable development, and the need to combine knowledge from different sources and of different types.

Table 1 – Innovations and case studies geographical distribution

Type of innovation	Innovations	Countries with case studies
Technological – IT (Information technologies)	Autonomous vehicles, robots, drones, intelligent sensors; Precision Farming	Czech Republic; France; Norway, Poland; Portugal; United Kingdom
Process – Integrated ecological farming	Biological Pest Control	Greece; Latvia; Netherlands; Portugal; Spain
	Soil Improving cropping systems	Czech Republic; Italy; Netherlands;
Marketing and organisational	Retro-innovation	Romania; Spain
	Introducing new crops	France; Greece (two cases)
	Direct marketing	Italy; Latvia; Portugal; Romania; Spain

	Developing new activities	Belgium; Poland
Social – Collaborative arrangements	Natural resources common management	Italy; Norway; Poland; United Kingdom
	Labour Innovative arrangements	Belgium; France

Concerning the adoption of innovations, Smith et al. (2010) argue that innovation studies broadened from a focus on promoting cleaner technologies in the 1980s to system-level changes in production and consumption. As such, innovation studies expanded from a technology focus, to current definitions which include methods, concepts and social aspects. Smith et al. (2010) also identify a broadening of understanding of how innovations emerge: early work emphasised economic price signals, whereas more recent work utilises innovation systems perspectives. Systems perspectives emphasise co-development of innovations, involving multi-actor processes and partnerships. Learning and change are shared and responsive to contexts (Klerkx et al. 2012). The iterative processes of innovation development and mainstreaming are developed particularly within the multilevel perspective (MLP; Geels 2005).

An innovation which does not have the potential improve either the economic, social or environmental condition of the farm is unlikely to be taken up. In many cases, however, there will be advantages in one area and disadvantages in another, i.e. trade-offs in what innovations achieve (Nelson and Nelson 2002, Tuomi 2002). Furthermore, some innovations will improve one aspect of sustainability at a cost of another. These trade-offs lead to variable adoption rates.

To acknowledge these aspects of innovation, AgriLink has adopted the following 'rules' as a point of departure:

AgriLink does not restrict the definition of innovation to technological innovation, but integrates process, marketing and social or organisational innovations;

AgriLink studies innovation areas where the contribution of innovation to sustainability is a matter of debate, hence there is a specific role for advice to play in that respect;

AgriLink explores innovation at different scales, and includes farmers who did not adopt an innovation that was analysed;

AgriLink not only analyses innovation but also aims to promote participatory methods for innovation within and through services, through six Living Labs.

Following classical taxonomies of innovation (OECD 1992), empirical research in AgriLink address four types of sustainable innovations: technological, processes and farming practices, marketing, and social and organisational. To acknowledge further variety, AgriLink assesses the role of advice in eight specific 'innovation areas' within these four general types (cf. table 1 above). These innovation areas were chosen to represent the challenges identified in the Strategic Approach to EU Agricultural Research & Innovation.

In AgriLink we will utilise both infrastructural and process approaches. Process approaches emphasise the interactive development of technology, practices, markets and institutions. An infrastructural approach identifies the actors and associated rules (including regulations) of AKIS; it is important to understanding the structure and functioning of the regional farm advisory services (R-FAS), and how they are influenced by the EU farm advisory regulations. The process approach emphasises the interactive development of technologies, practices and institutions which is important to understand on-farm innovation and microAKIS. Taking both perspectives is particularly useful within a multilevel perspective, and will be applied in different work packages.

Concepts used in AgriLink

AgriLink distinguishes three types of farmers, i.e. those who have, have not or have ceased adoption of a particular innovation. To understand the innovation process at the farm level the data collection had several foci:

To identify the sources of the information and support farmers drew on in deciding to (or not to) implement a particular innovation (i.e. the structure of their microAKIS).

To analyse the processes in which innovation decisions are embedded (e.g. informal networks, decision-making approaches, sequences of events).

To analyse the farm-level constraints and opportunities for engaging with innovations. These include the geographical features of the farm (e.g. land capability), the technological preparedness (e.g. ICT access) and the history of farm-level engagement with advisory services of various forms.

To analyse the innovation process at the farm level the concept of microAKIS was adopted which is based on Sutherland et al.'s (2012) conceptualisation of the 'triggering change model' (see figure 2 below).

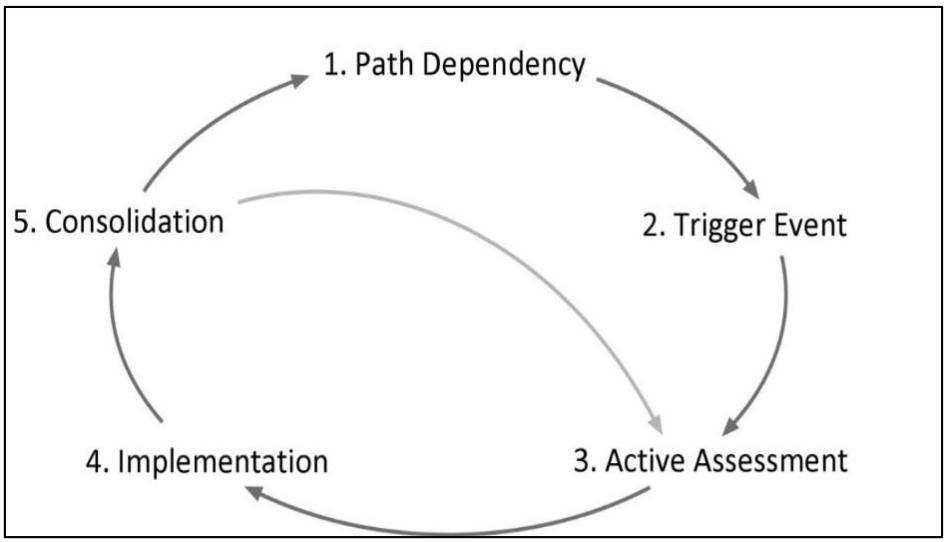

Figure 2: The Triggering Change Model (Sutherland et al. 2012, p. 144).

This model draws on social psychology (particularly the Elaboration Likelihood Model, Petty and Carpaccio 1986) to identify a sequence of events through which innovations come to be integrated into farming practices. The elaboration likelihood model argues that people do not attend to new information and opportunities in the same depth all of the time; only in particularly important situations do they process in the depth which is required to make a major change on farm. Farmers and their businesses are typically 'locked in' to their current trajectories. Making a change in farming practice therefore usually involves some form of trigger, which can range from a series of financial set-backs to the opportunity to integrate a successor into the business. These triggers lead to a period of active assessment or 'reflexivity' about opportunities and the overall farming trajectory. Once a viable option is identified, farmers may implement it. Subsequently, it takes time for the innovation to consolidate into the 'new normal' for the farm and become part of the status quo. Unsuccessful innovations trigger a return to active assessment. In AgriLink surveys were conducted on how this worked in concrete cases, yielding over 1000 responses.

Next to micro-level innovation adoption (or not), AgriLink evaluates the EU-FAS at the macro level, using a combination of structural and process approaches to assess how specific policies and governance approaches influence the structures and processes of advisory services 'on the ground' in the case study countries. EU-FAS is represented by a regulation by the European Commission on farming advice that is intended to guide member states on how to organise the advisory system in their country.

AgriLink also aims to increase understanding of the role and way of development of advisory support services by running of six 'Living Laboratories', where scientists, advisors and farmers work together to develop and explore new advisory techniques, in response to specific farming or farming related issues that could trigger innovation (e.g. shared marketing). This approach focuses on the processes of knowledge exchange, creation of links between advisors and farmers and conditions under which such an approach could be effective.

Different types of innovation require usually different advisory methods. Collaborative innovations where different actors have a stake and should be involved require facilitation of the process under group dynamics (Birner et. all 2009, Faure et al. 2016). This is also needed in some cases of advice on conflict resolution and substantial changes in farming systems (Faure et. al 2016). At the same time development of new advisory methods also requires in many cases close collaboration of several actors to address complexity of the issue and different interests of those with stakes in the relevant innovation process. Such activities build on existing social capital while also contributing to processes of building the social capital in AKIS and hence contribute to the creation of links between different AKIS actors. This requires the use of a group work format with facilitation provided, which is carried out using various methods and concepts. These include, for example: facilitation (Spencer 1996), design theory (Simon 1988) and systems thinking (Checkland 1999, Ostrom, Cox 2010).

To reflect the need for close collaboration of actors on new advisory tools or to assist farmers in their effort in collaboration, the Living Lab format was used within AgriLink (based on Design thinking theory, Simon 1988). The Living Lab design and run was inspired by system thinking (Checkland 1999). One aim was to test this particular approach in different innovation areas and different (national) contexts to provide lessons for different actors. Another aim was to identify and explain the role of such activities in the innovation process including creation of new links between AKIS actors.

A final element of the AgriLink approach is the use of so-called "transition scenarios". These will be developed in stakeholder workshops to explore which FAS changes and under which conditions could help to stimulate sustainable farming development in each partner country. All previous project findings will feed into these transition scenario exercises which will address both infrastructural and process approaches: the desired infrastructure under particular scenarios, and the processes associated with reaching these infrastructures, and characterising the associated AKIS.

Case studies

A set of case studies was carried out in 13 EU countries to collect data on how farming advice played out at the farm-level. This was analysed by studying the uptake of different types of innovations from 2-3 regions within each country. Farmers' micro-AKISs were surveyed and analysed for 32 case studies. These case studies focussed on farmers' decision-making processes regarding the adoption of specific innovations to understand the role that advisors, in particular each regional Farming Advisory System (R-FAS), played in these processes. Table 1 gives an overview of the innovations studied and the countries in which the cases were carried out.

The innovations were selected to cover the main innovation areas in agriculture and include innovations that were already partly disseminated in the chosen regions. This allowed surveying farmers that made different choices on adopting the innovation, distinguishing between adopters, non-adopters and droppers (farmers that started to use an innovation but dropped it after some time).

Data on farmers' micro-AKIS were collected by adopting a mixed-method approach, combining desk research with surveying of farmers, advisors and key actors from the AKIS underpinning the innovation. The structure of the survey followed the triggering change model (TCM) described above. Hence, data concerning farmers' micro-AKIS were gathered for the different TCM stages, to answer questions on who, how and why supported farmers in the different stages, *i.e.* raising awareness, assessment and implementation of the innovation.

Over one thousand interviews were conducted with farmers, corresponding to an average of 35 interviews per case. Additional interviews were carried out with nearly two hundred advisors and other actors with an important role in the AKIS related to the innovation area in each case. For these, the number of interviews per case varied considerably due to variation in the number of relevant advisory providers in different cases.

Initial results

General findings

A first result is that we found a large variation in the number of advisors that played a role in the various cases. In some cases, a farmer received advise from various sides in all stages of the process whereas in other cases hardly any advice was obtained. In addition, for most of the case studies, we observed that the advisor's diversity doesn't vary significantly during the different stages in the TCM, although in many cases advisors are absent or have a limited role in the innovation uptake stage.

The composition of a farmer's micro-AKIS, i.e. all sources of information and advice that a farmer uses, depends on the type of innovation although this tends to be strongly affected by the main features of the corresponding R-FAS. More specifically, the privatisation of the R-FAS across Europe, with the disappearance of the public advisory services in most of the countries resulted in a fragmented advisory landscape which is reflected in the micro-AKIS diversity across innovations and EU regions.

Results related to innovation areas

In this section we provide an overview of farmers' micro-AKIS by innovation type across different European regions. This will show a decreasing role of R-FAS and conventional advisory services when moving from 'off the shelf' technological innovations towards novel and complex social and organisational ones.

We analysed a diverse set of IT cases as shown in Table 1. The farm structure, more specifically farm size, appeared to be a determinant factor for the uptake of such innovations. These digital innovations appear to be more suitable for large farms, which are often led by farm managers or highly educated farmers. This could partly explain why there are only a limited number of actors involved in the micro-AKIS, given that 'self-learning' processes often occur and that in some cases there is a role for pioneering farmers at the regional level. An additional explanation is that specific technologies are usually owned by technology providers and that developments in this sector occur so rapidly that the R-FAS in most cases cannot keep up. Therefore, the private

companies selling the technology play a key role in all countries, while they play a leading role in CZ, PL and UK cases on precision farming technologies. Poland is relatively exceptional given that regional public advisory services are still existent and appear to complement the role of the private suppliers by delivering independent advice to farms of different sizes. In three other countries, with case studies involving specific smart technologies like drones (France), milking robots (Norway), and moisture probes (Portugal), the farmer-based organisations (FBO) were more prominent as advisors, although this was more limited in the French case (being active only in the awareness stage). In Norway, the FBO worked side-by-side with cooperatives advising farmers on software and with private suppliers involved in development and assistance with the equipment (the robots). This is similar to the Portuguese case, although the probe manufacturers not only play a residual advisory role in this case. The Norwegian and Portuguese cases show that conventional advisors, the cooperatives in both cases, can play a relevant role by developing back-office activities enabling them to be involved in the development of the technology, esp. software. Thus, cooperatives can acquire knowledge that they need to use in the front-office to advice the farmers.

Process innovation focused on methods and /or techniques for biologic pest control (BPC) and soil improvement cropping systems (SICS). These innovations and the respective farm structures varied considerable across case studies which limits possibilities for cross-comparison. Due to this diversity, it is not surprising that farmers' micro-AKISes tend to vary substantially across innovations and countries. A general feature of these cases is that they show a large degree of self- and peer-to-peer learning processes. The relevance of researchers, directly or indirectly present in the farmers micro-AKIS is another shared feature across most of the case studies involving BPC or SICS. These innovations build on scientific knowledge which explains why researchers tend to be involved as direct and /or indirect advice suppliers. Formal provision of advice occurred in the Czech Republic (demonstration farms), in the Spanish region of Navarra, and in Greece by establishing partnerships between research institutes and local cooperatives. Informal arrangements were found in Italy (SICS), the Netherlands (SICS), and Portugal (BPC). In these cases, researchers collaborate with independent advisors and pioneering farmers (IT, NL) or with a farmer associations and pioneering farmers (PT). All cases show an important role for public policies funding collaborative projects and/or research and demonstration activities, including recently established operational groups.

The role of R-FAS in advice provision in the cases of BPC and SICS tends to be secondary, with the exception of Navarra and Latvia, were public extension still plays a role and collaborates with the research sector. In other cases, innovative advisory organisations (Portugal) or collaborative arrangements between research and advisory sectors (Greece and Netherlands) resulted in a successful uptake of innovations. In general, farming structures don´t play a significant role in limiting access to innovation, although the farmer's business models and their perception of the costs and benefits of an innovation appear to be decisive for non-adoption. In addition, in some of the case studies (e.g. IT, PT, LV) small-scale adopters tend to depend only on informal peer-to-peer advice.

The marketing and organisational innovations analysed by AgriLink involved a range of innovations and a large number of countries with diverse advisory landscapes. A generally observed feature is the decreasing role played by conventional advisory services. In relation to these innovations, in particular in the cases of direct marketing and retro-innovation, the farmers' micro-AKIS tends to be quite small and consists mostly of informal peer-to-peer advisory networks. In some cases there is involvement from non-conventional advisory actors, such as NGOs and the LAGs (local action groups) related to rural development policies supported by the regional RDP (Rural Development Programme). However, as shown by the Portuguese case, these advisors experienced difficulties to go beyond the awareness raising stage and appeared to be

too dependent on dedicated project public funding to be able to support the actual uptake of collective direct marketing schemes. In other cases (Italy), successful new organisations (FBO NGOs) emerged along with these innovations and ensured the support to collectively involved farmers during the different TCM stages. The emergence of new types of advisors supporting marketing and organisational innovations and experiences from AgriLink Living Labs suggest that there is decreasing role of traditional advisory services (and an increasing role of new actors like NGOs) and, in general, insufficient supply of such services.

The uptake of various types of innovation, such as the 'pocket digesters' in Belgium, has failed due to the absence of an independent advisory service. In this case a very high rate of droppers was found due to lack of advice on the operation and maintenance of the equipment. The bankruptcy of the private supplier of the equipment left farmers in a problematic financial situation due to buying expensive equipment, following the advice of the seller. As a contrast, the introduction of similar activities (comprising a diversity of options for renewable energy production) in Poland was successful, partly related to the existence of local independent public advisory services.

The introduction of new crops is another rapidly spreading innovation across Europe. The micro-AKISes related to this innovation in the selected case studies showed an important role for the FBO, notably the local cooperatives involved in up- and down-downstream sectors. In these cases, peer-to-peer advice appears to be a relevant source of information in farmers' micro-AKIS, in particular in the Greek cases. In these cases (introducing stevia and avocado), researchers also appeared to play a significant role as advisors. This seems to be an innovation demanding an advisory system reflecting the value chain, triggering a farmers' demand for both technical and commercial advice.

The case studies on the uptake of social innovation showed the absence of traditional advisory services, with the exception of Poland, where local public advisory services played an important role. This is probably due to the trust that farmers have in these local advisors. Social innovation builds on collaboration and thus entails trust and motivation for participatory action. The importance of peer-to-peer advice along with the key role played by specific individuals, such as leading facilitators from NGOs, tend to shape the farmers micro-AKIS related to the collaborative arrangements for the natural resources common management.

EU and national advisory regimes

The first step in the analysis of national advisory regimes consists of exploring whether the recent EU regulation about farm advice actually had an impact on advisory regimes. Indeed, there has been an attempt by the European Commission (EC) to enforce a convergent guidance on advisory services in Member States (MS) through its regulation on Farm Advisory Systems. Since 2008, MS are compelled to set up such systems, aiming to guarantee that all European farmers can benefit from services to access information and knowledge to fulfil the EC's requirements about Good Agricultural and Environmental Conditions, or standards on the use of inputs (nitrates, pesticides), on health or on biodiversity issues.

Our preliminary results from desk research and interviews indicate that the European regulations had very limited impact on the national advisory regimes. There seem to be two potential explanations for this. The first applies to countries like France and the Netherlands, where farm advisory regimes are characterised by very strong institutions that define the identities of suppliers and frame the funding and attributes of services. In such contexts, national policy makers took the option to implement the EU regulation in its minimal scope, implying it had a very restricted impact on the system. The second applies to countries where the difficulties in the

implementation of the EU-FAS regulation seem to result from a crisis of national advisory regimes, for instance in Greece or Romania. Such crises may be related to radical shifts in the balance of power between public and private actors in a context of sharp privatisation of advisory services. But it can also be an expression of a more global complexification of agricultural and rural polices with multiple layers (local, regional, national) and more and more complex policy instruments. As a results, the monitoring of policies impacting farm advice (for instance in terms of beneficiaries of services) is clearly lacking in many EU countries. In some countries (e.g. Czech Republic), the EU-FAS did have a noticeable impact and stimulated the development of the basic FAS institutions that did not exist before 1990 and that had started to evolve slowly since the EU accession.

At this stage of the project these results serve as an important context for understanding the FAS role in the dynamics of innovation processes. In later stages the results will be used as an important factor in explanation of the whole innovation process.

Innovation in FAS and design of new FAS tools

Our preliminary results indicate that there are several shortcomings in regional advisory systems to effectively support farmers in the uptake of sustainable innovations. Hence, there is a need for innovations in the FAS as well, in the form of new advisory methods and tools. In AgriLink we explore the design of such new tools and assess their usefulness in interaction with various stakeholders using the 'Living Labs' method, i.e. a workshop format with real-life actors exploring conditions and effects of changes relevant to them.[9]

The FAS governance analysis and whole innovation process studied at the project level assessed rules and support of building such capacities in FAS. The analysis of the micro-AKIS level revealed a need for innovation of the FAS itself, especially for particular types of innovation (e.g. collective actions). For example, a collective action undertaken by farmers in Scotland to agree on the collective application of an agri-environmental measure clearly showed a need for specific advice provision. The first results of the policy analysis (e.g. assessment of support of back office, training provision provided in project partner countries) show a lack of policies supporting such methods of advice, as well as lack of collaborative means to develop new advisory tools in some countries despite the need for such services (AgriLink results are supported also by personal experience in policy design in the Czech Republic). The preliminary results show that the provision of collaborative efforts facilitation in AKIS may be limited by several factors, for example when actors have too different interests (Norwegian Living Lab) or are acting under strong competition (Dutch Living Labs). This is in line with results from previous collective action studies (Ostrom 1990). Lack of policies supporting such advisory methods is associated to lack of AKIS coordination (e.g. study of Czech AKIS governance).

Conclusion

The AgriLink project follows a multi-method and multi-level approach to analyse the working of farming advisory systems in Europe. The analysis of micro-AKIS at the farm level is based on a wide set of case studies in various European countries. Desk research, combined with interviews, have been used to analyse national or regional advisory regimes, as well as the impact on these from EU policies. All of these levels clearly influence one another. A Living Lab method is used to explore the usefulness of new advisory tools in a subset of countries, seeking to address some of the challenges that emerge from the case study analysis. In the remaining part of the project, scenario methods will be used to explore possible and required future changes of the R-FAS in all of AgriLink's partner countries.

[9] The use of Living Labs in AgriLink is elaborated in another paper for this conference by Potters et al.

The results presented here are only preliminary as, at the time of writing (fall 2019) the project still had 20 months to go. However, these results already indicate that the analysis of the different levels can be fruitfully combined to render suggestions to improve the farming advice system and test these in Living Labs. For example, insights in the gaps in advice provision in each step of the triggering change cycle (and their reasons), indicate where it would be useful to increase advisory competences, e.g. changes in governance and coordination. These can be translated into new policies to provide relevant training for advisors or stimulate other forms of knowledge transfer (e.g. in using collective forms of advice provision such as Living Labs) or trying to fill the gap in advice provision in the rapidly changing IT sector (e.g. in precision farming). Using these insights in scenario work later in the project will foster an identification of which particular steps could be taken by key actors to improve the role of FAS in innovation processes. In the remaining time of the project this will be further elaborated into concrete advice for various parties in the farming advice systems in different countries, as well as the EU level.

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A BUSINESS MODEL FOR INNOVATION SUPPORT SERVICES - IMPROVING INNOVATION CAPACITY BY DEVELOPING A BUSINESS MODEL BASED ON CONCEPTS OF PHYSICAL PROXIMITY, DIGITAL COUPLING AND SHARED COLLECTIVE INTELLIGENCE (WEQ)

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Abstract: Improving the Agricultural Knowledge and Innovation System (AKIS) has gained substantial attention during the CAP period 2014-2020. Innovation support services (ISS) and Innovation Brokers (IB) are considered to play a vital role in building bridges between different actors in the agricultural sector. By fostering co-creation they can e.g. support the quest for innovation to cope with the huge challenges the sector is facing, such as food security, climate change adaptation and mitigation or the over-exploitation of natural resources. However, the question remains how innovation system knowledge and ISS activities can safeguard these core functions within AKIS beyond the limited lifetime of funded projects like EIP-AGRI projects. In Germany a dedicated transdisciplinary team at the nexus of science and management conducted a dynamic and iterative management process to translate the strategic role of an ISS into a new business model for venture creation using a novel combination of business model elements. The business model elements were selected to create a) a financially sustainable support system for innovation, b) empower scientists, farmers as well as SMEs in the agri-food sector to develop new production and business opportunities, and c) generate socio-economic well-being and jobs in rural areas. They comprise concepts of proximity at the physical level, of digital coupling and of shared collective intelligence, thereby leading to a permanent cross-fertilisation of ideas, knowledge and experience between and beyond those actors (WeQ). The outcome was an ISS Hub organization in the Federal State of Brandenburg that has led to improved innovation activity level and the enhancement of the local AKIS. In this paper we describe the development of the ISS Hub organization to provide independent complementary services needed for improving and professionalizing knowledge and innovation transfer and commercialization from an action-research perspective. We assess how the resulting business model addresses the underlying issue of coupling by juxtaposing its main elements with the main characteristics of a system model for innovation given by Freeman as an outflow of the Maastricht Memorandum (1996). By outlining conceptual thinking behind the creation of an innovative business model for ISS we discuss how the individual elements foster their ability for knowledge transfer and increase their innovation capacity towards a faster adaptation within AKIS.

STRATEGIC FUNDING OF COMMUNITIES OF PRACTICE TO ACHIEVE POLICY GOALS: THE EXAMPLES OF MULTI-ACTOR INNOVATION PROJECTS IN THE FORESTRY SECTOR IN EUROPE

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Abstract: Sustainable solutions to complex socio-scientific problems, such as the rural exodus that is evident in many parts of the world, require mobilization of a growing range of stakeholders with multiple perspectives. Informal communities of practice (CoPs), with high degrees of autonomy in processes and activities, have formed to address such problems by enabling social learning, which can lead to co-innovation to implement joint visions and create solutions. Funding bodies have the potential to further their own agendas by supporting CoPs when the values of the CoP align with the funding body's goals, but they tend to prescribe processes and activities as a condition of funding, which is inherently top-down. This paper explores the possibility of using top-down funding instruments to support bottom-up programs to achieve mutually desirable outcomes. We focus on three cases in rural communities in Norway, Sweden, and Austria in which funding bodies have supported communities of practice in the forestry industry and analyze the projects in terms of their internal and external interactions. This approach of funding bodies supporting CoPs by negotiating specific outcome goals, while allowing a high degree of freedom of process, was found to facilitate the cases to be dynamic in their interactions. The dynamism enabled them to achieve outcomes such as collaborations to establish a competence center, an education program to showcase perspectives for girls in the forestry industry, and collaborations to find innovative applications for timber products. These outcomes each contribute to providing perspectives in the forestry industry for young people, which has implications for the viability of the communities and can contribute to stemming the rural exodus. We conclude that providing support to CoPs can indeed be used as a top-down tool to support bottom up processes to progress towards joint visions of desirable outcomes.

FARMER-LED INNOVATION NETWORK, AN EMERGING COMMUNITY OF PRACTICE IN THE UK

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Introduction

Policy context

Climate change, environmental degradation and increasing population growth are threatening our food systems (Foresight, 2011). Although great strides have been made, as crop and livestock yields have increased significantly since the 1960s, there is evidence that production is levelling off (Grassini, Eskridge and Cassman, 2013, MacMillan and Benton, 2013). Intensification and the extensive use of agrochemicals have created environmental problems (Steinfeld et al., 2006, Godfray et al., 2010) and more and more societal-ethical questions are raised about how food is produced, its quality, safety (e.g. antimicrobial resistance, BSE, salmonella, listeria) and animal welfare. Farming in the United Kingdom (UK) has gone through a process of transition from a '*productivist'* to a '*post-productivist'* regime (Wilson and Rigg, 2003). The role of farming in rural areas has changed from merely productive (production of primary goods) towards a multifunctional role delivering a range of public goods (Van Huylenbroeck et al., 2007, Van der Ploeg et al., 2000). This has now progressed towards concepts of public goods in UK (Bateman et al., 2018; RSA, 2019). Farming nowadays is conducted in an increasingly dynamic and unpredictable setting, in terms of market, policy, social and environmental circumstances and our thinking about research and innovation has evolved accordingly (World Bank, 2006, Hall, 2007).

For many years, the assumption in agriculture policy has been that scientists working in institutions and large enterprises are best placed to provide the innovations (technical solutions) to our policy challenges (Vogl, Kummer and Schunko, 2016). However, despite large investment, and big, centralised research projects focused on finding general answers or developing mass-market products, they struggle to support innovation to the farm context (MacMillan and Benton, 2013). Standard experimental methods, which rely on replication to rule out environmental difference, cannot cope with the complexity of whole systems (Cook et al., 2013). Thus, new approaches are needed to foster farmer innovation but draw on the body of scientific understanding. Over the years years, there is an increasing realisation that, to deal with the current challenges in agriculture, there is a need to go beyond linear models of knowledge transfer to processes of knowledge co-creation focusing on participation of multiple stakeholders, including farmers, and better use of knowledge to enhance sustainability (World Bank, 2006, Röling, 2009). This has led us to reassess innovation which is now seen as an iterative and evolving process involving interactions of many individuals and organizations possessing different types of knowledge in an innovation system, of which the linear model is a part (Hall., 2005). This co-innovation is now a preferred model for action research and innovation implementation (Dogliotti et al., 2014; Botha et al 2017). In this context, supporting research and innovation in farming systems requires working on real farms, drawing on scientific principles and environmental science and data. This entails recognising and supporting innovation *by* farmers,

in partnership with scientists, rather than seeing them as customers for technology invented by others.

There has been a growing policy interest in agricultural innovation generated through these collaborative knowledge creation processes involving both scientists and farmers, both within the UK and at European level (Brunori et al., 2013). The European Innovation Partnership has been promoting the interactive approach to innovation through the EU H2020 multi-actor approach and Operational Groups of the Rural Development Programme which both include a high level of practitioner engagement (SCAR, 2013). Farmer-led innovation initiatives (formal and informal) have had an increasing presence in the UK AKIS since the privatisation of advisory services, responding to a shift towards more farmer-centred thinking and opportunities for support (Garforth et al., 2003, Dwyer et al., 2007, Curry et al., 2012). This has been in line with a general ethos to support collaborative mechanisms and incentives to foster group activities such as catchment and landscape partnerships, agri-environment co-operative schemes, as well as informal farmer cooperative activities. The DEFRA 'Health and Harmony: the future for food, farming and the environment in a Green Brexit' (2018) consultation states, '*We want to explore how collaborative research ventures, involving farmers and other partners (such as research syndicates) can develop a new generation of agricultural technology. This would enable farm businesses to work together to overcome common challenges through bespoke technological solutions*.' It continues, '*There is an important role for knowledge sharing, producer cooperation, and farmer-to-farmer learning to kick-start a wider culture of excellence.'* Hence, opportunities exist for the enhanced integration of more participatory approaches to farmer-led research and innovation in future strategy and policy initiatives.

Farmer-led research and innovation

Farmer-led research and innovation (practice-driven or practice-led) is a process through which farming practices are developed on farm, either through individual or collective action, with suitably applied science input, and directly and indirectly shared amongst farmers, to inform both science and the wider stakeholder community (retail, food service, government and others). Farmer-led innovation can be either challenge-led or opportunity-led and responds to the demand for innovation to solve local problems using practical knowledge and creativity at the farm level and (Vogl et al., 2016). Akrich et al. (2002, p. 202) argue, '*the evaluation of the disadvantages and advantages of an innovation is entirely in the hands of the users: it depends on their expectations, their interests, on the problems, which they* raise'. Farmer-led innovation is derived directly from the '*rooted*' experiences of '*doing*', their practice, to cope with and adapt to the challenges faced in everyday as well as strategic contexts (Hoffmann et al., 2007). The word 'innovation' (singular), refers to a process of on-farm practice change, including changes in resource use, outcome (animal), farm management, relationships (social), market and policy and includes either developing new ideas or using existing ideas for a new purpose and/or in a new (specific farm) context (Conroy et al., 2008). This definition goes beyond the traditional thinking of what constitutes innovation. Traditional thinking focuses on innovation as merely technological solutions; however, increasingly other types of innovation, such as innovation in social and institutional arrangements, are recognised (Conroy et al., 2008).

Paradoxically, this in-practice and on-farm demand for innovation is rarely seen as a major driving force for applied science research. The call for innovation does not emerge from scientific research processes but emerges from the social interactions and cultural context of individual farmers with varying management practices operating within their communities. Enabling and mobilising this demand requires creating space for joint learning and knowledge sharing, bringing together farmers and different actors, with different (forms or sources of) knowledge (Spielman and Birner, 2008, Moschitz et al., 2015, McKenzie, 2013). Intermediary organisations or

Innovation Support Services facilitating such processes typically use participatory approaches and are funded through a variety of sources.

The UK has been at the leading edge of new initiatives that put farmers in the driving seat, supporting them to work together and with scientists on their own terms. Pioneering initiatives include Innovative Farmers[10], the ADAS Yield Enhancement Network[11], Rothamsted's FarmInn programme[12] and Scotland's Rural Innovation Support Service[13]. Pilot funding from UK Research and Innovation (UK Research Councils), the levy boards and government has helped make this possible. A private foundation, the Prince of Wales's Charitable Fund, has been the largest investor in this sector to date. However, there has been limited cooperation and coordination between the intermediary organisations supporting these processes, hence, there is a risk of fragmentation of the support landscape. Moreover, with the potential increase in funding opportunities encouraging more farmer-led approaches, there is a need to build the capacity of existing and new organisations supporting these types of initiatives, ensuring the use of tried and tested best practice and avoidance of past replicable mistakes.

At the end of 2018, the Farmer-Led Innovation Network (FLIN) was established to tackle the above-mentioned challenges. This network can be described as a Community of Practice (CoP) in that it is a group of people informally bound together by shared values, expertise and passion for a joint enterprise (Wenger and Snyder, 2000). This paper presents the results of the ongoing work of this CoP and the opportunities and challenges involved with operating as a network over the past year.

The Farmer-Led Innovation Network

Aims and objectives

The Farmer-Led Innovation Network (FLIN) was established in the UK in October 2018 to share knowledge and experiences and provide a collective advocacy voice for farmers directly involved in these initiatives. The establishment of this network of intermediary organisations was inspired by the PROLINNOVA (Promoting Local Innovation) network (Waters-Bayer et al., 2004). The main aim of this network is to understand, learn from and 'power up' farmer-led innovation initiatives in the UK and increase the impact of these kind of initiatives across the industry. The network objectives are:

Work collaboratively to advance farmer-led innovation and research in the United Kingdom.

Share best practice and support each other, as necessary, to enable each member to enhance and promote farmer-led innovation and research.

Promote concepts, which put farming in the driving seat and support and normalise research with impact.

Develop projects and/or programmes together, as appropriate, to maximise the impact of the network.

Currently, over 20 organisations involved in farmer-led innovation and research initiatives are part of the network, including governmental, non-governmental organisations, research institutes, the levy board, farmer organisations and advisory services. The network brings together initiatives directly representing farmers involved in farmer-led innovation across the UK;

[10] https://innovativefarmers.org/
[11] https://www.yen.adas.co.uk/
[12] https://www.rothamsted.ac.uk/farminn
[13] https://www.innovativefarmers.org/welcometoriss

an estimate of at least 1500 farmers directly involved and over 3,000 farmers in initiatives engaging farmers in like-minded types of processes but with a less specific focus on innovation. Around £2 million of pilot funding from public, third sector and industry R&D has been invested to date and in some cases, the initiatives also leverage in-kind contributions, for example, from scientists or input providers. None of the initiatives routinely quantify in-kind investment by farmers but, extrapolating from examples where they have done so, they estimate this to at least match the level of cash funding indicated above.

Outcomes sought and activities

With the increasing interest in these types of initiatives, there is a need to build the capacity of organisations supporting these types of initiatives. Hence, the network is collectively working through workshops, working papers and commissioned research on:

Development of better, more structured and monetised evaluation of the success and effectiveness of these types of initiatives to provide evidence for policymaking. The network is working on harmonising data sharing and consistent use of benchmarking services across a diverse range of farmer projects (and contributing to the development of those services) to support cross-community meta-analyses.

Skill development for innovation facilitators and researchers to work effectively with farmer groups and increase the number of advisors and researchers involved in these initiatives. The network collectively provides workshops and training for innovation facilitators and researchers to improve their facilitation skills in these collaborative learning processes.

Sharing and documenting best practice, drawing on the knowledge and experience of the organisations involved to develop working 'standards' or principles to ensure effective engagement with farmers and relevant actors.

In the first year of the network, two network meetings took place, one face-to face and one virtual, and several workshops were organised to share experiences, including an Innovation Facilitation workshop. Initial work was commissioned on the development of better, more structured and monetised evaluation of the success and effectiveness of these types of initiatives, and a policy-influencing workshop was held to share experiences of designing farmer-led innovation funds and support services with policy makers.

Organisational structures and roles

Network membership is open to any organisation involved in farmer-led research and innovation in the UK and new members can be proposed by any existing FLIN member. Although the intention was to have no formal membership and have a fairly loose affiliation of individuals, in the first network meeting it was decided that for the network to function and create an identity, some sort of agreement needed to be in place between its members. A membership Terms of Reference (ToR) was developed; however, these ToR did not create any binding obligations on or between any of the FLIN members and were merely established to clarify the objectives, roles and responsibilities involved with FLIN membership. They also included consent to use the logos and organisational names of network members for FLIN communication and promotional purposes. The membership ToR did not commit FLIN members to any specific level of engagement in the network, the level of participation was completely based on individuals' and/or organisations' time and interest; the ToR also did not commit members to fund or support any FLIN activity. FLIN members agreed to meet together at least twice a year, either face-to-face or virtually, to discuss FLIN activities. To better manage the activities carried out under the ToR, the members agreed that any activities to be carried out by FLIN will be managed by a Steering Committee appointed for a period of two years.

Challenges and opportunities for intermediary organisations supporting farmer-led innovation in the UK

The work of FLIN in its first year generated several insights into the challenges and opportunities that intermediary organisations supporting farmer-led innovation and research in the UK face.

Developing farmer-led initiatives takes time and effort

During the network inception meeting, it became clear that amongst members there is a diverse mix of farmer-led initiative 'models' with different goals, audiences and funding structures. Initiatives can be plotted across a spectrum from those characterised by close facilitation of small groups that meet on a regular basis and informally steer the topics through to those characterised by formalised activities and large networks with farmer involvement. At one end of the spectrum, they are funded through public, NGO support, whilst at the other they are funded through industry support. Recognising this diversity may bring challenges for the network in terms of different initiatives having different support needs; however, this diversity also brings opportunities in terms of benchmarking performance amongst members and learning which 'models' work well or better under certain circumstances and contexts. Regardless of this diversity, the network members advocate that these initiatives harness farmers' ingenuity to benefit the whole industry. Many of the initiatives were designed as pilot projects and programmes to develop models that could be upscaled and network members indicated it takes time and effort to develop these types of projects. Not only does it take time to initiate these on the ground in terms of working with farmers (relationship building amongst the group and with the facilitator and creating a common vision), but also to develop capacity within their organisation to manage and coordinate these types of initiatives effectively. Part of the objective of FLIN is to support each other, as intermediary organisations, to develop this capacity collectively.

Facilitating farmer-led innovation: emerging new roles, new relationships, and new skills

At a meeting of FLIN in February 2019, a session was held to identify the skills required and current practice in facilitating innovation. Following this meeting, a one-day Innovation Facilitation workshop was held in July 2019. During this event, drawing on the expertise of FLIN members and their networks, participants further explored and shared best practice in facilitating farmer-led innovation to identify the skills and competencies required to effectively facilitate innovation. This led to an agreed action plan for capacity development for FLIN members in this area. Most of the initiatives involve a facilitator, who range from scientist such as agronomists and vets to farmers and knowledge exchange officers. Often, this facilitator is involved in multiple initiatives. From the workshop, it was clear that there is an abundance of potential facilitators available, so that was not likely to be a limiting factor; however, a lack of facilitators skilled in supporting innovation projects by farmers may be a limiting factor. Often, the facilitator has facilitation skills in running events or meetings, but limited skills in the practicalities of developing farmer groups and in facilitation for group action. The network members indicated that the quality of support for and from facilitation varies within the current initiatives, so training and capacity-building should be a priority.

Discussions further revolved around the role of a scientists in farmer-led processes. It was recognised that in these processes, farmers' and scientists' roles have changed and these initiatives have created new (and often more complex) relationships between scientists and farmers based on experimental learning and co-production of new solutions. Farmers are valued for conducting their own experiments and are now partners in co-innovation processes, whilst

scientists support the innovation process, often with an enabling or facilitating role. Both acknowledge the joint contextual knowledge developed through the innovation process, which emerges as a collective rather than the individual property of the scientist. Facilitation of these processes requires skills scientists may not necessarily have gained through their academic careers and provides a diverse range of opportunities for scientists to understand and respond to industry priorities, as well as make their previous research relevant and accessible to farmers.

The question on measuring effective facilitation was explored from the perspective of facilitators, farmers, and support organisations. Group discussion revolved around the need for the facilitator to create space for learning, their ability to guide farmers in the co-creation process of developing solutions to their real-life problems, unlock the collective knowledge within the group, generate the energy for action, and stimulate self- and group reflection on their performance. The session recap asked each group to present their top three key insights from the group discussion about monitoring and evaluation (M&E) and potential indicators for effective facilitation, see Table 1.

Table 1. Top three insights from the group discussion about M&E and potential indicators for effective facilitation

Facilitators	Farmers	Organisations
1) Be clear about your own expectations 2) Identify where people are in the innovation spiral[14] 3) Develop a decision tree so you can self-assess, engagement, learning, idea generated, and the energy of the network	1) Measure success by what they need 2) Measures could include involvement, ownership, willingness to pay, sustained involvement (motivation to continue), change. Not one size fits all measures and M&E methods 3) Get farmers to define what successful facilitation looks like and use to this to evaluate	1) At programme level, attributing success to the facilitator is hard 2) Evaluate how you coordinate innovation as a whole 3) Consider different types of learning, not just farmers/facilitators, also reflective process at the organisational level

Evidencing impact

There are multiple methodologies available for evaluating farm-led initiatives and this is an area of interest for the CoP. In general evaluation approaches can measure, understand or learn (Berriet-Solliec et al., 2014). Whilst policy makers prefer measurements of for example practice change or acquired knowledge as evidence of an effective initiative, this approach rarely captures the learning and reflection that occurs amongst all actors in such initiatives. One of the main challenges in enhancing farmer-led innovation is the limited UK evidence of the success and effectiveness of these types of initiatives for policymaking. In the first year of FLIN, some initial work was commissioned to map the M&E approaches of FLIN members, Table 2. Preliminary results showed that members undertake a range of in-house or independent external evaluation, which may be available from them on request, and also publicly report project findings. For example, the latest independent evaluation of Innovative Farmers found that (of the full membership, not those directly involved in projects): 98% of farmers would recommend membership, over 75% have learned something new and over 50% either have made or are

[14] The spiral of Innovations p 61 in Wielinga,et al. (2008).

planning changes to their business as a result (Reed et al., 2016). Recent projects have generated farmer-relevant insights on issues such as productivity of intercropping; drone use to predict potato yield; iron deficiency effects on growth in dairy calves; herbicide-free min till systems; and phosphate availability. However, although there was overlap in the success of FLIN members' initiatives, comparability was limited due to use of different methods and/or metrics to monitor and evaluate their implementation and impact.

Table 2. The diversity of monitoring and evaluation approaches that FLIN members reported.

	Methods	Metrics
Monitoring	Reporting against milestones *Options: monthly / quarterly / annually*	Uptake and growth *Options: increasing participation, event / training attendance*
	Data collection *Options: automated, participatory, facilitator, online/hard-copy*	Learning and change *Options: implementation of plan, change in management practices*
	Participant feedback (surveys) *Options: event-based, per season/project cycle*	Performance *Options: benchmarking (financial), quantitative results*
Evaluation	Qualitative and quantitative (both in the approach and data collected) *Options: semi-structured interviews, questionnaires, participatory assessments, telephone surveys, quantitative feedback forms*	Evidence base aligned with aims & objectives *Options: qual/quant results on increases / decreases / changes in management practices desired, quality of experience for individual participant / event attendee*
	Formal vs informal *Options: structured against long-term objectives, short-term milestones*	Difference made / measure of effectiveness *Options: benchmarking results improved, learning demonstrated*
	Independent *Options: internal / external*	Mechanisms / cause & effect *Options: participatory process impact on technical implementation and uptake*
	Timing *Options: designed from initiation of programme/project, set intervals, forward-looking (2- to 5- to 10-years time)*	

Often farmers mention clear benefits in terms of changing the way they think about farming and trying new practices. Unfortunately, network members indicated they often lack the structures for assessing these gains against their objectives. There is also a wide variation in the methods used to gather feedback and results amongst the FLIN members. Another challenge mentioned was the short project spans over which to measure change; members indicated change may take longer than the project or be an ongoing process, so short-term measurement may not

demonstrate that. Qualitative data is also often highly context dependent, hence, its limited scope and generalisability between farms.

Based on this initial mapping, in the coming year further work will be done on harmonising data sharing and consistent use of benchmarking services across diverse farmer projects (also contributing to the development of those services) to support cross-community meta-analyses. This is aimed at allowing initiatives to compare and assess where improvements can be made, reduce cost by pooling resources, promote best practice and use approaches that others have tried and tested as practical and effective rather than spending time, money and effort reinventing the wheel. Although participatory evaluation methods were preferred by network members, they recognised the need for external evaluation in order to influence policy as it strengthens the robustness and validity of the findings and potentially benefits from comparative analysis. Robust, consistent evaluation evidence is important when making the case to research funders and policymakers that farmer-led initiatives can meet their objectives and warrant their support.

Public and private investment priorities

Funding from various public and private sources has helped to make these farmer-led initiatives possible. Comparing their investment to the overall R&D investment budget in the UK, investment in experimentation and innovation in farming systems and methods, particularly farmer-led innovation and research, is still very little. One of the objectives of the network is to influence policy and include this type of research as part of mainstream R&D investment. From the start of the network, policymakers were involved and attended network meetings and other activities. Several network members also spend time working with policy makers and provide direct support in the design and development of new policy to include these types of approaches. Relative to overall public investment in agricultural R&D, the cost and risk would appear low, the potential impact high, fast and directly attributable, and the potential public return on investment highly favourable (Frontier Economics, 2014). The public value of this investment will derive not only from the improved economic performance of a sector that currently receives billions in taxpayer support, but also through innovation that restores natural capital and delivers ecosystem services. Policies designed to encourage farmer-led innovation approaches should measure this return on investment and aim to exceed private and public rates of return from established agricultural research (Salter and Martin, 2001).

Scaling up farmer-led innovation in the UK

Several of the initiatives in the network have been deliberately designed as pilot projects and programmes to develop models that could be upscaled. Whilst a key lesson from members' experience is that it takes time and effort to develop farmer-led projects, the main factor limiting their scale has been the availability of funding, including funding for that development time. With more funding available, organisations involved in FLIN are confident they could grow significantly, with proportionate increases in impact. Key question is, though, *how far could such models really be upscaled*, *how many farmers could realistically be engaged*? Furthermore, farmers are not a homogeneous group, so their willingness, interest (motivation) and time to engage in these processes varies widely. Based on existing levels of engagement in wider, likeminded initiatives, as mentioned previously, it seems plausible that at least 5,000 farmers in the UK would potentially have an interest in participating in innovation projects.

More so than the potential availability of interested farmers, the practicalities of developing farmer groups seem likely to limit growth. The current initiatives have mostly developed over the past 2-5 years, amidst an uncertain patchwork of funding. With a more predictable funding

environment, it seems plausible that growth could be accelerated. Moreover, the availability of facilitators and researchers skilled in supporting innovation projects by farmers may be a limiting factor, with the quality of support varying even with the current initiatives, so there should be a priority for training and capacity-building. To answer the question *how far could such models really be upscaled* would realistically rely on a steady increase in available funding for projects, sufficient investment in project development, and additional support to build capacity amongst facilitators and researchers. In practice, the design of fund schemes and accompanying innovation support should accommodate collaboration on diverse scales, including larger networks of farmers working together on the same topic. Tools such as Agronomics and Innovative Farmers' proposed protocol packs enable this. New technologies in precision engineering, remote sensing, big data and breeding offer exciting opportunities for a new generation of agricultural inputs that are more resource efficient. However, the truly revolutionary potential lies in putting farmers, and the citizens they ultimately provide for, in the driving seat of changes to farming and food systems (RSA, 2019).

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LINKS BETWEEN THE ADVISORY SYSTEM BUILT BY DAIRY FARMERS AND THEIR REPRESENTATIONS OF THE AGROECOLOGICAL MANAGEMENT OF ANIMAL HEALTH

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Abstract : Today's farming is subject to various political, economic, and social expectations on practices. In the case of dairy production, farmers must face the challenge of ensuring quality milk production while improving their practice in an agroecological way by, for example, reducing their use of chemical medicines. These new challenges imply developing new knowledge and skills for farmers in order to create their situated health management, while there is no shared representation of what is or should be an agroecological health management among the agricultural knowledge and innovation system (AKIS). In farms, many agricultural extensionists (veterinarians, but also technical advisors, processors...) individually help farmers in animal health management and in learning new practices. We thus choose to think of such sets of professionals as “advisory systems” built by farmers. We assume that famers choose health prescriptions according to their own representation of what means a healthy herd and what should be health management. The question remains on how each farmers build a coherence between the multiple prescriptions they receive from their advisory systems and their own representation. Our objective in this paper is to investigate both the advisory systems and the socio-cognitive representations farmers have of health management and to evaluate to what extent they match or not. We conducted in-depth interviews with dairy cattle farmers in the Massif Central Region (France), chosen for their engagement in agroecological management of animal health. We then carried out a qualitative analysis of the speeches, exploring the relationships between each farmer and his advisors, and how they think and manage health. Using the repertory grid tool, we identified a typology of advisory systems modeling the various organizational forms built by farmers regarding the social and cognitive distribution of advising for their health management. In parallel, we formalized the different ways of thinking and managing animal health farmers endorsed by identifying their aims, conceptions, beliefs, rules and practices related to animal health management. We then discuss the links that we see between the socio-cognitive representations of agroecological health management and the forms of advisory systems. The links we made open avenues to investigate the socio-cognitive development of farmers in their engagement in an agroecological management of animal health, and the conditions in which they may learn to be more autonomous in these agroecological practices. This will also raise some important highlights regarding the potential synergies between advisors, and their training about agroecological animal health management.

THE ROLE OF DIFFERENT TYPES OF ORGANISATIONS SUPPORTING INTERACTIVE INNOVATION IN AGRICULTURE AND FORESTRY

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Abstract: A large variety of organisations provides support for cooperative approaches in the field of research and innovation in agriculture, forestry and rural development, and acts as Innovation Support Services (ISS). The findings from ProAkis (2015) show that different types of organisations such as administrative offices, public or semi-public advisory services, rural academies/universities, producer organisations, other NGOs or private consultants engaged in the Agricultural Knowledge and Innovation System (AKIS) can act as ISS. The funding of ISS can be public, private or a mix of both. A first literature review indicates that studies often focus on the larger "enabling environment" and the structure of the Agricultural Knowledge and Innovation Systems (AKIS). Moreover, many authors pay particular attention to the role of public or semi-public advisory organisations (Knierim et al., 2015; Sulaiman 2015). The aim of this paper is to assess the different types of organisations that provide support for interactive innovation, and to analyse the particular role of each type of organisation for interactive innovation projects. Particular attention will be payed to the divers group of organisations that are not part of a (semi)-public advisory organisation. The paper is based on the analysis of more than 200 case studies of publically or privately funded interactive innovation projects within the EU and beyond. The selection of cases took place under the framework of the project LIAISON funding by the EU research and innovation programme Horizon 2020 (grant agreement No 773418). European and national databases contain several thousands of projects in agriculture, forestry and rural development. We selected projects applying the interactive innovation approach from a) EU programmes (EIP-Agri, Horizon2020, Interreg, and LIFE+); b) nationally/regionally or privately funded projects; and c) informal initiatives or networks in the agri-food, forestry, bioeconomy or nature conservation area. Preliminary results indicate that publically funded IIS play a core role for legal/administrative compliance of projects. Semi-public advisory services take up this role as well, and they are strong in linking farmers with scientists, technicians, entrepreneurs etc. However, they often exist and offer efficient ISS only for those industries that have a long tradition for a sector or area (e.g. dairy, pork, poultry or club fruit). Niche sectors or industries with little policy engagement often lack the support of a publically funded advisory service but profit more from producer organisations or rural academies/universities when they take up the role of ISS.

THE LOGIC OF INNOVATION: EXPLORING THE ROLE OF INSTITUTIONAL LOGICS IN SHAPING INNOVATION IN AUSTRALIAN AGRICULTURE

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Abstract

The rationale informing innovation investments in Australian agriculture is one which views innovation as the source of productivity growth. Productivity is a measure of how efficiently inputs are converted to outputs, with the benefits of this efficiency theoretically being passed on to society through higher incomes which in turn deliver a range of societal benefits. Since the early 2000's Australia generally has experienced an extended period of low productivity growth which can be observed in stagnating median household incomes. More specifically, productivity growth in Australian agriculture has been the lowest of almost all OECD countries over the last 2 decades.

There are three key drivers of productivity growth which the Australian productivity commission describe as immediate causes, underlying factors and fundamental influences. Current 'innovation investments' typically target immediate causes. Workers in the field of agricultural innovation have been grappling with how best to sustainably address the productivity challenge in the face of an increasingly complex operating environment for nearly a century, with systems approaches having evolved as a direct response to this challenge.

The history and traditions of innovation in agriculture and the emergence of systems approaches can be viewed as an expression of different views on how the world works, how knowledge is generated and communicated and how best to solve problems. We equate these 'worldviews' with the 'underlying factors and fundamental influences' which the productivity commission suggest shape productivity performance.

In this paper we outline how these 'underlying factors and fundamental influences' may be influencing innovation performance in agriculture and by extension its sluggish productivity growth given the way in which institutions shape all aspects of human agency. A conceptual framework is proposed which has been designed to inform exploration of competing 'institutional logics' in Australian agriculture, with a view to enhancing change mechanisms and refining roles of relevant actors within the Australian AIS.

The Productivity problem in Australia

The vast majority of documentation concerning innovation in Australia outlines a chain of logic along the lines of the following quote:

"Investment in research and development (R&D) and innovation is vital for ongoing growth and improvement in the productivity, profitability, competitiveness and sustainability of Australia's agriculture, fisheries, forestry and food industries. " http://www.agriculture.gov.au/ag-farm-food/innovation.

This logic, even if it is not clearly stated, goes like this:

Invest in science/innovation, which will……

…… deliver economic growth through productivity gains, which will…….

…….lead to greater prosperity and living standards.

Sometimes there is a pivot toward the social and environmental elements of sustainability, such as this from the chair of Innovation and science Australia:

"Since the dawn of civilisation, innovation has driven human progress. What many take for granted - the elimination of diseases such as polio and smallpox, breakthrough antibiotic treatments such as penicillin, safe and efficient travel courtesy of the jet engine, individual access to computing and communications power within a hand-held device—all of these benefits have been delivered by innovation."(ISA, 2016)

This broader view which places social progress at the centre of innovation is refreshing, but sadly the gravitational pull of the economist cannot be resisted, as in the next breath, the chair notes:

"Innovation is an essential driver of productivity and economic growth; hence governments around the world are grappling with how best to encourage and support more of it."(*Ibid*)

So the interest in innovation currently in Australia relates to the way in which it, as a process of change and transformation, delivers to us gains in productivity. *"The best summary statistic for our success in embracing new and better ways of doing things is productivity growth."* (Cutler, 2008)

Steindel and Stiroh (2001) describe the two main measures of productivity. Labour productivity in its simplest form is defined as real output per hour of work. Total, or multi factor productivity (TFP and MFP) is defined as real output per unit of all inputs. They go on to state that three primary factors determine growth in productivity. Capital deepening reflects the increase in output from physical capital available to workers. This largely speaks to the equipping of a workforce. The second element is labour quality, which attempts to capture the increase in output resulting from a change in worker mix or skills. The third contributor to productivity growth is total or multi factor productivity growth, which effectively measures the increase in output not attributable to capital deepening or labour quality. So how is Australia tracking on these measures? According to Cutler, (2008), not so good:

"Sometime around 2002 Australian productivity went from growing substantially faster to growing substantially slower than the Organisation for Economic Cooperation and Development (OECD) average. Though some of this may be an artefact of increased mining investment, it is unlikely to be the whole story. The conclusion is that, had it not been for the hunger the emerging giants of the developing world have had for our resources, we would have felt the effects of our complacency more directly as stalling living standards."

The trend noted by Cutler in 2008 has continued for the last 10 years. Whilst labour productivity has continued to show relatively typical, cyclical variation[15] MFP growth has been subdued for almost two decades[16]. Median household incomes have also remained virtually unchanged for more than a decade[17]. Whilst there is not a tight relationship between these three indicators given that labour productivity has shown some significant growth over the last 10 years, the overall picture that emerges is one of low productivity growth and limited or no average wage or income growth.

When looking at the case of agriculture, the story is much the same. USDA international productivity data show a declining trend in TFP over the last 30 years (Figure 1). Data from the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES) provides a more nuanced look at sectoral contributions to productivity growth within the broadacre industries,

[15] https://www.ceicdata.com/en/indicator/australia/labour-productivity-growth
[16] https://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/5260.0.55.002
[17] https://www.abs.gov.au/household-income

and while showing glimmers of hope, the overall picture is one of low growth over the last 30 years, averaging 1.6% (Sheng, Nossal and Ball, 2013).

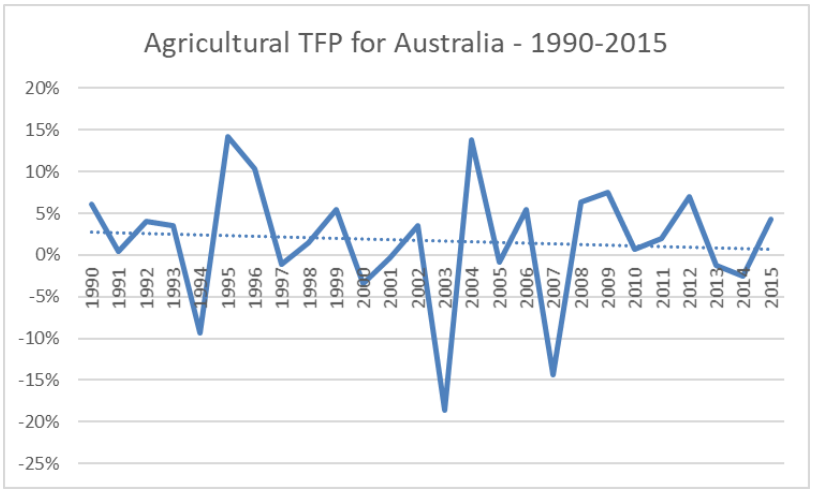


Figure 1: Total Factor Productivity Growth in Australia between 1990 – 2015. Source: https://www.ers.usda.gov/data-products/international-agricultural-productivity/

This being the case, the question needs to be asked: why the poor performance? Some may be explained by adverse seasonal conditions, however Hughes *et al.* (2011) through their exploration of climate adjusted productivity frontiers in the Grains sector, demonstrated that whilst climate variability impacts upon productivity, the trend of poor productivity performance since the early 2000's holds. Besides, Australia is not the only nation where its agricultural sector is beset by climate and structural challenges, and these challenges have not suddenly materialized since 2000. Whilst these may play a role, it does not explain the relatively poor performance when Australian agriculture is compared internationally. Figure 2 uses USDA productivity data to compare countries from around the world with regards to productivity growth over time. As can be seen, Australia has been one of the worst performers over recent times. A key point to note is the relative fortunes of Australia versus the Netherlands. This data shows the exact opposite performance over the two time series, with Australia achieving an average growth rate between 1990 and 2002 of 2.7% compared to the Netherlands 0.8%, whilst for the period 2003-2015 Australia achieved an average growth rate of 0.7% and the Netherlands 2.5%.

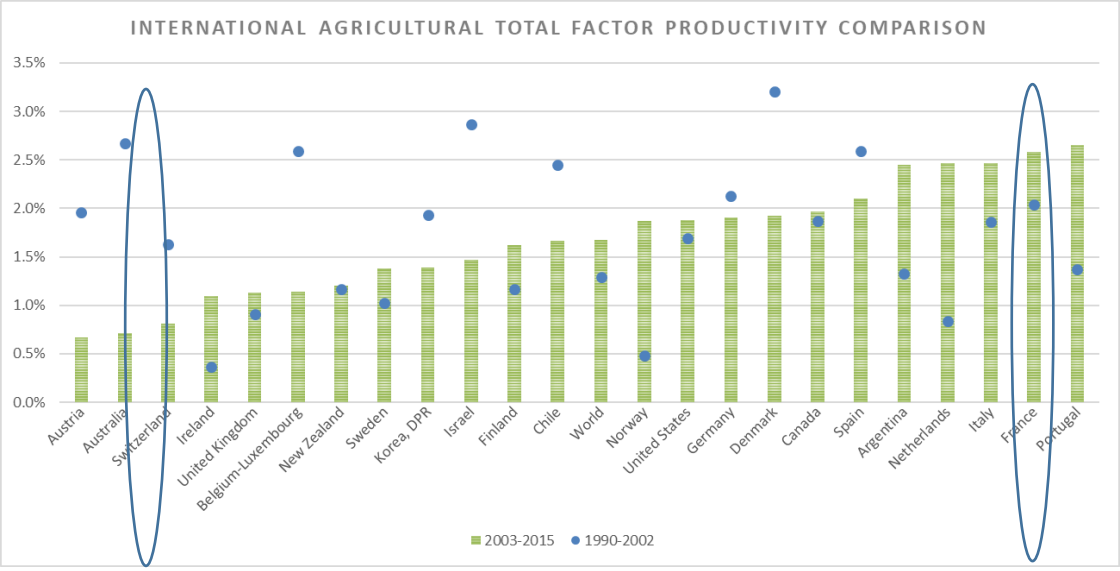


Figure 2: International comparison of average growth in total factor productivity for two times series – 1990-2002 and 2003-2015.
*Source:*https://www.ers.usda.gov/data-products/international-agricultural-productivity

So does this poor productivity performance mean we are not 'innovating'? The productivity commission identify three primary drivers of productivity change as summarised in Figure 3.

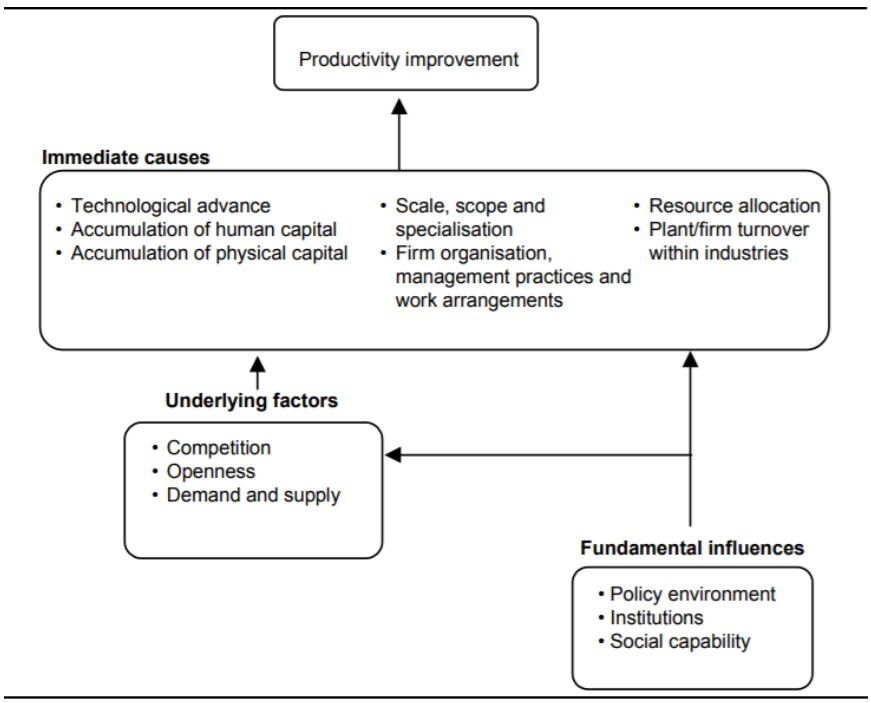


Figure 3: Main influencers of productivity growth.
Source:https://www.pc.gov.au/research/supporting/productivity-growth/productivity-growth.pdf

'Immediate causes' relate to the development and enhancement of technology, skills, knowledge and practices that shape and underpin organisation and firm performance. Underlying factors

relate to the drivers of change, whether they be market signals or other incentives/constraints. Fundamental influences *"condition productive potential and its long term realization"*(Productivity Commission, 2009). The policy settings, institutional 'rules of the game' and orientation of the population toward change, all dictate both the starting point and trajectory of change. Thus when looking for reasons as to the poor productivity performance in Agriculture, all three of these influences need to be examined.

Over the last 10 years, numerous reports and strategies have been written to do just this. (The Council for Rural Research and Development Corporations, 2018, Australian Academy of Science, 2017, CSIRO, 2017, Food Innovation Australia Ltd, 2017, Australian Trade Commission, 2017, Millist, Chancellor and Jackson, 2017, Keogh and Henry, 2016, Australian Government, 2015, Hajkowicz and Eady, 2015, OECD, 2015, Cutler, 2008,). From these reports a number of key issues can be identified (Howard Partners, 2018):

Market and technology opportunities are presenting themselves yet there are a range of barriers to exploiting these

Investment in agricultural research and extension is declining

Insufficient product differentiation in global markets

Limited value adding and participation in global value chains

Human resource constraints leading to reduced uptake of technology

Increased questioning of social licence to operate in agriculture

Impacts of climate change will significantly impact agriculture

Inadequate digital infrastructure and services

Lack of support for the development of specialist suppliers in the technology space

Inappropriate research governance leading to short term focus and a lack of systems perspectives

These reports extend back more than a decade. Industries have had access to their wisdom and have continued to invest considerably in innovation activities, presumably whilst taking into account the insights presented. Depending on the estimates used, investment in the agricultural innovation system in Australia amounts to between $3 and $3.5 billion dollars annually (Millist, Chancellor and Jackson, 2017; Department of Agriculture, 2019). Based on the annual reports of the 14 rural research and development corporations and the 2018/19 federal government budget tables, the combined investment of federal government and industry levies is $901 million. Once state government investment is added, approximately 62% of all investment in research, development and extension can be classified as 'publicly funded' if levies are included (Millist, Chancellor and Jackson, 2017). In light of the number of reviews and strategies developed over the last decade, and the ongoing poor productivity performance of Agriculture, it could be argued that levy and tax payers are not getting value for money out of a system which seems unresponsive to change.

Making progress on the productivity problem in Australia

Two potential 'reasons' for this poor performance can be articulated:

The agricultural innovation system is failing to achieve improvements in productivity because of an inability to adequately influence the 'immediate causes' of productivity. *This could be seen as a failure of method – ie: how innovation investments are defined, designed, managed and delivered.* Or;

The agricultural innovation system is not adequately addressing the 'fundamental influences' of productivity which underpin the capacity of actors in the system to influence 'immediate causes' of productivity. *This could be seen as a failure of those within the AIS to engage with and address root causes and reorient perspectives, approaches and structures associated with agricultural innovation accordingly.*[18]

The position taken on this reasoning has significant implications for policy and practice. If the key limiting factor to achieving innovation and associated productivity improvements relates primarily to the approach to innovation, then the response is to change the approach. If its to do with the 'fundamental factors' which influence all elements of the system, the response is to explore shifting the 'logic' which underpins the system and effectively change the way actors in think about innovation entirely.

The aim of this paper is to explore proposition 2 in more detail, through examining the history and traditions of innovation in agriculture; examining the area of 'fundamental factors' more closely and linking these to institutional theory, and finally, propose a framework through which institutional logics in Australian agriculture can be understood and used to enhance innovation performance.

The history and traditions of Innovation in Agriculture

Since the second half of the nineteenth century, where research stations were seen as the 'generator of knowledge' which was then 'extended' into the farming community, the evolution of perspectives on innovation can be distinguished by 7 key characteristics as follows (adapted from Röling, 2007; Klerkx, Van Mierlo and Leeuwis, 2012):

Underlying rationality

Theoretical perspective

Mental models

Focus

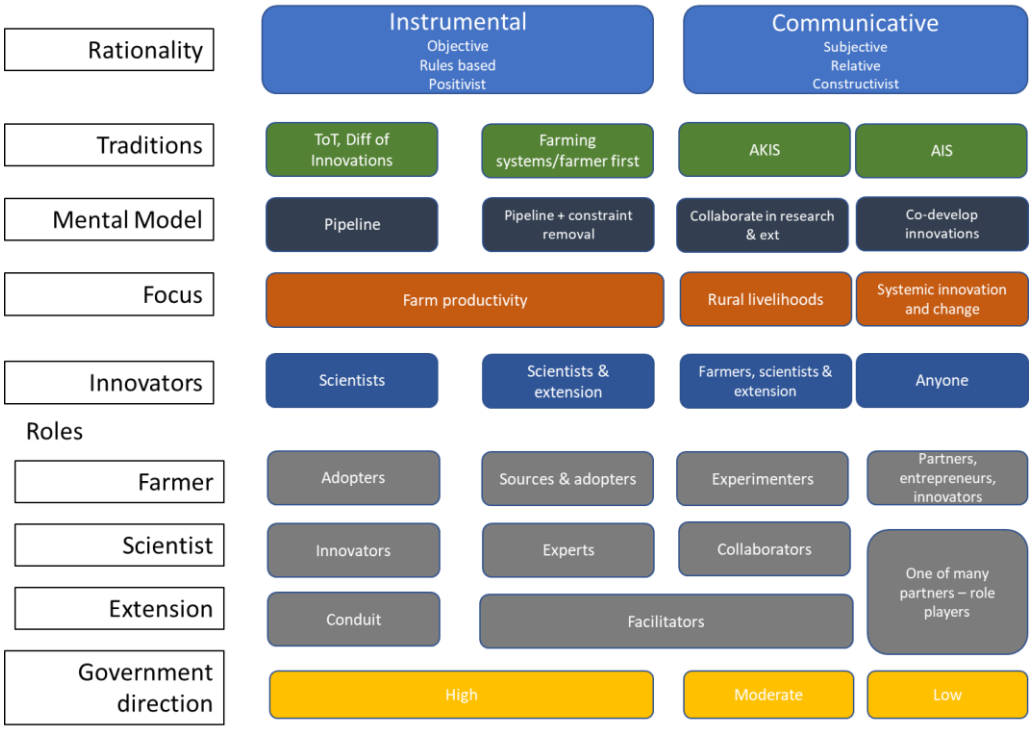
Perspective on who innovates

Roles of key actors

Level of government direction

The table below summarizes how each of these traditions differs in relation to these defining characteristics:

[18] There is a third consideration here, which is that productivity is a fundamentally flawed metric for innovation. Whilst not part of this current discussion, further analysis of this proposition will occur throughout the life of this PhD research.



The perspectives outlined above represent not only different traditions of innovation, but also different orientations toward what the means and ends of innovation might be. The progression toward the right of the summary diagram - in thought and theory at least - represents an increasing appreciation of the world as 'complex' and its problems as 'systems' in nature. However the idea of 'systems' approaches is not new, rather is *"a contemporary expression of perennial problems which have been recognized for centuries and discussed in the language available at the time."*(Von Bertalanffy, 1972). With regards to Agriculture, Bawden (1995), writing retrospectively on the evolution of systems approaches in the 1970's, commented that the problematic situation in agriculture during that period was characterised by an "ever increasing complexity". This drove the academics within the department of rural development at Hawkesbury Agricultural College to radically transform their curriculum to make it more 'systems oriented'. Complexity can be seen as a fundamental characteristic of agricultural systems (Bawden, 1991, 1992; Crawford *et al.*, 2007; Klerkx, Aarts and Leeuwis, 2010; Turner *et al.*, 2017). In fact, it is an attribute of all systems (Boulding, 1956; Checkland, 1981) and is therefore a defining feature of work focused on the improvement of problem situations.

Complex and therefore systems 'problems' present a problem to science. Von Bertalanffy, (1972) again:

"Science, however, was not well prepared to deal with this problem. The second maxim of Descartes' Discours de la Methode was "to break down every problem into as many separate simple elements as might be possible." This, similarly formulated by Galileo as the "resolutive" method, was the conceptual "paradigm" of science from its foundation to modern laboratory work: that is, to resolve and reduce complex phenomena into elementary parts and processes."

Whilst highly effective, the 'machine' model stands in conflict with the Aristotelian idea of synergy, later articulated as 'emergence', inherent within systems. Whilst we can develop an understanding of a system through detailed analysis of its parts, its 'emergent properties', its expression when these parts come together, can only really be understood in terms of the 'whole'.

In considering systems approaches within agriculture, Bawden, (1991) distinguishes between two types of systems inquiry - 'ontosystemic' which is concerned with the study of things as they exist in the world and 'episystemic' inquiry, which is concerned not with an external reality, but with "*peoples perceptions of reality"*. Bawden goes on the state that Farming Systems research is an example of the former, whilst Checklands (1981) Soft Systems Methodology is an example of the later. Von Bertalanffy, (1972) labels this 'system philosophy, and identifies systems ontology and epistemology along similar lines to Bawden, and adds the idea of systems values. His 'systems ontology' concerns itself with the distinction, or lack thereof, between 'real' and 'conceptual' systems and how such distinctions can be made. His 'systems epistemology' emphasises how 'reality', 'truth' and 'knowledge' are *"an interaction between knower and known, and thus dependent on a multiplicity of factors of a biological, psychological, cultural, and linguistic nature."* Von Bertalanffy (ibid) contrasts his systems philosophy with systems technology and systems science, which is akin to Checkland's (1985) hard and soft systems distinction. The hard/soft systems divide has several analogues in the social sciences. Habermas(1984), in critiquing the nature of western society and its dominance by positivist science, divides human action into two main types – purposive/rational and communicative action. Mingers, (1980) highlights that such a distinction is;

"similar in spirit to previous sociological categorisations such as Gemeinschaft/ Gesellschaft (Tonnies), informal/formal (Mayo, Homans) and traditional/bureaucratic authority (Weber)." (pg 41).

Such categorisations are viewed by Greeley (2002) as being part of the great sociological story which attempts to describe and explain the massive social transition of the enlightenment and industrial revolution(s). They speak, somewhat romantically, of a progression from traditional, familial, agrarian social roots to more formal, structured and machine based ways of working and relating. This progression is often seen as not one of choice by the masses, rather one of disruption and disturbance. There is always an air of longing for one world over the other and a concern for the plight of society as it lurches toward the unknown. Implicit – sometimes explicit - within all of these categorisations are a view of what is right, rational, practical and useful, what could be, should be or might be if we, as society, were to organize ourselves in one way versus another (Gray, 1964; Swidler, 1973; Victor and Stephens, 1994).

These distinctions point to different views on what the world is, how it can be known, what it means to act in the world, and how our action may influence the future. They can therefore be understood as different worldviews. The term 'worldview' or 'Weltanschauung' has been variously described as *"a comprehensive conception or apprehension of the world especially from a specific standpoint"* (Miriam Webster), *"an intellectual construction which gives a unified solution of all the problems of our existence in virtue of a comprehensive hypothesis, a construction, therefore, in which no question is left open and in which everything in which we are interested finds a place."* (Freud, 1936), and *"a coherent collection of concepts and theorems that must allow us to construct a global image of the world, and in this way to understand as many elements of our experience as possible."* (Aerts *et al.*, 1994).

Worldviews are akin to Schon and Rein's (1994) 'generative metaphors'. These are grand stories which carry over from context to context and enable the familiar and unfamiliar to be seen in new ways. These stories have a deep psychology and are ground in not only value and belief systems, but images and cultural forces that have stood the test of time. Schon and Rein (ibid) go on to suggest that it is the way in which individuals, organisations and institutions 'name and frame' problem situations via such metaphors which sows the seed of conflict in complex problem domains.

The importance of ontology, worldviews and generative frames to agriculture and innovation relate to their role in framing problem contexts and articulating what action to make progress in such context may be. How a problem is framed dictates how it is understood and therefore what constitutes action to make progress. If the problem of live export of sheep is viewed as a violation of animal rights, the only viable solution is the cessation of the trade. If however the problem is viewed as a failure within an ethical trade associated with international food security, a very different solution is imagined. So whilst actors within the Australian AIS may agree that systems approaches are necessary to address contemporary challenges, the underlying 'worldviews' upon which such a view is based may not be aligned and therefore may be the root of conflict, confusion and a mismatch of 'means' to 'ends'. In fact, agreement around 'ends' becomes problematic due to divergence within the constitutive elements of worldviews. In the next section we explore how worldviews, frames and ontologies can be linked with institutional theory to progress a framework for exploring the 'fundamental' forces shaping innovation in Australian agriculture.

Institutional Logics and organising for innovation.

Fundamental factors - the policy environment, formal and informal institutional rules of the game and the orientation of society toward change - are not really 'fundamental' at all, rather they are informed and shaped by further underlying forces. Social theory would suggest that policies, institutions and societal orientations within a domain form part of a 'socio-technical regime' which:

"……..*forms the 'deep structure' that accounts for the stability of an existing socio-technical system. It refers to the semi-coherent set of rules that orient and coordinate the activities of the social groups that reproduce the various elements of socio-technical systems*"(Geels, 2011a)

In the context of innovation and change, socio-technical regimes can be understood as an element of a "Multi Level Perspective" (MLP) on social transition:

"The MLP distinguishes three analytical levels: niches (the locus for radical innovations), socio-technical regimes, which are locked in and stabilized on several dimensions, and an exogenous socio-technical landscape. These 'levels' refer to heterogeneous configurations of increasing stability. The MLP proposes that transitions, which are defined as regime shifts, come about through interacting processes within and between these levels." (Geels, 2011b).

Change in the key elements underpinning productivity growth as defined by the productivity commission therefore could be seen as the outcome of transitions and alignments between these 'multiple levels' (Geels and Schot, 2007). This provides a starting point for exploring how such forces and factors may be influenced to enhance innovation. Fuenfschilling and Truffer, (2014) suggest that these levels can be understood as different degrees of structuration. Structuration theory holds:

"……that structure does not exist outside the actions of agents; rather it is the outcome of repeated actions by multiple actors. For example, authoritative management can be practised only as long as both employers and employees adhere to this routine. Once people start to ignore this routine, or start acting differently, the structure that once sustained this precarious work practice ceases to exist. This two-directional reinforcing process is called the 'duality of structure' reflecting the idea that the structure that drives the behaviour of agents only exists because agents act according to the structure." (Kroon and Paauwe, 2014a)

This 'duality of structure' (Giddens, 1984) would seem to describe well the nature of innovation in agriculture at the moment. On the one hand there exists a range of complex, multifactorial

problems such as water policy and management, labour availability and capability, social licence around precarious natural resources and animal welfare, and managing the impacts of a variable climate, yet on the other hand you have a 'research, development and extension system' which, based on its self description, still adheres to a science centric, liner model of innovation. According to structuration theory, this model persists, largely due to the continued routines of agents within the structure which perpetuates it. These routines are informed by an underlying logic, likely unconscious and somewhat disconnected from the complexity of problems facing agriculture. Many authors (Thornton and Ocasio, 1999; Fuenfschilling and Truffer, 2014; Dahlmann and Grosvold, 2017; Mutch, 2018; Waeger and Weber, 2019) identify these 'institutional logics' as being both the core constituent of 'structures' and a key 'influencer' of routines within any given context. They are:

"The socially constructed, historical pattern of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality."(Thornton and Ocasio, 1999).

These logics can be seen as material and symbolic (Thornton and Ocasio, 1999), define the formal and informal rules of the game, shape values and guide interpretation and adjustment of action. The nature of human existence dictates that context and experience shapes how these overarching 'logics' get combined and reconfigured through practice.

"These ideal typical institutional sector logics get reconfigured and translated in organizational fields. Field logics emerge as a combination of one or more institutional sector logics. Since actors are assumed to be bounded in their rationality field logics are used as guiding principles that offer specific rationalities, set the rules of the game, allocate power and status and steer attention towards specific problems and solutions (Thornton and Ocasio, 2008). A change in field logic will lead to a change in actors' strategies, problem focus or technology." (Fuenfschilling and Truffer, 2014)

Agriculture can be seen as an organisational 'field' (Kroon and Paauwe, 2014b). Productivity and hence innovation, can therefore be seen as an expression of practice and performance within this field. Such practice is shaped and reinforced by institutional logics which in turn perpetuates the system. If productivity performance is poor, which under the logic outlined from the outset suggests our innovation capacity is poor, then there is a distinct possibility it is due to some limiting element within the logic(s) which underpins the organisational field of agriculture.

Exploring how institutional logics shape innovation performance in Australia – a conceptual framework

The purpose of our research is to progress an understanding of the nature and influence of institutional logics on Agricultural innovation in Australia, and contribute to the capacity of the AIS to enable 'institutional innovation'. A number of questions emerge from this which inform our research:

What institutional logics can be observed within the Australian Agricultural Innovation system?

Are particular institutional logics more effective at reproducing and sustaining innovation in agriculture?

How do institutional logics change?

Based on the above discussion we have developed a conceptual framework to direct exploration of these questions. Part one of this framework is described in figure 4. Structuration within the organisational field of agricultural research and development will be explored with the view to

illicit a) the dominant logic 'in use' within Australian agricultural R&D, and b) competing logics which may be also evident. This will be done through analyzing the espoused 'logic' of innovation through analysis of relevant policy and investment documents within the field, along with developing understanding of the 'logic in use' via interviews to understand routines within the field. The aim is to use an understanding of innovation practice (espoused and in use) to describe the structural elements of innovation and through this inductively describe existing institutional logics. With regards to linking logics to innovation performance, the R&D systems of Australia and the Netherlands will be compared given their contrasting productivity performance.

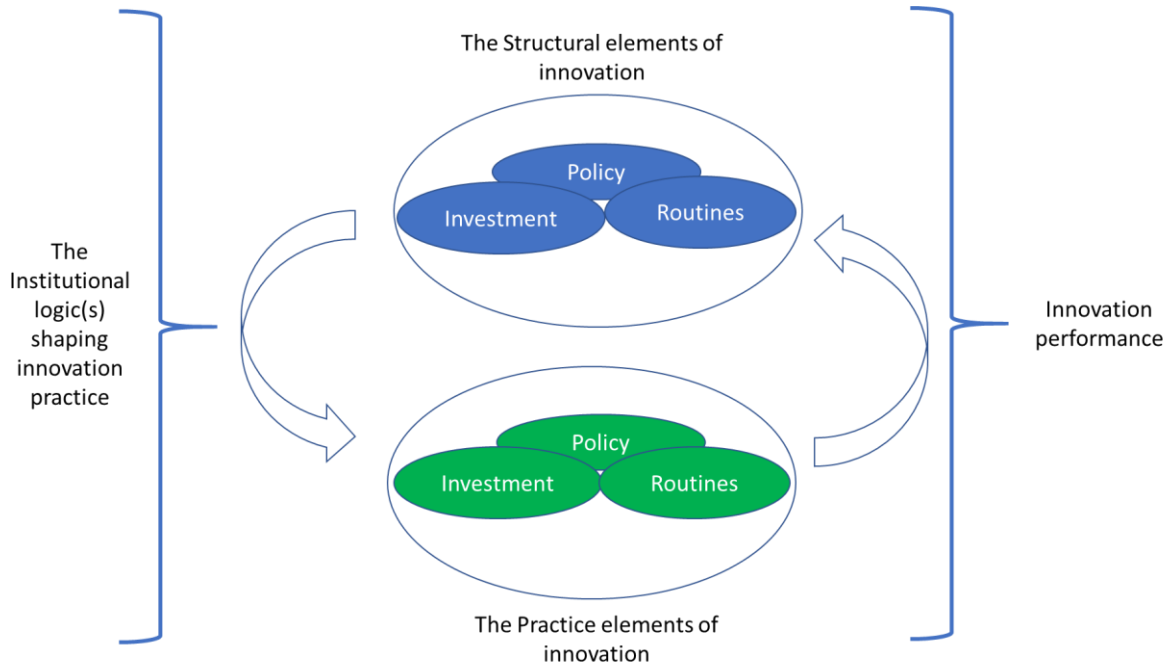


Figure 4: Conceptual framework for the exploration of institutional logics and their impact upon innovation practice and performance

Just identify logics alone however is not enough. Change in institutional logics and how this may be enabled therefore becomes of interest. Organisational fields such as agriculture are clearly diverse, with socio-technical regimes surviving presumably due to their relative 'fitness'. Fuenfschilling and Truffer, (2014) suggest that the overall structuration of a field is due to the relative strength of alternative field logics. *"At any moment, these logics may coexist, compete, contradict or complement each other and thereby reinforce or weaken the structuration of the field."*(Fuenfschilling and Truffer, ibid).

Institutional 'work' therefore emerges as a useful concept with regards to bringing about change within the prevailing/dominant logic inherent in an organisational field. Lawrence and Suddaby, (2006) define institutional work as *"purposive action of organizations and individuals aimed at creating, maintaining, and disrupting institutions" (pg 215)*. Such work is; "*concerned with how change happens through the agency of individuals who form part of, or are affected by, an institution."* (Dahlmann and Grosvold, 2017). Figure 5 sumarises part two of our conceptual framework guiding the exploration of institutional work as a mechanism for change in the dominant logic. Drawing on the MLP, institutional work can be viewed as a mechanism for competing, or 'niche' logics, to alter the prevailing logic within the field of agricultural R&D. We aim to use case studies to both describe the existence of institutional work in practice and articulate the key enablers and barriers to institutional work within the field of Australian

agricultural R&D. Of interest is the role different actors in the AIS may play in this, particularly extension, given the key role brokering practices play in innovation.

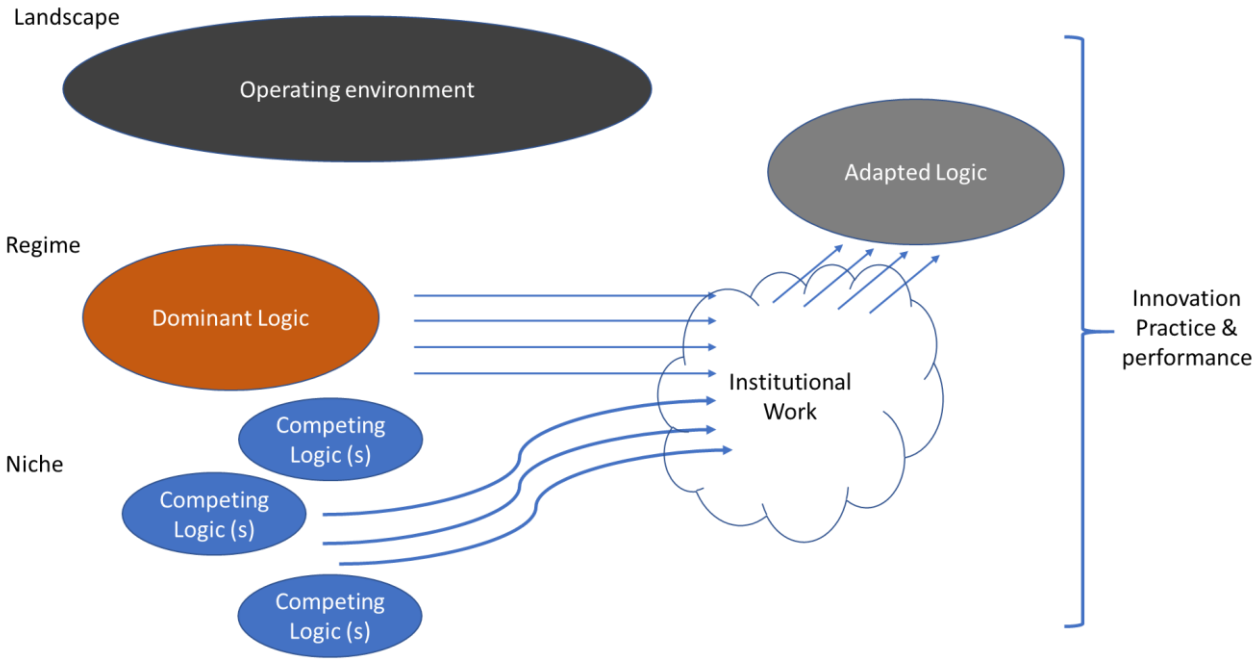


Figure 5: Conceptual framework for exploring institutional work using the MLP.

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UNRAVELLING SYSTEM FAILURES WITHIN EUROPEAN MULTI-ACTOR CO-INNOVATION PROJECTS IN AGRICULTURE: A COMPARATIVE ANALYSIS

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Abstract: European Union (EU) level funding programmes in support of research and innovation in agriculture such as Horizon 2020 and INTERREG, increasingly require prospective partnerships to bring together different types of actors in order to co-create knowledge and innovation. Although the multi-actor and geographical distribution requirements have created opportunities for new types of actors to participate in these EU-wide multi-actor co-innovation projects, a few pertinent questions point to areas of concern in the way these projects are currently being stimulated by the EU: What are the key challenges met during the project lifecycle? Who is involved in these projects, i.e. do they truly represent a diversity of actors, or rather a distinct set of established, dominant or specialised actors? What is the added value of working with different nationalities, does it allow for broad cross-fertilisation and diffusion of knowledge or is it merely a complex management challenge? How do these projects thus succeed in combining complementary expertise and in finding a balanced relevant representation in terms of Member States, sectors, stakeholders and governance levels? Even though these EU-wide multi-actor projects take up a significant amount of funding and are perceived to play a pertinent role in the transition to a more sustainable agrifood system, in-depth and comparative studies in search of answers to these questions are scarce. Furthermore, it requires a perspective which recognises not only the complexity of this type of co-innovation processes, but also the multi-level reality in which they take place. The Multi-level Innovation System (MINOS) framework enables such an analysis by defining the presence, influence and interdependence of multiple Innovation Systems (IS) in these projects at four levels; the European, the national, the project and the partner level. Applying this framework will allow us to identify different types of multi-level system failures influencing the performance of these projects, i.e. failures which are the result of the interaction and connection between different IS levels and which influence the occurrence and severity of system failures in other IS levels. We aim to analyse and compare the functioning of two European multi-actor projects: an H2020 project on solving drink water pollution from agricultural origin and an INTERREG North West Europe project on the reduction of food losses in the first part of the value chain. INTERREG projects have a more narrow geographical focus, are smaller in size and fit in more open calls for proposals than the H2020 projects. Useful lessons on how to improve co-innovation processes in multi-actor projects can be learnt from both policy frameworks. For both practitioners and policy-makers alike, it would be beneficial to improve understanding on how these projects accommodate differences in institutional, infrastructural, cultural and social contexts.

DETERMINANTS OF SUCCESS IN THE MULTI-LEVEL IMPLEMENTATION OF THE MULTI-ACTOR APPROACH TO INNOVATION IN AGRICULTURE, FORESTRY AND RURAL DEVELOPMENT: AN ANALYTICAL FRAMEWORK

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Abstract

The Multi-Actor Approach (MAA) is a normative standard the European Commission (EC) formally applies to many of its (co-)funded innovative projects in agriculture, forestry and rural development. The MAA requires projects 1. to build on the activities of partners with complementary types of knowledge, including in particular (representatives of) the targeted users of the project results; and 2. to ensure the joint engagement of these diverse partners in all phases of the innovation process.

Projects that are required to comply with the MAA are officially called 'Multi-Actor projects'. They include some international research and innovation projects funded under the EC's Framework Programme for Research and Technological Development Horizon Europe (or its predecessor Horizon 2020), as well as local EIP Agri Operational Groups (OGs), which are co-funded by the EC and the Member States (MS).

As with all public policies, several groups of actors – including the EC itself – have a legitimate interest in learning how well the MAA is being implemented by its intended target actors. A general answer to this question is complicated by the fact that Multi-Actor projects differ in many respects, such as the innovative objectives they pursue, the size and composition of their consortia, the duration of their activity, and their geographic scope. One aspect that makes it particularly difficult to identify general implementation determinants is their embeddedness in distinct multi-level governance settings. For example, while Horizon Europe-funded research project consortia operate under the direct management of the EC's agencies, OGs are funded under a measure which is formulated by the EC but implemented at the national, or in some MS, regional level. These differences inevitably have an impact on how success in the implementation of the MAA can be achieved.

In this paper, we propose a framework for analysing the factors that determine success in the implementation of the MAA, as well as their interrelations. This framework builds on a review and integration of insights from various fields of social scientific research, notably research on public policy implementation, multi-level governance, and participatory approaches in agricultural policy. To test the framework, we apply it to data from four case studies of OGs that we conducted in 2020 in the frame of the H2020-funded research project LIAISON.

1. Introduction

The Multi-Actor Approach (MAA) is a normative standard the European Commission (EC) formally applies to many of its (co-)funded innovative projects in agriculture, forestry and rural development. These projects are officially called 'Multi-Actor projects' (MA projects) (cf. EIP Agri 2017). They notably include all projects that form part of the *European Innovation Partnership for Agricultural Productivity and Sustainability* (EIP Agri) such as some international research and

innovation projects funded under the EC's Framework Programme for Research and Technological Development *Horizon Europe* (or its predecessor *Horizon 2020*), as well as local *EIP Agri Operational Groups* (OGs), which are co-funded by the EC and the Member States (MS). However, other EU funding programmes such as LIFE, Interreg or LEADER/CLLD apply similar approaches.

A review of relevant policy documents reveals that the EC does not currently offer a consistent definition of what the MAA actually requires of the project consortia to which it applies. Requirements vary for different types of MA projects and typically also individual projects. However, the MAA – in any of its specifications – entails *at least* the following normative elements:

1. It requires innovation projects to build on the activities of "partners with complementary types of knowledge – scientific, practical and other" (EIP Agri 2017: 1), including in particular (representatives of) the targeted users of the project results (multi-actor requirement); and
2. to ensure the joint engagement of these diverse partners in all phases of the innovation process, "from participation in the planning of the project and experiments, to implementation, the dissemination of results and a possible demonstration phase." (EC 2020) (interactive innovation requirement).

As with all public policies, several groups of actors – including the EC itself – have a legitimate interest in learning how well the MAA is being implemented by its target actors. Presupposing that 'success' in the implementation of the MAA means compliance with the above requirements – how well are MA consortia faring, and which factors determine implementation success? In this paper, we will leave aside the first of these questions – that of assessing actual MAA implementation *performance* – and focus on the second: that of performance *determinants*.

A general answer to this question is complicated by the fact that MA projects differ in many respects, such as the innovative objectives they pursue, the size and composition of their consortia, the duration of their activity, and their geographic scope (cf. Fieldsend et al. 2020). One aspect that makes it particularly difficult to identify general implementation determinants is their embeddedness in distinct *multi-level governance* settings (cf. Hooghe/Marks 2003). For example, while *Horizon Europe*-funded research project consortia operate under the direct management of the EC's agencies, OGs are funded under a measure which is formulated by the EC but whose implementation is managed by authorities at the national or, in some MS, regional level. These differences inevitably have an impact on how success in the implementation of the MAA can be achieved. How can such heterogeneous cases be compared in terms of the factors that determine implementation performance?

In this paper, we propose a framework for analysing such factors as well as their interrelations. This framework builds on a review and integration of insights from various fields of social scientific research, notably on public policy implementation, multi-level governance, and participatory approaches in agricultural policy. To test the framework, we will apply it to data from four case studies of OGs that we conducted in 2020 in the frame of the H2020-funded research project LIAISON (cf. Cronin et al. 2021). OGs are a particularly challenging study object because they are co-funded from the European Agricultural Fund for Rural Development (EAFRD) and the national or, in some MS, regional Rural Development Programmes (RDPs) and are being managed by national or regional public bodies within the legal scope defined by the EAFRD regulation. This means that more levels of governance are involved in OG implementation than in other MA partnerships, especially consortia funded by the EU research fund Horizon Europe or its

predecessor H2020. Furthermore, MS/regions implement the OG measure differently through their RDPs. For example, while several MS have designated an innovation support service provider (ISS) to assist the OG with application or problems during project implementation, not all have done so, and the structure and function of the ISS differs from MS/region to MS/region.

In the next section, we will describe the theoretical background of our framework and define its key variables (2). We then present the main findings from applying this framework to the four OG case studies (3). The article concludes with a discussion of the empirical findings and the framework's benefits and limitations (4).

2. Theoretical background and key variables of the analytical framework

In this section, we define the dependent variable (2.1) and independent variables (2.2) of our framework, together with a visualisation (graph 1). (Numbers in square brackets refer to the respective numbered elements in the graph.)

2.1 Dependent variable: Implementation performance

The core concept of our framework is that of 'implementation'. Implementation means the act of realizing a goal [1] – understood as formulation of a desired state of the world – defined by a public policy (cf. O'Toole 2000). While 'implementation' in this sense can both refer to a single actor's activities or the activities of diverse actors at once, our framework focuses on the implementation performance of a single (individual or collective) actor, or actor *type*.

For each policy goal, we assume there exist (in reality or hypothetically) *objectives* which identify the activities that are needed to achieve the policy goals (cf. Aragrande/Argenti 2001). By thus translating goals into concrete mandates that can be attributed to actors, objectives effectively provide the *success criteria* against which to measure actors' implementation performance.

By *'implementation performance'* we mean the extent to which an actor actually manages to comply with the particular objective(s) the policy maker expects him/her to comply with. Accordingly, we consider an actor's implementation performance successful to the extent that s/he complies with the objectives he/she is expected to comply with, and unsuccessful to the degree that s/he does not.

2.2 Independent variables

There is a broad consensus among researchers that implementation performance depends both on the characteristics of the implementing actor and various external factors, i.e. factors beyond the implementer's control (cf. Mazmanian/ Sabatier 1989; Velten/Jager/Newig 2021). As one observer of the field noted as early as 1986, empirical studies of policy implementation as well as conceptual contributions have identified over 300 such potential determinants of implementation performance (cf. O'Toole 1986; cf. Saetren 2014). Our framework represents an attempt to integrate most of these findings into one coherent analytical approach. It is based on the premises that (1) an actor's implementation performance is a function of his or her *ability to implement* and that (2) this ability is determined to varying, case-specific degrees by the *implementation context*.

2.2.1 Ability to implement

By an actor's ability to implement we mean all the *features of an implementing actor that determine the likelihood of his or her implementation success.* We focus here on those actor features that either make implementation success more likely ('assets'), or less likely ('deficits'), compared to a hypothetical state in which those features are not present and in which all other determinants permit implementation success. While assets constitute a *success factor*, 'deficits' constitute an implementation *bottleneck*.

We propose that all of an implementing actor's assets and deficits fall into *six* categories [2]. The relevance of each of these categories for implementation performance and, within each category, the extent and direction of influence of each determinant, will vary across empirical cases.

Three such categories of determinants are largely uncontroversial. Researchers of various disciplines agree that an actor's ability to achieve certain goals depends on (a) his or her possession of material *resources* needed for implementation, such as budget, facilities and time; (b) his or her possession of relevant *capacities*; and (c) his or her *motivation* to perform the activities needed for goal achievement (cf. e.g. Mazmanian/Sabatier 1989). Within each of these categories, an actor may feature multiple assets and/or deficits. Which of his or her features may become assets or deficits for implementation depends, among else, on the goal being implemented. For instance, not all goals require the same kinds of resources or capacities to be achieved.

Furthermore, a major interest of practitioners and researchers of policy implementation concerns the *normative coherence* of implementation, i.e., whether implementation is compatible with certain other norms at a higher or at the same regulatory level (cf. Fischer-Lescano/Teubner 2004). We integrate this concern into our framework by assuming that most policies are associated with a *claim to legitimacy*. While 'legitimacy' can refer to a policy's compatibility with legal as well as ethical or social norms, the focus of our framework is on *legal* compatibility, i.e. *legality*. We further assume that policy implementation may only be considered successful to the degree that it preserves the *policy's legitimacy basis*, i.e., does not violate other legal norms that the policy claims to be compatible with. Accordingly, another feature that matters for an implementer's performance is (d) which *legal resources* s/he possesses for goal implementation; referring to both the rights and duties that arise for the implementer from the policy itself and from other legal norms the policy claims to be compatible with. While some rights and duties provide the implementing actor both with *incentives* and *options* to implement the policy objectives ('assets'), others may create negative incentives or legal hurdles ('deficit').

But even where an implementer possesses appropriate legal resources for implementation, s/he may not always be fully aware of these resources, i.e. of what s/he can and cannot legally do to implement the objectives (cf. Wagner 2009). Since one arguably cannot intentionally observe duties or make use of rights that of which one is unaware, an actor's degree of (e) *certainty about his or her legal resources for implementation* is likely to affect his or her implementation performance as well.

Finally, research has shown that the ability of a collective to achieve certain goals is highly dependent on the ability of its individual *members* to contribute to collective performance (cf. Collective Action, Ostrom 2009). We propose that this has two implications for policy implementation when the implementer is a collective. First, it means that implementation performance does not only depend on how well the *collective* fares with regard to the above categories of factors (a-e). Rather, performance is also influenced by whether the *individual*

members possess all they need to contribute to the collective's performance. Secondly, this dependence of the collective on its individual members also means that the collective's performance will be determined by (f) the *quality of collaboration* between members, e.g. whether they have established appropriate mechanisms for decision-making, knowledge sharing, and conflict resolution (cf. e.g. Stokes Berry/Berry/Foster 1998).

Overall, then, our framework considers an actor's ability to implement a certain policy to be comprised of six categories of factors or features:

1. the *rights and obligations* the actor possesses (category of 'right')
2. the extent he is *aware of these rights and obligations* ('knowledge of right')
3. the *resources* he possesses to make optimal use of his or her legal leeway for implementation ('resources')
4. the *capacities* s/he possesses to make optimal use of these rights and resources for implementation ('capacity')
5. the *motivational resources* s/he possesses to make optimal use of those rights, resources, and capacities for implementation ('motivation')
6. and the *mechanisms for collaboration* the actor has established internally ('quality of collaboration')

Based on the above considerations, we assume that in collective actors, the first five of these categories apply both to the collective as a whole, *and* to its individual members. In addition, the sixth category only applies to collective implementers, not individuals.

Determinants of implementation performance may interact with each other both within and across categories in various ways, e.g. strengthen or weaken each other's effects or jointly contribute to or result in a third factor [3].[19] With this assumption, we account for the fact that the features that comprise an actor's ability to achieve goals are neither causally independent from each other, nor static, but that, very often, assets and deficits accumulate. Including this assumption also invites thinking about how implementing actors may build on their assets to compensate for some of their deficits.

2.2.2 Implementation context

An actor's ability to implement a policy is always influenced to some extent by determinants s/he may not affect (cf. Mazmanian/ Sabatier 1989; Velten/Jager/Newig 2021). These factors comprise his or her *implementation context*. We assume that some features of this context can *strengthen* the actor's ability to implement, i.e., constitute *success factors* of implementation performance, while others can *weaken* it and thus constitute *bottlenecks*. Since these factors become effective more 'upstream' in the implementation flow, we propose to call them 'upstream bottlenecks' respectively 'upstream success factors'.

We distinguish between two types of such factors: 1. the activities of actors at higher governance levels, and 2. the wider environment, which consists of activities of informal governance actors as well as aggregate features of the implementation context.

[19] An exception from this assumption is the implementer's possession of rights, which our framework assumes will be solely determined by his or her implementation context.

2.2.2.1 Actors at higher governance levels

As mentioned above, our framework takes into account that most policies, including the MAA, are implemented in multi-level governance settings (cf. Hooghe/Marks 2003; Börzel 2020; Jeffery/Peterson 2020) [4]. Analysing the implementation of policies as embedded in multi-level governance settings means recognizing that the ability of an actor to implement a specific policy will partly be determined by other actors who have authority over him/her, i.e., have a *formal right* to condition his or her ability for implementation (governance actors).

Governance actors operate at different levels in that they have different *degrees* of decision-making power relative to one another with regard to the policy goal being implemented. Accordingly, we call an actor an ‚actor at a higher governance level' who may define implementation conditions which other governance actors may either only specify further or implement, but not alter or override. In this view, the 'implementing actor' occupies the lowest governance level, for s/he has, relative to all other actors, the least governance options (even though s/he may have some discretion in his or her implementation of the policy goal). Our framework also acknowledges that multiple actors may operate at the same governance level and may employ some form of division of labour.

Governance actors need not be governments or public agencies (cf. Börzel 2020). In fact, many current EU policies require the involvement of a broad range of societal actors in their implementation and monitoring (cf. Newig/Koontz 2014). In our framework, the sole criterion for defining an actor as a relevant governance actor is therefore whether that actor has, in relation to the policy that is being implemented, a formal *right to intervene in the implementation process at any stage.*

Actors at higher governance levels may either affect an implementing actor's performance directly by positively or negatively affecting one or more of the six categories of factors that comprise his/her *ability to implement*, especially his/her possession of rights and duties. However, they may also affect his/her performance indirectly, namely by affecting the *activities of actors at lower governance levels* (who in turn affect his/her ability to implement) or by affecting his/her *environment*.

Feedback from governance actors at lower governance levels – including from the level of implementation – to actors at higher governance levels or at the same governance level may also impact implementation performance indirectly (cf. Moynihan/Soss 2014) [5]. By feedback we mean any type of activity by actors at lower governance levels that has the potential to alter the activities of actors at higher governance levels.[20] Importantly, our framework does not consider activities here that lead to *reformulations* of the very policy objectives being implemented, but only activities that change *implementation* (cf. section 4).

[20] The difference between governance and feedback activities is that while both may lead to alterations in the activities of the actors at which they are directed, they exert a different degree of *pressure to comply*. The fact that policies are formulated at a higher governance level means per definition that all actors who occupy lower governance levels in the implementation process are legally obliged to comply. In contrast, it is not mandatory for actors at higher governance levels to comply with feedback from lower-level governance actors; rather, they may do so if they consider it prudential. For a similar argument, cf. Mazmanian/Sabatier 1989.

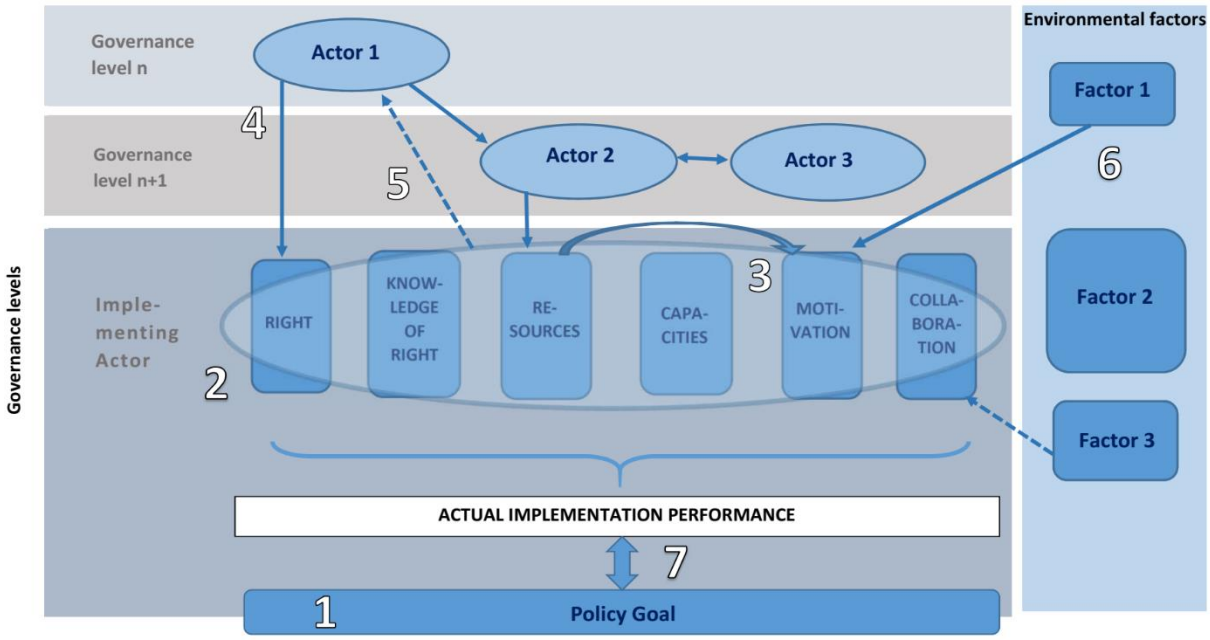
2.2.2.2 Environment

Next to governance actors, a variety of determinants not anticipated in and regulated by the formal implementation procedure are decisive for the outcome of most implementation processes (cf. O'Toole 1986; 2000). In our framework, we use the term 'environment' as a catch-all denomination for such determinants [6]. This category contains, in turn, two groups of factors: the activities of actors without formal decision-making power in the process, such as informal interest groups (cf. Cahn 2013), and aggregate features of the implementation context such as ecological, demographic and socio-economic conditions as well as policies from other policy areas. Considering the diversity of cases of policy implementation, our framework refrains from precluding which environmental factors will actually be relevant for explaining implementation performance in a particular case. Rather, the analyst must make informed decisions about which environmental factors to include in the analysis.

Like governance actors, informal governance actors and environmental factors may be ranked according to the level of influence they have over each other. According to this logic, features of the global economy are more likely to affect social and economic conditions in a particular area or sector than vice versa. Ranking environmental factors in this way will help to explain also the kind of influence they each have on implementation performance, and why they may effect certain stages in this process, but not others. Like between governance actors, feedback may occur from less influential environmental factors to more influential ones.

Our framework also assumes that environmental factors interact with the activities of governance actors, and that feedback takes place both from environmental factors to governance actors and *vice versa*. For instance, global markets (environment) respond to the activities of governance actors, and governance actors respond to markets.

Conceptualising an actor's implementation performance thus as a function of his or her ability to implement, which is in turn at least partly shaped by actors at higher governance levels, the implementation context, and feedback mechanisms between these determinants, allows to identify the *causal pathways* that resulted in a particular performance. Determining such causal pathways of implementation success respectively failure is precisely the aim of our framework [7].



Graph 1: Visualisation of the analytical framework for multi-level policy implementation

3. Determinants of success in the implementation of the Multi-Actor Approach by Operational Groups: Results from four case studies

In this section, we present selected findings from applying the above framework to case studies of four OGs conducted in summer 2020 in the context of the EU research and innovation project LIAISON (2018-2022). The selected OGs were located in different countries (France, Germany, Italy and Poland) and addressed different issues (local introduction of hemp production, reintroduction of two ancient grains, establishment of a laboratory for local producers' shared use, participatory development of area-specific action plans). The collection of data was based on desk studies of relevant documents and interviews (partly face-to-face, partly online) with OG coordinators and various members as well as key stakeholders, e.g. from the managing and granting authority or business partners. Data collection followed an agreed guideline and was documented in a standardised 'case study reporting template' which was reviewed internally to ensure the comparability of data (cf. Cronin et al. 2021; Fieldsend et al. 2020).

Our case studies show that OG members generally approve of the concept of the funding scheme, which offers beneficiaries' of up to 100% funding for the *attempt* to innovate, rather than making funding conditional on a particular *outcome* such as an increase in productivity. Beneficiaries did not object to the amount of funding granted, which suggests that the activities they implemented matched the awarded amount. However, some interviewees also mentioned that they applied for funding from additional sources to implement some of their activities.

However, there are major bottlenecks in the implementation of MAA by OG. First, practitioners such as farmers or foresters generally have fewer resources and capacity to participate in OGs or in specific OG activities compared to other actors. Reporting requirements impose a particularly heavy administrative burden on small (family) businesses, who often lack administrative capacity and time.

Secondly, differential economic stakes of OG members have a major impact on their cooperation. While the project funding is the main or a major source of income for some partners, it is only an

additional support for partners whose main income comes from other sources such as business activities or employment. OG partners of the latter type typically have relatively lower economic stakes in the project results and therefore less incentives to 1. follow the requirements of the Grant Agreement in case of a (perceived) collision with the necessities of their main income-generating activity; 2. invest time in project activities or engage in stakeholder activities that yield no economic benefit; and 3. disseminate marketable findings/innovative solutions (risk of losing market advantage). In contrast, similar economic stakes in the project and trust through previous collaboration appeared to be motivational success factors for good internal collaboration.

The *implementation context* influences OGs' ability to implement the MAA in several important ways.

The inflexibility of the OGs' Grant Agreement with the *national/regional granting authorities* and (in two cases) the *paying agencies'* perceived rigidity in implementing them add to the administrative burden of beneficiaries and, sometimes, financial cost. Our case studies also reflect that *beneficiaries' rights differ considerably across MS*. In some MSs or regions, the OG measure is designed more favourably than in others, offering beneficiaries a comparatively higher maximum amount and a longer funding period, as well as a lower rejection rate and access to innovation support services (ISS). In addition, ISS differ in their design. In some regions/MS, ISS lack rights (limited remit), resources (understaffing) or capacity.

Legal collisions between funding requirements and national/regional laws or procedures (e.g., administrative provisions about funding rates for staff; different budget periods) often lead to legal obstacles or increase the administrative burden. For example, although in principle OGs can apply for investment funds from EAFRD under privileged conditions, the requirements (e.g. the obligation to use acquired machinery for the same purpose for several years, even after the end of the eligibility period) make it more attractive for OGs to pursue other investment funding options. These legal conflicts and shortcomings were insufficiently considered in EAFRD programming at the time of the case study analysis.

The *interplay of the governance actors involved* also has the potential to greatly influence MAA implementation and the implementation of OGs in general. Notable success factors include good collaboration between funding authorities; their adjustment of the funding measure based on beneficiaries' feedback – which in turn requires the existence of good feedback mechanisms between OGs and the funding authorities, as well as funding authorities' willingness and capacity to actually improve the measure's design; and their lenience towards beneficiaries in administrative matters.

Apart from differences in MS' implementation of the OG measure, the *overall support by the social and policy environment also varies among MS*, which also influences implementation performance. Notable bottlenecks include a weak Agricultural Knowledge and Information Systems (AKIS) and funding authorities' unfair privileging of certain actors as well as funding authorities' lack of resources, capacities and/or motivation to improve programming of the measure. In contrast, a strong national, regional or sectoral AKIS; a favourable market situation; good cooperation of local/regional/national public authorities with funding authorities; and the availability of additional funding sources on which OGs can constitute supportive environmental factors.

We further found that the *local context* is an important determinant of OGs' success in implementing the MAA. First, some of the studied OGs exhibited a strong local embeddedness. This improved their access to resources such as local informal support networks, which in turn

provided missing resources (e.g. facilities) and capacities (e.g. in administration). Secondly, our case studies indicate that spatial proximity of partners enhances their motivation to collaborate. Conversely, cooperation in OGs has long-term benefits for partners that can last even beyond their joint activities, which also increase their motivation to participate. Notable benefits include better networks and trust building, as well as capacity building (professional skills, experience with project participation).

4. Discussion

4.1 Empirical findings

The empirical findings confirm that successful multi-actor collaboration in agriculture, forestry and rural development depends both on internal features of the respective partnerships, and environmental factors (cf. Velten et al. 2021) such as the state of the national or regional AKIS and the availability of additional funding sources to supplement OG funding. While the small sample does not allow to generalise findings, some of them, such as observed legal collisions between the OG measure and other EU or national laws, are clearly relevant for OGs and their implementation of the MAA in general.

One decisive *internal* factor that determines OGs' performance in implementing the MAA is how they manage their internal differences, especially with regard to the *economic stakes* their members have in their joint project. Different economic stakes mean that members have different – and differently strong – motivations to participate in OGs and to engage with others in activities (cf. Molina et al. 2021). Failure of (prospective) OG members to address such differences early on is therefore bound to lead, first, to a low participation of partners with lower economic stakes, which tend to be farmers, and secondly, to suboptimal collective performance and partners' frustration.

A particularly important *contextual* determinant of OGs' performance in implementing the two objectives of the MAA is the *multi-level governance* of the OG measure, which allows MS to implement the measure *differently*. As is typically the case with 'differentiated integration' in the EU (cf. Leuffen/Rittberger/Schimmelpfennig 2012), the implementation choices MS make here clearly do not only reflect their governments' legitimate priorities, but also their differences in resource and capacities. If national funding authorities lack budget, staff, or understanding of the measure or the MAA, they are unlikely to improve their implementation of the measure. This can reproduce existing power differences between MS, in that MS that already possess sufficient resources and capacities are likely to reap more benefits from the measure than those MS that lack these resources and capacities. The unequal relation of costs to benefits of implementation is also likely to make some countries more willing to implement the measure than others.

4.2 Reflections on the framework's benefits and limitations

Next to yielding empirical insights into the determinants of the implementation of the MAA by OGs, our case study analysis also shows the benefits of our framework. Firstly, the framework is able to cover simultaneously a variety of factors that affect OGs' implementation performance, as well as their causal interrelationships. This is certainly required if one wants to explain MAA implementation outcomes in contexts that involve not only multiple governance levels but also a great room for discretion of governance actors at lower levels. In doing so, our framework enables

an assessment of implementation bottlenecks and success factors *across* OGs, despite their embeddedness in considerably different policy and social environments.

The framework may also serve as a starting point for the conceptualisation of various more specific explanatory approaches, as its concepts invite further theoretical elaboration. For instance, an in-depth analysis of the role of motivational resources in explaining implementation performance may operate with a more fine-grained concept of 'motivation' that distinguishes between different types of motivational resources, and otherwise adopt the general concepts proposed by the framework. Likewise, one may apply a particular analytical distinction of different modes of horizontal cooperation between governance actors in order to gain a more differentiated understanding of how such cooperation may affect policy implementation performance.

Moreover, the framework has the potential to bridge a gap between approaches to implementation which consider successful implementation an act of *compliance* with predefined goals, and approaches that focus on how implementers *redefine* policies and/or adapt them to their specific contexts (cf. Mazmanian/Sabatier 1989). From the first strand of theories, our framework adopts the understanding of implementation success as 'compliance'. While policies are always intermediate products of an ongoing cycle of formulation, implementation and reformulation, we propose that at some point in any policy process we also have an interest in measuring societal progress towards agreed policy goals and holding implementers accountable. At the same time, our understanding of policy goals is sufficiently broad to allow for policies that, rather than prescribing a particular course of action, only define some *minimal criteria* for implementers to meet. This definition anticipates that many policies – including the MAA – allow for implementers' discretion. By considering feedback mechanisms an independent variable, our framework also accounts for recursive implementation practices that involve specifications – albeit not actual *revisions* – of the initial policy goal.

Finally, we also found that by highlighting the multi-variate causes of implementation performance, the framework helps to identify multiple intervention options for optimising implementation. For instance, by reflecting that some of the current failures of OGs to implement the MAA requirements result from an interplay of the measure's design and socio-economic features of the different implementing MS and regions, the framework helps to see that implementation performance may be either improved by altering the measure's design, MS' socio-economic features, or both.

However, the framework also faces several shortcomings. For one, as much of current work in implementation research, it is so far purely suitable for qualitative, not quantitative analysis of implementation performance. While it helps to determine some of the factors that contribute to a particular implementation outcome, as well as the direction of that influence, it does not allow for an assessment of the actual *strength* of these influences. It would be worthwhile to see how the framework could be adapted to suit quantitative research purposes also.

Although the generality of the framework's assumptions is partly a strength, some assumptions could profit from further clarification. For example, it might be useful to include a more precise understanding of the interrelationships between variables, such as the distinction between moderating and mediating variables (cf. Baron/Kenny 1986). Other assumptions of the framework, on the other hand, may be more ontologically challenging than has been assumed here. For example, one may wonder whether focusing on the activities of actors with a formal right to participate in an implementation process does not overstate their influence compared to

informal actors. Thus, Schakel (2020: 767) observes that there is a "significant sharing of authority between governmental actors within and beyond national states even in cases where the formal right to make a decision lies with national governments or the EU legislator". Further testing of the conceptual framework on a variety of empirical cases of multi-level policy implementation will help to better identify key areas for its use and further improvement.

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CONTRIBUTIONS OF PARTICIPATORILY DESIGNED ORGANIC RESOURCE MANAGEMENT TECHNIQUES TO THE IMPROVEMENT OF SOIL FERTILITY IN AFRICA: EVIDENCE FROM KENYA, MALI, GHANA AND ZAMBIA

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Abstract: Depletion of nutrients in smallholder farmers' soils that produce the major part of food is the main reason for food insecurity in many countries of Sub-Saharan Africa. Mineral fertilizers have been used in agricultural production systems in substantial quantities to improve crop yields. However, mineral fertilizer alone cannot increase and maintain soil fertility, particularly in tropical soils, where organic inputs allow for an increase in soil quality and fertility parameters. The ORM4Soil project has tested participatorily designed organic resource management techniques aiming at the improvement of soil fertility in Kenya, Mali, Zambia and Ghana. In Mali, agroforestry systems with *Gliricidia sepium* has been shown to have a positive effect on yields and soil fertility. In Ghana, local organic residues such as the palm oil empty fruit bunch have helped farmers improve the quality of their soils. In Kenya, the use of *Tithonia* has added organic matter to the soil and in Zambia, an improved version of a locally practiced green manure technique has proved advantageous to farmers.

ARE ADVISORS THE PRIMARY PROVIDERS OF INNOVATION SUPPORT SERVICES IN FORESTRY AND AGRICULTURE? PRELIMINARY FINDINGS FROM THE PROJECT LIAISON

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1. Introduction

In recent years, notions such as 'innovation support services', 'innovation facilitation', and 'innovation brokerage' have become more and more commonplace in the field of agricultural innovation in many countries. While the use of these termini is not unified (cf. Ndah et al. 2018: 6f.), their overall emergence testifies to a *paradigm shift* in thinking about agricultural innovation. They represent the growing acknowledgment that innovation processes are *complex* – and in fact are becoming increasingly so – and therefore demand for the cooperation of multiple actors. In this perspective, *enabling coordinated action in a broad network of actors with various backgrounds* becomes a crucial function in innovation processes. It is precisely this function of 'enabling', which the above notions – with somewhat varying connotations – aim to capture.

Core actors engaged in the Common Agricultural Policy have picked up the terminology of 'innovation support services' and 'innovation brokerage' as well (cf. EC 2014). Some of them such as the *Directorate-General for Agriculture and Rural Development* (DG Agri), the EIP-Agri Service Point (2014, 2019), and the *Strategic Working Group of the Standing Committee of Agricultural Research on Agricultural Knowledge and Innovation Systems* (SWG SCAR AKIS) propose that, ideally, *farm advisory services* (FAS)[21] should take over these functions. They suggest that "farm advisory services can act as good innovation brokers or innovation support services because they have broad networks and [are] well-positioned to bring the right people together" (EIP-Agri SP 2019, emphases in the original). In order to be able to perform this role, it is suggested that FAS should receive greater public financial and institutional support and be more involved in the

[21] Note that while these actors generally translate FAS as 'farm advisory services', they are actually referring to the national *farm advisory systems* according to EU REGULATION No 1306/2013 of 17 December 2013 on the financing, management and monitoring of the common agricultural policy. Title III, Art. 12 of the Regulation states that "Member States shall establish a system for advising beneficiaries on land management and farm management ('farm advisory system'); and that farm advisory system shall be operated by designated public bodies and/or selected private bodies". Farm advisory systems are supposed to offer advice to farmers on, among else, the legal obligations that result from EU agricultural regulation, e.g. with regard to environmental standards, as well as on "measures at farm level provided for in rural development programmes for farm modernisation, competitiveness building, sectoral integration, innovation and market orientation […]". Importantly, as the article explicitly states, the organisations that participate in the national farm advisory system may be either public or private bodies. However, they are subject to EU- and national, i.e. public regulation. When the DG Agri et al. – as we will shortly see – juxtapose the farm advisory services they wish to strengthen to 'private' or 'commercial' farm advice, this is thus due to the fact by farm advisory services they really mean the national farm advisory systems of the EU member states. However, this distinction will be less relevant in this paper, since we will review the role of farm advisory organisations in supporting agricultural innovation more generally, not just of specific types (public/private) of advisory organisations.

development of agricultural policies and programmes than in the past (SWG SCAR AKIS 2017: 1; DG Agri 2019: 5).

This paper aims to better assess which types of organisations are currently acting as 'innovation support services', and if FAS are indeed as central to the performance of this role as the above claim suggests. For that purpose, we will first offer a short review of the general evolution of the concepts of 'innovation support services', 'innovation brokerage' etc. and make their relation to each other more transparent (2). Then, following an overview of the applied methods for data collection (3), we present some research findings from the H2020 project LIAISON[22] on 200 interactive innovation projects and initiatives[23] from the agri-food and forestry sectors that may shed some light onto the actual functional set-up of innovation processes (4). We argue that these findings indicate that, rather than farm advisors only, in practice various types of organisations provide innovation support services in agriculture. This confirms other research on that issue (cf. Faure et al. 2019; Ndah et al. 2018; Klerkx and Gildermacher 2012; Klerkx et al. 2012). We conclude that policies aimed at supporting participatory innovation processes should focus on the *functions* provided by organisations in these processes instead of devoting special attention to a particular *type* of organisation (5).

2. Conceptual background: innovation support services, innovation brokerage, innovation facilitation

2.1 Conceptual clarification

The use of the concepts of 'innovation support services', 'innovation brokerage' and the like is not unified in the field of agriculture: both researchers and practitioners use the terms differently (cf. Ndah et al. 2018). Some authors operate with quite clear-cut conceptual distinctions. The EIP-Agri Service Point, for instance, distinguishes between 'innovation support services' as a more general term, which "covers various tasks that support innovation". They see 'innovation brokerage' and 'innovation facilitation' as two distinct of these supporting tasks. In their definition, 'innovation brokerage' takes place in the *initial stages* of the cooperation for innovation and entails the following activities: 1. the discovery of innovative ideas; 2. "connecting potential partners with complementary knowledge, competences and infrastructure" ('match-making', EIP-Agri SP 2014: 3) and "taking the initiative to help them to refine the innovative idea" (EIP-Agri SP 2014: 3); 3. identifying funding sources and providing partners with a solid understanding of what criteria need to be fulfilled in order to make an application for financing (EIP-Agri SP 2014: 4); and 4. the preparation of a project proposal, which all actors involved can endorse. In contrast, 'innovation facilitation' refers to mediating activities that "bridge the language of science/markets and entrepreneurial practice" (EIP-Agri SP 2019). Unlike 'innovation brokerage', this kind of mediation needs to be performed not only at the initial stages, but continuously during the project cooperation. According to the EIP-Agri Service Point, the

[22] The H2020 project LIAISON (http://liaison2020.eu/) was launched in 2018 with the intention to contribute to the optimization of interactive innovation project approaches and the delivery of EU policies to speed up innovation in agriculture, forestry and rural areas. One key concern of the project is the identification of success conditions and challenges to collaboration in interactive innovative projects, i.e., projects in which various types of actors such as farmers, researchers, advisors and consumer organisations are actively involved.

[23] A project is carefully planned to achieve a particular aim and is characterized by a defined start and end. In contrast, networks and initiatives can be ongoing and can come from or lead to projects (cf. O'Neill et al. 2012).

supporting tasks of 'innovation brokerage' and 'innovation facilitation' may (but need not) be performed by the same person.

Similar to the EIP-Agri Service Point, Faure et al. (2019) use 'innovation support services' as an umbrella term for all activities that support cooperation and co-creation for innovation. Drawing on other studies on 'innovation support services' in agriculture, they offer a distinction of several sub-tasks of such services. Among these tasks are "awareness and exchange of knowledge" or "networks, facilitation and brokerage", the latter referring to the "provision of services to help organise or strengthen networks […]" (Faure et al. 2019: 151). So, while the authors do not distinguish as clearly between the tasks of 'innovation brokerage' and 'innovation facilitation' as the EIP-Agri Service Point, it is obvious that they as well consider them sub-categories of the broader concept of 'innovation support services'.

In contrast, Klerkx et al. (2012) and Klerkx and Gildemacher (2012) use the term 'innovation brokerage' in a broad sense that is analogous to the EIP-Agri Service Point's understanding of 'innovation support services'. In their definition, innovation brokerage is not the name of a sub-task of innovation support that should be performed in the project development phase only, but instead "be applied in a flexible and iterative manner" (Klerkx and Gildemacher 2012: 222) throughout the project. The authors propose that it is dividable into three distinct tasks, namely 1. context analysis and demand articulation (assessment of problems and opportunities), 2. network composition ("facilitat[ing] linkages among relevant actors"), and 3. facilitating interaction (cf. Klerkx and Gildemacher 2012: 222f.). In this understanding, then, innovation brokerage and innovation facilitation become indistinguishable, with 'innovation brokerage' serving as a general concept that captures, besides 'narrow' brokerage tasks, also facilitating or mediating activities.

Still other actors are using all three of these concepts interchangeably or at least without any obvious differentiation. For example, in a recent policy document the DG Agri proposes that advisors should "collect farmers' needs" and "feed these needs and opportunities into the AKIS [Agricultural Knowledge and Innovation System] for further development – possibly as an 'innovation support service'" (DG Agri 2019: 6, emphasis in the original). In the pursuing sentence, they say "[f]arm advisors within the AKIS should also be trained to act as innovation brokers/facilitators" (ibid. emphasis in the original). How exactly 'innovation support services', 'innovation brokerage' and 'innovation facilitation' relate to each other, and if they in fact designate different roles at all, remains somewhat vague.

As these few examples already demonstrate, the concepts of 'innovation support services', 'innovation brokerage', and 'innovation facilitation' are not used consistently in the agricultural field. For the remainder of this paper, however, we will adopt the EIP-Agri's conceptual distinction. That is, we will use 'innovation support services' (hereafter ISS) as the overarching notion, and to 'innovation brokerage' and 'innovation facilitation' as two distinct sub-tasks of innovation support that are performed at the beginning of or during the project, respectively. This terminology promises to avoid conceptual confusion. In addition, it seems to be particularly influential, as it informs European agricultural policy.

2.2 Background: paradigm shift in thinking about innovation

Although the respective meanings of the concepts of ISS, innovation brokerage and innovation facilitation may be somewhat ambiguous and difficult to discern, their overall emergence mirrors a paradigm shift in thinking about agricultural innovation. It testifies to the gradual transition of an understanding that considers research the main driving factor of innovation towards a 'systemic' understanding that recognizes that innovation requires the coordination of a much

wider network of actors and activities. It is only against the background of this *broadened notion of innovation* that the concept of 'innovation-supporting activities' that help this coordination becomes relevant (cf. Koutsouris 2014; Ndah et al. 2018: 2; Klerkx and Gildemacher 2012: 221).

For many decades, agricultural policies in the EU have been informed by a 'linear approach' to agricultural innovation "in which new knowledge is developed through research, distributed through advisory and education services and then practically implemented by entrepreneurs" (Détang-Dessendre et al. 2018: 11). However, this approach has been increasingly criticised for not being fit to cope with the complex social reality of most innovation processes. In particular, it did not respond enough to differences between agricultural production contexts and complex natural resource management conflicts (cf. Klerkx et al. 2012: 54; Faure et al. 2019: 149).

These shortcomings led to a *first change* in the concept and practice of agricultural extension: participatory approaches to agricultural innovation emerged, whose main objective it was "to enhance research uptake and impact […] by adapting research to specific contexts and creating ownership of the research" (Klerkx et al. 2012: 54). This more inclusive perspective considered, next to the bilateral relation between farmers and research, "the broader knowledge systems in which farmers were embedded" (ibid.), or what was then labelled the 'Agricultural Knowledge and Information Systems' (AKIS).[24]

However, this adjusted approach to agricultural innovation still retained a narrow focus on research and did not recognize the importance of other, not research-related activities. Agricultural extension was largely identified with '*knowledge* brokering', i.e. the facilitation of knowledge exchange between research and practice (Klerkx et al. 2012: 54). It thus remained in a linear "transfer of technology and information framework" (Faure et al. 2019: 148), even while it had been "fine-tuned by scholars to take into account the diversity of technologies or the diversity of farmers" (ibid).

The introduction of the roles of the 'innovation broker' and the 'innovation facilitator' finally represent a shift to an *even more holistic understanding of innovation* which acknowledges that "research does not equal innovation" (Klerkx et al. 2012: 55). In this perspective, innovation consists not just in the development of new technologies but requires the active management of the interplay between these technical solutions and established social practices. In such a changed understanding, next to *knowledge* gaps between actors, "several other divides among groups involved in innovation and development" (Klerkx et al. 2012: 57) such as differences in interests/values and incentives that hinder effective collaboration have to be bridged as well. Against this background, innovation support is not something that some providers deliver to 'passive' beneficiaries in the form of linear advice (Faure et al. 2019: 148ff.). Instead, it is performed through a mutual and interactive learning process, where borders between 'providers' and 'beneficiaries' of support blur and the exchange of knowledge replaces linear instruction.

2.3 Farm advisors as innovation brokers/facilitators?

One key issue that emerges repeatedly in discussions related to innovation support services is the question of *who* is actually performing these services or who *should* perform them, and why. Many studies show that, with the increasing (acknowledgment of the) complexity of agricultural innovation processes, the division of labour between innovation partners becomes more complex as well. While traditional agricultural extension was typically performed by farm advisors who instructed farmers on "how to act to improve their firms" (Faure et al. 2019: 148), today's more complex ISS vary greatly from context to context, with a variety of actors taking over different

[24] More recently re-labelled *Agricultural Knowledge and Innovation System*, cf. Faure et al. 2019:147.

tasks in support of innovation (cf. Faure et al. 2019: 150; Ndah et al. 2018: 4f.). In one case, for instance, a private business might act as innovation broker together with a NGO as innovation facilitator, while in another agricultural industry or administrative context; these roles might be split among several organisations. Alternatively, an advisory organisation might provide both services, 'innovation brokerage' and facilitation at the same time due to the regional infrastructure.

By contrast, as mentioned above, some central actors involved in EU agricultural policy making are currently calling specifically on farm advisory organisations to take on the roles of innovation brokers and facilitators. Organisations such as DG Agri and the EIP-Agri Service Point in particular as well as some think tanks like the *Strategic Working Group of the Standing Committee of Agricultural Research on Agricultural Knowledge and Innovation Systems* (SWG SCAR AKIS) suggest that farm advisors are especially suited to perform task that support interactive innovation. For instance, on a website entry on "Innovation support services (including advisers with a focus on innovation)", the EIP-Agri Service Point (2019) argue that "[m]any advisers are ideally positioned to set up and join groups that deal with technical, financial, social, environmental or market-related issues and problems. They established a trust-based relationship, which enables them to act as brokers and which brings together farmers and others actors who can help each other". In a similar vein, the DG Agri (2019) highlights that "advisors play a key role to collect farmers' needs and opportunities, thanks to their one-to-one interactions with farmers while giving advice. They should feed these needs and opportunities back into the AKIS for further development – possibly as an 'innovation support service' – helping the knowledge systems to improve their impact" (DG Agri 2019: 6, emphasis in the original).

Since the activities of 'innovation brokerage' and 'innovation facilitation' go beyond the 'linear advice' that FAS traditionally performed, it is argued that FAS will need more public financial support or "a mix of public and private funding" (SWG SCAR AKIS 2017:7) as well better institutional backup than they currently have. In addition, they should be more involved in agricultural policy making, since "[s]upporting an interactive role of advisors already in the early stage of definition of policies and programmes would help creating an enabling environment to better connect practice and science" (SWG SCAR AKIS 2017:3). Without this improvement of FAS, they fear that corporate advisors, who are independent from FAS, will take over the provision of 'innovation support services' instead.[25] This will not only disadvantage small farming businesses that often cannot afford to pay for private advice, but also threaten the ideal of impartial farm advice since private advisory organisations have profit interests to consider (SWG SCAR AKIS 2017: 1; DG Agri 2019: 5).

This line of reasoning suggests that it is in a way 'natural' that advisory organisations should provide ISS. The required policy decision, in this view, is that between increasing public support for existing FAS, and surrendering innovation support to FAS-independent private advisors. In the remainder of this paper, we will re-evaluate this argument. While it raises some important concerns, we venture that it rests on a somewhat *narrow* understanding of agricultural innovation since it seems to assume that advisory organisations are the main providers of innovation support. In the following sections, we will present and discuss some preliminary findings from research in the H2020 research project *LIAISON* that suggest that other organisations such as research institutes, NGOs, producer organisations as well as agricultural education providers can take over innovation support services as well.

[25] On the distinction between FAS and non-FAS-related private farm advice, see footnote 1 above.

3. Methodology

3.1 Light Touch Review of 200 innovative projects in agriculture and forestry

In the framework of LIAISON, 200 innovative projects and initiatives in the agri-food and forestry sectors throughout Europe were subjected to a 'light touch review' (LTR). This consisted of a desk study of published material of each project (e.g. website, public documents) as well as a 'one telephone call' semi-structured interview with a key informant (e.g. the coordinator). The purpose of this review was to identify the main traits of these projects and initiatives and to determine best practices as well as challenges to collaboration both within the project and between the project consortium, external stakeholders and funding bodies. Projects and initiatives were partially identified through databases of the funding programmes Horizon 2020, INTERREG Europe and LIFE and national databases, and partially through a Europe-wide Rural Innovation Contest (EURIC) launched by the LIAISON consortium in 2019.[26]

The selection of the reviewed 200 cases from all identified projects and initiatives was based on three criteria:

- The 'insightfulness' of the project (i.e. its relevance and/or information-richness with relation to the issue of interactive innovation);
- The availability of a suitable contact person who can provide insight into collaborative processes within the project
- Funding source of the project or initiative: in each country, a set of projects and initiatives with diverse funding schemes were reviewed.

3.2 *Data from the LTR relevant to the research on ISS in agriculture and forestry*

Although the LTR was not conducted with the explicit aim of identifying innovation support service providers, the gathered data still offer insights on current features of ISS in agriculture and forestry. The following information from the LTR are particularly relevant in this regard:

- First, an overview of the *types of organisations that are coordinating the studied projects*. As we have seen before, most usages of the terms 'innovation brokerage' or 'innovation facilitation' consider 'coordination' of multi-actor processes a central part of these roles. In order to assess the importance of FAS as providers of such innovation support services, it may therefore be helpful to look at *who is actually taking over the role of the coordinator in interactive innovative projects in agriculture*. In section 4.1, we will present the pertaining LTR findings from all reviewed 200 projects and initiatives, gained through desktop surveys and verified in semi-structured interviews with project participants.[27]
- Second, information about the actual *reasons for the choice of the coordinating organisation*, which was obtained through telephone interviews ("What were the

[26] 750 interactive projects and initiatives were identified through research of EU and national databases, and 229 additional companies, projects and initiatives from 21 EU member states and two EU neighbouring states entered applications to the EURIC.

[27] We are well aware that the kind of funding a project receives will likely affect its features– such as for instance the choice of the coordinator or the role of advisory organisations within the project. For that reason, we attempted to cover a wide range of different types of EU-funded, co-funded and non-funded projects and included the type of funding as one variable in our assessment template. However, in this paper, we will not differentiate between different types of project-funding but only present general trends across the reviewed projects. More elaborated hypotheses on the causal links between the type of funding and the functional set-up of projects remains a topic for further research.

reasons underpinning the selection of the project coordinator?"). Based on the arguments given by the interviewees, we clustered their answers into different categories while allowing for multiple answers. Their responses illuminate which features in an organisation project members consider necessary for the performance of coordination and thus, of innovation brokerage and facilitation. In this way, they may also *help to understand the current extent to which FAS are performing these roles* in interactive innovation projects in agriculture. Since this paper focuses on the status of farm advisors in interactive innovation in the EU in particular, in section 4.2 we will present the findings from projects funded or co-funded by the EU[28] only, which is the case for 108 out of the 200 reviewed projects.

- Thirdly, information on the performance of two other tasks that are associated with *'innovation brokerage'* in the more narrow sense, namely the initial 'match-making' between actors and the proposal-writing. This information was obtained through two further interview questions of the LTR: "How was the project set up?" and "Who took charge of the proposal writing process and why?". In case of the first question, answers were again clustered and multiple answers allowed. We present the responses of the interviewees from the 108 reviewed EU (co-)funded projects to these two questions in section 4.3.

4. Preliminary findings

4.1 Desk survey results: coordination of innovative projects (n = 200)

If advisory organisations were indeed in a privileged position to perform the roles of innovation broker and facilitator in innovation projects in agriculture, one would expect them to be listed as project coordinators more often than other types of organisation. However, quantitative findings from the desk surveys conducted in the course of the LIAISON LTR do not confirm this expectation. Different types of organisations such as research and education institutions, businesses, individual farmers, representative/supporting institutions, public bodies, NGOs and processing/ marketing organisations led the projects. Of the studied projects, the largest share were coordinated by research organisations (30,5%), followed by farmers' representing/supporting organisations (12%), NGOs (12%), public bodies (11%), and businesses (7%). Only 4% of the project coordinators were classified as advisory organisations. The large number of projects coordinated by research institutions might be less surprising in projects that focus on policy programmes such as the H2020 RIA scheme (n= 34). In other cases such as the Thematic Networks funded under the H2020 CSA scheme (n= 16), however, we would have expected more advisory organisations to be listed as coordinators. Yet we find that none of the studied Thematic Network projects was coordinated by an advisory organisation.

Importantly, if there are only few advisory organisations among the coordinators of the studied projects, this is not because their participation in these projects would have been generally low. In fact, while research organisations were the type of organisation that was most frequently listed as project participants (155 times), advisory organisations participated at least in 104 projects – about as often as representative/supporting organisations (111 times) and processing/marketing businesses (106) and significantly more often than public bodies (91) or NGOs (76).

[28] These are (i) projects funded in the H2020 Research and Innovation scheme (RIA), (ii) Thematic Networks (TN), which are Coordination and Support Actions (CSA), (iii) Operational Groups (OG) funded under the Rural Development Programmes of the Member States, and (iv) Interreg projects.

4.2 Telephone interview results: reasons for choosing the coordinator (n=108)

Most of the interviewees from the reviewed 108 EU (co-)funded projects stated that the choice of the coordinator was in a way a 'natural' consequence of the coordinator's *pre-existing relation to the project*. That was the case e.g. where the coordinator had also developed the project idea or had been coordinating a precedent project (46 out of 108 interviews). Other important reasons for the choice of coordinator were the respective organisation's *expertise in proposal writing and/or project coordination* (36 out of 108) and its *availability of resources* (time, money, staff) (34 out of 108). Only a minority of the interviewees said that an external entity had been involved as a coordinator (9 out of 108), or that a formal 'Innovation Support Service' or 'Innovation Broker' were in charge of the coordination (6 out of 108).

These results help to illuminate why advisors are underrepresented among project coordinators, compared to their actual participation quote. They indicate that, rather than the specific *type* of organisation, what matters in the decision about whom to appoint as project coordinator is in fact a collective assessment of an organisation's *fitness* for that role. Apparently, the organisation to which a project consortium ascribes this fitness the most varies from project to project.

4.3 Telephone interview results: 'match-making' and proposal-writing (n=108)

In some of the reviewed EU (co-)funded projects, one of the consortium members took the leading role in initiating the project and invited other project partners (26 out of 108). 34 of the other projects evolved from previously existing formal and informal relationships between participants and thus in a way emerged, as one interviewee framed it, as the "logical next step". In these latter cases, no project partner took a particular leadership role in the setting-up of the project. In 22 cases, some members of the consortium knew each other from existing cooperation while others were invited to complete the group. Eight interviewees stated that a governmental organisation set up the project.[29]

These answers indicate that no specific type of organisation acted as innovation broker or initial 'match-maker'. Rather, projects either typically emerged either from previous links between the participants, or from one partner's (independent of the specific type of organisation he represents) active rallying of participants, or from a combination of both.

The findings on the organisation of the proposal writing in these reviewed projects are in line with that. The majority of the interviewees reported that the project initiator took charge of the proposal writing (57 out of 108). 24 interviewees named the expertise or formal capacity of the proposal writer as decisive factors, while 37 interviewees indicated that the members of their project's core group had shared responsibility for the proposal writing. Only nine interviewees stated that the group hired an external expert, and only three said that an official innovation support service wrote the proposal.

Here too, then, other factors than the actual type of organisation seem to affect the collective choice of who is taking charge of the proposal writing. Attribution of this role seems to depend on previous developments within the project consortium, such as established patterns of interaction between the partners and/or whether some partner was particularly involved in the initiation of the project idea. Finally, actors' expertise in proposal writing and experience and recognition in the field are decisive in the distribution of tasks.

[29] in eight cases, the answers were not clearly attributable to any of these response categories.

5 Discussion of findings

Overall, these data allow for some tentative conclusions as to the status of innovation support services in agriculture and forestry and the role which different types of organisations play in the provision of these services. One conclusion is that ISS provision is not a prerogative of specific organisations. This is because just as innovation processes become more multifaceted, so do the tasks that are required in order to initiate and facilitate innovation. Many more kinds of social divisions need to be overcome between a much wider range of actors, beyond "bridging the divide between research and practice". This may include conflicts or other discrepancies among farmers themselves, or between farmers and businesses or NGOs. In order to enable coordinated action between these actors, the social and institutional setting in which they operate will need to be changed before innovation can become effective. These brokerage and facilitation tasks, however, can be performed by *various kinds of actors*, since their successful execution depends less on specific organisational features than on experience in mediation activities and trust-based relationships within the relevant field. This interpretation confirms results from other research (cf. Klerkx et al. 2012; Faure et al. 2019).

If that is the case, however, how do we make sense of the DG Agri's, the SWG SCAR AKIS' and others' proposal that farm advisors are particularly well suited to act as innovation brokers/facilitators? One possible analysis is that while these actors refer to the *labels* of 'innovation brokerage' and the like, the actual *framework* they apply is in fact still very much that of knowledge brokerage, i.e., a "transfer of technology and information framework" (Faure et al. 2019: 148). A closer reading of the above-mentioned policy papers indicates that in these actors' understanding of innovation, the transfer of research results into agricultural practice is still conceived as the core of innovation. While 'linear advice' may not be the most appropriate medium for innovation anymore, the *facilitation of coordination between science and practice*, or research and farming still appears to be the central focus of innovation-supporting interventions. From the premises of such an understanding of innovation, however, it is indeed reasonable to ascribe FAS a crucial supporting role, since the role of the intermediary between research and farming practice is the very role they have traditionally performed and that they have specialized in.

However, while such an approach may work out in some cases (cf. Faure et al. 2017), it will likely prove to be too reductive in more complex cases of innovation. If innovation support focuses too much on the optimisation of *knowledge* transfers between researchers and practice, or even among practitioners, we risk losing track of the various other linking activities that are required today to enable innovation in agriculture. Therefore, if policy-makers are thinking of ways to strengthen ISS in agriculture, rather than channelling support to specific *types of organisation*, they ought to make sure that the *functions that enable and facilitate innovation* are performed.

6 Acknowledgement

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HOW LASALLIAN PEDAGODY ENABLES COLLABORATIVES LEARNING: THE EXAMPLE OF UNITECH DAYS

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Abstract

Lasallian Pedagogy (LP) sprouted from the initiative of Jean-Baptiste de La Salle. Dated back to the Eighteen century, he founded a community of teachers consecrated to the education of children of artisans and the poor. With time, this became a worldwide network ran by the Brothers of the Christian schools and ministering from kindergarten to university level. Crucial for LP is the inclusive education whose key goals are: i) to professionalize students according to relevant contextual business activities, and ii) to join commitment and skills both of teachers and students in a unique community for the good running of each school. A teacher is therefore considered a mentor supporting the student's own training process rather than a "knowledge bearer". Thus, LP is natively meant as collaborative learning, with strong interactions between the students, their associations and the whole teaching community (teachers and other employees). In this paper, we analyze how LP might enable collaborative learning within the agricultural knowledge and innovation system. We focus on a farming demo recurrent event organized by a students' association belonging to the oldest high education institute of the Lasallian network. The event is named "Unitech Days" and take place yearly at UniLaSalle (campus of Beauvais, northern France). Its goal is to promote exchanges of knowledge between farmers, students, teachers, and professionals in the farming sector through demonstration of innovations. We identify two levels of collaborative learning. First, the Lasallian one, via the involvement of the teaching community in the co-organization of the Unitech Days by the student association (Festival de la Terre et de l'Elevage) that promotes it. This level implies multiple interactions that stimulate mutual learning and listening and create a peer relation between two stakeholders, students and teaching community. Second, the on-farm demonstration, aimed at enhancing peer learning in a real agricultural learning situation. These demonstrations showcase farmers' and students' technological innovations, as well as agronomic innovative projects carried by teachers, in which students are involved during their education. Altogether, students' commitment to the organization of on-farm demonstrations can enrich the collaborative learning because: (a) the students' language reaches more easily farmers, namely if one considers that they are for at least at 1/3 children of farmers; (b) students' education benefit from the beginning of a multi-actors networking including farmers and other agricultural experts and advisors.

Introduction

Farmers are entrepreneurs facing complex decisions, frequently solved through a pragmatical approach. When realizing daily farming operations, they mix traditional knowledge about the agronomical and pedoclimatic context with continuous marginal innovations. Indeed, farmers develop and carry a place-based knowledge of farming management based on an evolutive multicriteria decision-making system. For that, farmers tend to privilege learning from their peers, reckoned as the most relevant actors bringing a reliable knowledge. Yet, the deep structural changes in the European farms' structure, primarily related to the growing farm size due to the decrease in the number of famers, steadily reduce the number of accessible peers. In this regard, three projects funded by the European Commission federated to create a hub (FarmDemo.eu)

aimed at describing, understanding and promoting the peer learning in agriculture, particularly through on-farm demonstrations. But how this approach could be adopted in the educational programs in agriculture?

This paper aims to present a specific approach to pedagogy adopted by a French higher education institute. After an overview of the pedagogy background and key principles, we focus on on-farm demonstration as a relevant example of collaborative and peer-learning that could enable sustainable agriculture. On these bases, we make a reflexive analysis of UniTech Days, a case study bridging the specific Lasallian Pedagogy and the on-farm demonstrations. We conclude with a few lessons learned from the students' engagement to improve farmers involvement in educational programs towards a wider collaborative learning.

1. Lasallian pedagogy

UniLaSalle is a higher education institute in Earth, life and environmental sciences in northern France, with three campuses: Beauvais, Rouen & Rennes. UniLaSalle is member of one of the largest education networks in the world: the International Association of Lasallian Universities (IALU), sponsored by the Brothers of the Christian Schools. The Brothers' congregation (identified by the Latin abbreviation FSC) dates back to the Eighteen century. In a period of elitist teaching, where pupils were usually individually supervised by tutors, they founded a community of teachers consecrated to the collective education of children of artisans and the poor; of notice, classes were composed of children coming from a same region, so teaching was contextualized to the peculiarities of this region. Their aim was to promote a broader and collective scope of knowledge. Lasallian institutions share a common identity of design and implementation of educational processes, organizational arrangements and social integration. Fundamental values are: fraternity, dialogue, participation of all educational community actors, reception of others, struggle for justice, mutual respect and solidarity (Gils and Munoz, 2013). Membership of this network implies the continuous improvement of the teaching approach based on the input and experience of other Lasallian institutions worldwide.

Lasallian colleges and universities are located in five delimited IALU regions: Asia and Pacific Islands; Central and South America; Europe and French-Speaking Africa; Mexico; and North America, Bethlehem and English-Speaking Africa (Ramirez Barba, 2018). At one time, Lasallian institutions of higher education were considered exceptional to the mainstream activities of the Brothers, who were, initially and for the most part, involved in primary and secondary education. Nowadays, each Lasallian higher educational community is challenged to address the impact of globalization, massification, unequal access, student mobility, and information and communication technology. Yet, there is no universally applicable Lasallian solution (Schieler, 2018). The current bases of Lasallian pedagogy are similar of those from the origin: they have to be contextualized, clearly related to the socio-educational requirements of each country (i.e., *delimitated state*) of the IALU network, without losing the bases that define and express its identity (Rangel, 2011). Universities implements a transformative, learner-centered approach to education. For example, UniLaSalle holistic approach is based around three components:

taking care of the needs of each and every young person entrusted to us;

recognizing that everyone has a role to play in our educational approach;

developing a sense of fulfillment based on commitment and individual responsibility.

Those components are inspired by the didactic principles of FSC Congregation founder, Jean-Baptiste de La Salle, adapted to contemporary pedagogy. In this article, as in Lasallian institutions, *pedagogy* is intended as the educational context, whereas *education* is understood as the daily

school practices, in the broadest possible sense (Munoz, 2011); finally, *didactic* is meant as the study of the educational act of teaching (Rangel, 2015).

Based on Rangel (2015) we can summarize the actualization of original Lasallian didactic in contemporary didactics through eleven principles, with a focus on the complementary between theory and practice in teaching-learning.

Affection - The education inclusive is based on the principle of foster care and respect for individual characteristics and their differences without discrimination. Therefore, students learning capability and sensitivity are emphasized in Lasallian didactic.

Dialog and example - The dialogue involves for teachers a role of accompaniment to mentor the students and not a limiting role of trainer. Lasallian schools create a personalized relationship between teachers and students, and environments that are conducive to community life.

"The school 'runs well" - The valorization of coexistence (of "co-existence", the existence in collectivity) is one of the main formulations of La Salle, inserted in its democratic action. To strengthen community life, La Salle campuses offer a combination of living spaces and class, to perform knowledge, associative responsibility, relationship and sports. The development of these living spaces reaffirms their importance for learning, as an environment conducive to didactic relations and collaborations between teachers and students and among teachers.

Discipline and moderation - Discipline is a condition and a learning imperative: acquisition of knowledge requests attention and concentration. For La Salle, the less the teacher speaks better. This involves making the student active in his learning to promote his attention and his memorization. Therefore, La Salle institutions must deploy a set of conditions to promote learning, without dispersions or negligence.

Contextualization - When La Salle instituted collective preparation for life and work, he created the principle of contextualization. Contextualization fosters the relation practice-theory-practice. That relationship is especially indicated in the current didactic approach.

Didactic transposition - Didactic transposition consists in transposing the knowledge, transposing the theory to the level of learning of the student, according to the age and the study level. In this approach, the proximity between teachers and students is fundamental: a presence of the teacher close to student and an accessible language constitute principles of the Lasallian pedagogy and one of his significant contributions to teaching.

Multiple methodologies - choose from multiple methods the best one suited to the content, the student and the context. Teachers tailor their resources to the nature of knowledge and of students.

Learning as a means of social emancipation - Lasallian institutions practice teaching based on learning by doing, including try to get knowledge valor, its importance, its political implications, for the interests of all the community, and not only of social privileged groups. Education becomes a process (and right) of social emancipation.

Collective decisions: integration - Collective decisions apply to all pedagogical procedures: objectives, contents, methods, evaluation, as well as for material. Community decisions need collective awareness value of the learning-by-doing, that makes sense of the practices.

Organization and planning - The organization, with a planned teaching-learning is one of the criteria of didactic process, thus for forecasts and for the planning of practices, in their circumstances and factors. Organization, forecasting, planning help the teaching-learning process and brings flexibility, and lessen improvisations, analyzed for their effects on insecurity of students and teachers.

Competent mentor-teacher - Qualitive pedagogical practice for a democratic and not elitist learning requires a competent teaching. LaSallian institutions offer vocation training to mentor-teachers, for a teaching lead to learning, by prioritizing the *coexistence*.

To conclude on the Lasallian pedagogy, the identity of a Lasallian school deals with such "deep simplicities", more acquired through experience than through description. The core principles have also come to articulate an accessible set of pathways for Lasallian students to recognize, appreciate and promote their personal experiences in a Lasallian school (Van Grieken, 2019).

2. Collaborative learning: focus on on-farm demonstration

Approaches to knowledge exchange, learning and innovation in agriculture are rapidly evolving. Agricultural Knowledge and Innovation Systems (AKIS) is used to describe news ways people and organizations interact. The 'linear knowledge transfer' model is becoming increasingly outdated and peer learning between farmers is becoming increasingly important as well as co-creating knowledge between all the stakeholders (EIP-AGRI, 2018).

2.1 Concept of participatory education in agriculture

In agricultural higher education, *inter-disciplinary* education is promoted to the detriment of *disciplinary* education (Gibbon, 2012). In a didactic inter-disciplinary approach, experiential learning constitutes an integral part of education (

Table 5).

Table 5: Differences between disciplinary and inter-disciplinary education (source: Gibbon, 2012).

DISCIPLINE BASED	INTER-DISCIPLINARY BASED
DEVELOPMENT OF BEST TECHNICAL MEANS	Adaptive performance based on adaptive learning
EXPERT BASED RESEARCH	Collaborative research, including farmers
CROP DISEASES AND CROP PROTECTION	Integrated pest management
NUTRIENT DEFICIENCIES	Integrated nutrient management
TEACHING	Adult education approaches and experimental learning
POSITIVIST-REALIST EPISTEMOLOGY	Constructivist epistemology
PROBLEM SOLVING	Situation-improving
LOGIC OF CAUSATION	Logic of reasons

In an inter-disciplinary research approach, scientists must work together as a team to share understanding and interpretation of how they see the system working and the dynamic interrelation between elements and structure (Gibbon, 2012). Tress and colleagues (2005) further specify that the inter-disciplinary approach involves several unrelated academic disciplines in a way that forces them to cross subject boundaries to create new knowledge and theory and solve a common research goal. Moreover, *trans-disciplinary* both integrates academic researchers, from several unrelated disciplines, and non-academic participants, involving

cooperation among multiple stakeholders of society (Gibbon, 2012; Tress et al., 2005). Trans-disciplinary combines interdisciplinary with a participatory approach. Participartory studies are not research exclusive and can include academic goals (Figure 5).

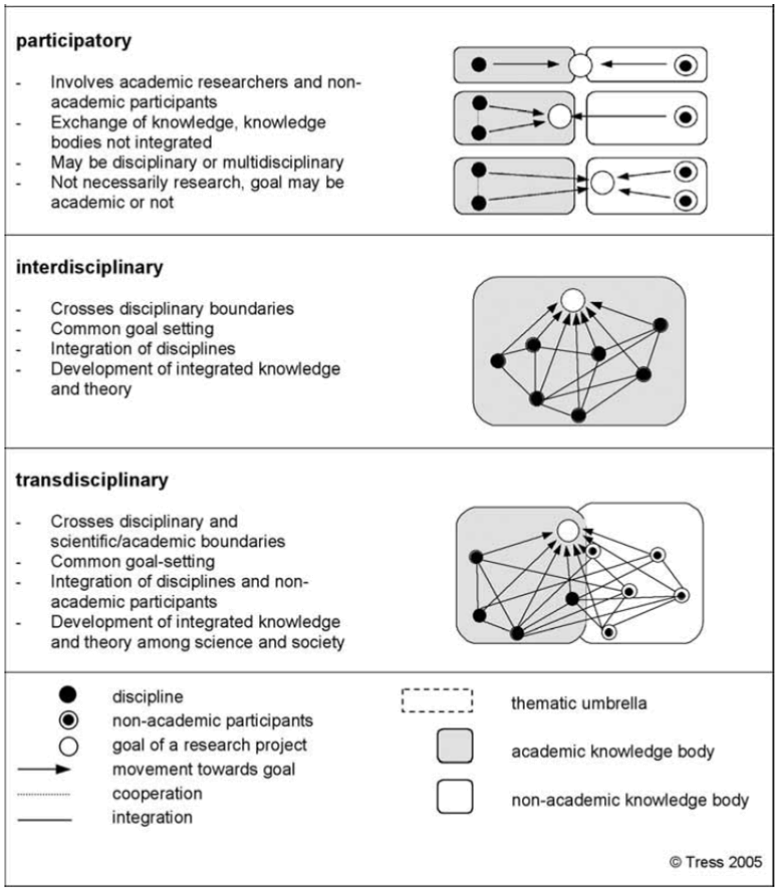

Figure 5: Overview of concepts (Tress et al., 2005)

In participatory methodologies four principles unite all agricultural contexts (Gibbon, 2012):

A systematic and group-learning process

The acceptance of the multiple perspectives of stakeholders

Facilitation leading to transformation

Learning leading to sustained action.

Those principles are quite equivalent of some Lasallian didactic principles: group and rather than individually focused; principle of dialog and collective decisions; principle of contextualization; principle of multiple methodologies.

2.2. Collaborative learning: a didactic participatory methodology

In educational research, collaborative learning (CL) refers to instructional arrangements that involve two or more students working together on a shared learning goal. CL emphasizes the importance of positive interaction among students: during CL, students are encouraged to ask questions, give elaborate explanations, exchange arguments, formulate new ideas and problem solutions, and so on. However, these positive results can only be achieved when teachers make

adequate instructional decisions. Particularly while students are collaborating, teachers are expected to monitor which problems the students may encounter so as to intervene when necessary (van Leeuwen and Janssen, 2019).

Collaborative learning involves some Lasallian didactic principles such as principle of dialog and example; principle of discipline and of moderation; principle of contextualization; principle of didactic transposition.

A declination of collaborative learning is the peer learning (also referred to as peer-to-peer learning), when learners become themselves mentors. Peer learning suggests a two-way, reciprocal learning activity. Peer learning should be mutually beneficial and involve the sharing of knowledge, ideas and experience between the participants (Bould et al., 2013) This reciprocality requires initiative, active participation and engagement of the learner towards the own learning process. Peer learning is not student exclusive and is deployed in agriculture between farmers, particulary during on-farm demonstration (Cooreman et al., 2018).

2.3. On-farm demonstration: an example of peer-learning for sustainable agriculture

On-farm demonstrations have been organized originally to introduce farmers to innovation, but more recently also to share experiences in a farmer-to-farmer setting (peer learning), and to support knowledge co-creation between farmers and other actors. As peer learning is not merely a single practice but covers a wide range of different activities (Cooreman et al., 2018), on-farm demonstrations aim at one or more of the following (Pappa et al., 2018):

research implementation: established by researchers to validate and demonstrate new technologies;

knowledge creation, development and processing on demonstration farms: results of cooperation between farmers, specialists, researchers, fields advisors;

demonstrating new technologies-innovations uptake: to make clear what is entailed in opting for a new farming innovation;

knowledge transfer, educational and training opportunities: to get advice, information and knowledge on a wide variety of topics from advisers and specialists;

policy implementation: to become aware of regulations and supply chain standards;

networking: strengthens links between producers and their markets, the food chain industry, local communities and authorities, consultants and national agencies;

locally oriented implementation, participating processes enhancement and feedback opportunities: links education provision with the needs of local farmers and ensure that researches and solutions are directly relevant and focused on farmers' needs.

3. UniTech Days: a Lasallian on-farm demonstration

To explain UniTech Days, the seven categories of an on-farm demonstration are taking back (Marchand et al., 2017). For each category, the main Lasallian didactic principle is itemized.

3.1. Context: principles of collective decision and dialog

Organized yearly, the UniTech Days represents the completion of a year of interaction between the stakeholders involved in their organization process. Co-organizers are the students, throughout a dedicated association (Festival de la Terre et de l'Elevage), UniLaSalle agricultural

academic staff and Chair in Agricultural Machinery and New Technologies (Chair AMNT) members (Figure 6). The initiative comes from the students' association and the first edition took place on April 11th, 2019.

The main goal was collectively defined to promote exchanges of knowledge between farmers, students, teachers, and professionals in the farming sector through demonstration of innovations.

3.2. Goal of the demonstration: principle of contextualization

The theme of the day was "Innovation by Farmers", to highlight farmers' levers on the farm, to turn an innovative idea into action and understand the innovation process. To incite students' participation during this first edition and create peer learning between actual and future farmers, organizers decided to select some innovations demonstrated through students' projects. The day was organized around three possible innovations:

technology: innovative soil tillage equipment demonstration, some of which engineered by UniLaSalle students and alumni;

agronomy: visit of experimental plots included in a systemic territory project of agricultural biomass valorization, involving UniLaSalle researchers and academic students' projects;

organizational: two plenary conferences and *in-situ* demonstrations.

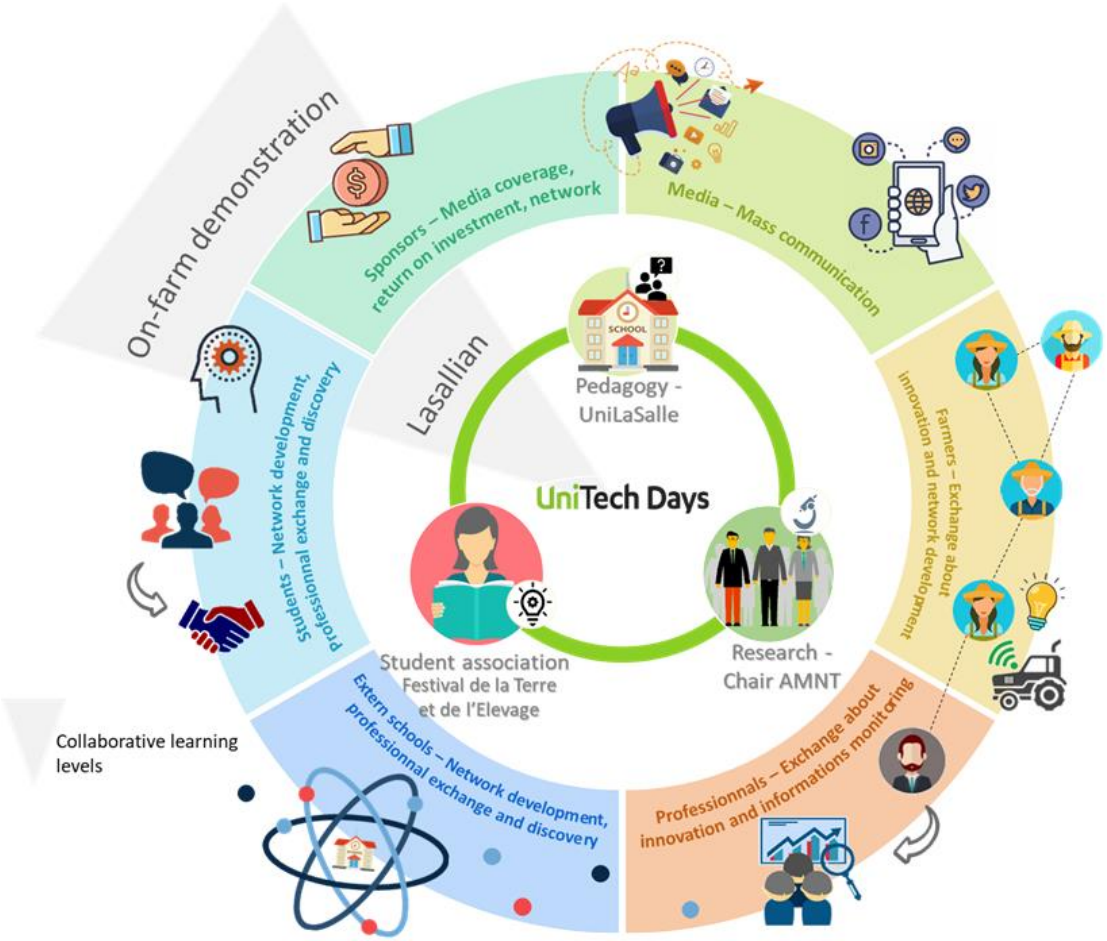

Figure 6: Unitech Days – two collaborative levels: Lasallian and on-farm demonstration

3.3. Host farm & logistics: principle of organization and planning

The locations used where tailored for the objectives of the day: farm demos have to occur on a farm to promote peer learning between actual and future farmers. The Unitech Days take place on UniLaSalle Beauvais campus, into three different spaces:

the UniLaSalle experimental farm, located on the campus;

AgriLab, a FabLab dedicated to open innovation towards sustainable agriculture, spanning from equipment to digital tools;

the academic building.

As organization was carried by a UniLaSalle student association, placed the event on campus facilitate logistics, allow to use all infrastructures (parking, university restaurant, signage ...) and strengthen relations with students during the all day.

3.4. Demonstration set-up: principle of the school 'runs well and didactic transposition

For technology and agronomy innovations demonstrations, co-existence of students', researchers', alumni', and professionals' demonstrations was favored. Groups included professionals, researchers and students, from UniLaSalle and others. We focus here only on the technology demonstration.

Technology: demonstration of 3 strip-tills, designed and prototyped by and for farmers. During demonstrations, the participants were split into three groups, and each demonstration was repeated three times for 20 minutes. The strip-till is a soil tillage tool that to prepare the seedbed only on the seed line, thus allowing to preserve the previous crops residues to cover the space between rows. It is one of the tools used in conservation agriculture, particularly targeting soil protection. The highlight was the demonstration of the strip-till designed and prototyped by UniLaSalle's students. It attracted the interest of many professionals because this type of strip-till with hydraulic driving is little known (Rizzo et al., 2018). This is a great example of a successful student farming knowledge transposition.

3.5. Recruitment: principle of learning as a means of social emancipation

Target audience is clearly actual and future farmers. Invitations have been sent to agricultural upper secondary and post-secondary non-tertiary education schools, agricultural professional organizations. Several networks were mobilized to disseminate information:

Students' network: as minimum 30% of agricultural students are sons or daughters of farmers, they mobilized their own network, especially president of the association, with high local network. Association creates a dedicated web page (https://www.festival-terre-elevage.com/unitech-days-vegetal);

Alumni' network: publicity was disseminated in newsletters and website. Alumni network has more than 18000 alumni around the world, with almost 200 farmers in Northern France;

Chair AMNT' network: a diffusion was published in the monthly newsletters, send to more than 200 alumni of UniLaSalle, prospects, professionals and farmers.

Altogether nearly 270 people came, including 170 students, from UniLaSalle, other schools or higher education, and 100 professionals, including 35 farmers.

3.6. Learning and facilitation methods: principle of multiple methodologies

Along with peer exchanges – students / farmers – several knowledge exchange methodologies were used:

Promoting interactions by putting the actors of innovation as center of attention: the innovative farmers were offered the opportunity to present their innovation with their own language and communicate about it. For the students presenting innovative works, they had the responsibility to communicate beyond the academic circle of usual staff, etc.

Presenting the technological innovations in the field despite the cold weather and soil humidity gathered participants around the farmers' usual dilemma of intervening in the field with hazardous climatic conditions. Even though tools could not be demonstrated running due to the humid soil conditions, participants expressed satisfaction to bond outside around innovative farm machinery;

Use of technological tools to promote live feedback from the audience during presentations (conference and panel but also and more importantly during introduction and conclusion of the day) i) generated a lot of interactions: students gained in confidence by interacting with a tool they know well (smartphone or computer) and farmers expressed interest for this interactive method; and ii) placed the participants in a perspective of bottom-up knowledge sharing.

Time management throughout the day has been guaranteed by changing of locations for each activity of the day: several rooms, fields, spaces were allocated for a specific time. There were no significant delays at the end of the day and participants expressed satisfaction about the load and repartition of activities (inside / outside) throughout the day.

3.7. Follow up and evaluation: principle of organization and planning

This event was considered a success as interactions were reckoned by all as beneficial for main targets, actual and future farmers. The role successfully taken by the students illustrates their ability to evolve from learner to mentor, in their turn.

Overall, collaborative learning was implicit and explicit throughout the whole process or organization & implementation (Lasallian level of collaborative learning) and during the day for the participants (on-farm demonstration level of collaborative learning).

The generated interest induced an availability of funding for the organization of the next UniTech Days 2020.

4. Conclusion

We proposed an interlocking collaborative learning to integrate on-farm demonstration in students' background and promote their ability of farming knowledge transposition. On these bases, we can draw a few lessons about the peer learning.

First, the implementation of Lasallian principles, in particular via the co-organization of the Unitech Days by student association and UniLaSalle staff. This level implies multiple interactions that stimulate mutual learning, dialog and collective decisions and create a collaborative relation between members of a unique community, dialed by students and mentors.

Second, the on-farm demonstration, aimed at enhancing peer learning in a real agricultural learning situation between actual and future farmers. These demonstrations showcase farmers' and students' technological innovations, as well as agronomic innovative projects carried by teachers, in which students are involved during their education. This event demonstrates that contextualization during an on-farm demonstration and co-existence of actual and future farmers can promotes peer learning, when learners are not considered as student or professional but future and actual farmers.

Altogether, students' commitment to the organization of on-farm demonstrations can enrich the collaborative learning because: (a) the students' language reaches more easily farmers, namely if one considers that they are for at least at 1/3 children of farmers; (b) students' education benefit from the beginning of a multi-actors networking including farmers and other agricultural experts and advisors.

To succeed further in Lasallian pedagogy, it would interesting to study how agricultural universities members of IALU promotes on-farm demonstration by students on their own experimental farms. As all of our engineers' students study abroad in a Lasallian agricultural universities for one semester, we can include this comparison in one course of the curricula dedicated to comparative analysis of agricultural systems.

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Author contribution. All the authors conceptualized the framework and the research challenges. DR and AC curated the selection and analyses of relevant documents. AC DR and SR wrote and edited the text, students schematise the Unitech Days in a synthetic figure and all of revised the article.

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DEVELOPMENT OF AGROFORESTRY 'MASTERCLASSES' TO OVERCOME POTENTIAL BARRIERS IN THE FLEMISH CONTEXT

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Introduction

Agroforestry as a way to transform agriculture

Agroforestry (AF) is a system where trees or shrubs are combined with crops and/or livestock, with the aim to deliver novel products and/or services. AF has been recognized for nearly half a century as a sustainable agricultural practice (Nair & Garrity, 2012), and the concept of integrating trees into the agricultural landscape is as old as the practice of cultivating land (Wilson & Lovell, 2016). However, agricultural practices have changed quite significantly over the last decades. Agricultural production has more than tripled in the last 50-60 years, due to processes of intensification and expansion (FAO, 2017). These processes have however come at a cost to biodiversity, ecosystem functioning and climate, as well as product quality, animal welfare and human health (Martin et al., 2013). To address these challenges, approaches that protect and improve the natural resource base are needed. This could imply technological improvements such as climate-smart agriculture, but also agroecological farming systems that build on traditional knowledge, like AF. The beneficial outcomes of AF include reductions in nutrient and pesticide runoff, carbon sequestration, increased soil quality, erosion control, providing shelter for livestock, and diversification in production and increased resilience, at least on the condition that suitable trees are selected and appropriate tree management is applied (e.g. Caudill et al., 2015; Davis et al., 2012; Dixon et al., 1994; Jordan & Davis, 2015; Nerlich et al., 2012). The fact that AF systems can simultaneously provide economic, ecological, and cultural benefits to famers and the wider society gives AF great potential as a transformative solution, to deal with the aforementioned challenges (Borremans, 2019; Wilson & Lovell, 2016).

Agroforestry implementation in Flanders

Flanders is one of the few regions in Europe which supports AF systems through both pillars of the CAP. As part of the first pillar, AF systems were qualified as Ecological Focus Area. As part of the second pillar, Flanders included AF in the list of agri-environment measures and management agreements eligible for subsidies. This resulted in 2011 in the set-up of a subsidy program for the installation of AF plots, which was renewed in 2014. Through this subsidy, farmers can retrieve up to 80% of the investment made when implementing an AF system. However, the Flemish subsidy program only finances 'AF *sensu stricto*', following the rather narrow definition of AF as defined in the Flemish regulation (Borremans, 2019; Departement Landbouw en Visserij, 2019), which excludes windbreaks, shelterbelts, dispersed trees in grassland and rows of trees at the border of agricultural fields. Typical AF systems in Flanders are intercropping systems (regular tree rows with an agricultural crop planted in between the rows) and trees in grassland (in combination with livestock). In addition to the subsidy as a supportive measure, the consortium 'Agroforestry Vlaanderen', encompassing the main actors working around AF in Flanders, offers support to anyone interested in implementing an AF system.

However, despite the possible associated benefits and existing support measures, the adoption rate of AF in Flanders remains below the initial expectations (Borremans, 2019). Borremans et al. (2018) investigated the barriers for AF development in Flanders. They identified challenges related to, amongst others, lacking technical knowledge, financial constraints, legal uncertainty,

lacking organizational support, and social pressure. Based on these challenges and the already existing merits of the agricultural system in Flanders, they suggested 5 development pathways focusing on i) science and technology, ii) market and financing, iii) policy and institutions, iv) education and organization, and v) social and behavioural aspects. They also propose several strategies and actions for each of the development pathways to overcome the existing barriers.

In the following sections, we will first describe the FarmLIFE project, with a focus on the organization of the masterclass programme, followed by a brief literature review on the potential of masterclasses as a learning approach. Second, we describe in more detail the set-up of the masterclass programme, and the evaluation approach. Third, we describe preliminary results of the masterclass programme in Flanders, discussing i) the value of the first masterclass series in Flanders, and ii) the potential of the masterclasses to contribute to the development pathways described by Borremans et al. (2018). We conclude with a short description of the next steps in the masterclasses programme, and suggestions on a further evaluation of the programme.

At this stage, this paper is an introductory part of a study that is still being conducted, and presents only preliminary results.

FarmLIFE as a platform to support learning on AF

The FarmLIFE project

FarmLIFE is a 5-year project funded by the LIFE+ programme, aiming to support the EU climate policy priorities. Main objectives of the project are to enable the transition of conventional agriculture towards climate resilient agroforestry. This is done through two main elements. First, the project cooperates with 3 landowners to develop adaptive farm plans for three AF sites, which in time should serve as demonstration sites for innovative adaptation measures. Second, the projects aims to develop and test replicable learning tools for connecting farmers and other societal partners in resilient rural networks. For the second objective, several actions have been formulated, including the organization of a 'masterclass' series, both in the Netherlands and in Flanders (Belgium).

In the course of the 5-year project, 2 sets of 18 masterclasses are being organized (with an intended average of one masterclass per month), both in the Netherlands and in Flanders. Main objective of the masterclasses is to facilitate the transition towards more climate-adaptive AF systems by creating a supportive learning environment for farmers. During the masterclasses farmers have the opportunity to engage with various societal partners (researchers, technical experts, government representatives, businesses, institutes, consumers), to share concerns/questions, and jointly discuss existing concerns/questions, address these issues, and define possible solution strategies. The masterclasses intend to support an educational approach based on learning rather than on teaching. The content of the masterclasses is as much as possible demand-driven, using flexible & interactive learning tools, which can include training sessions, demonstrations with hands-on activities for the participants, field visits, but also presentations on specific topics by experts, group discussions, etc. More information on FarmLIFE: http://farm-life.eu.

The masterclass programme as a learning approach

A learning approach may be understood as a patterned set of generalized ingredients and relationships that are promoted as desirable for the learner and the learning outcomes (OECD, 2013). Approaches vary in terms of e.g. student-teacher relationship, individual versus community emphasis, active and passive knowledge building and so on. The masterclasses fit well

within current ideas on of knowledge sharing and (co-)creation to support more sustainable farming system. The objective of creating a setting enabling opportunities for joint problem solving is in line with the increased acknowledgement of the importance of knowledge co-creation - as opposed to unilateral knowledge transfer – processes, focusing on interactions between science and society, and where farmers are recognized as equal co-producers of knowledge (Moschitz and Home, 2014; Sumane et al., 2017). In this transdisciplinary approach for knowledge co-creation, networks and communities of practice (CoPs) are increasingly used as 'tools' in knowledge management (e.g. Oreszczyn et al. 2010; Wenger et al. 2011). Wenger et al. (2011) define CoPs as learning partnerships among people who find it useful to learn from and with each other about a particular domain, use each other's experiences of practice as a learning resource and join forces to address individual and collective challenges. Also, Curry et al. (2012) report on the importance of networks in which farmers develop knowledge and innovation from the 'bottom up', through mechanisms of sharing experiences and learning together.

The concepts of tacit knowledge and peer-to-peer learning are central in such configurations. Tacit knowledge is considered as indispensable in processes of sustainable development, because it is context-specific and holistic (Hoffman et al., 2007; Curry & Kirwan, 2014; Sumane et al, 2017), encompassing both an individuals' skills and crafts and mental models, ideas and values (Nonaka & Takeuchi, 1995; van den Ban, 2002). Two types of processes have been considered as pivotal in knowledge co-creation processes, because they enable tacit knowledge sharing, i.e. "socialization", which is supported by practical experience, interactions, and observing practices, and "externalization", where the tacit knowledge is transformed to new, explicit concepts, making them more easily shareable (Nonaka & Takeuchi, 1995; Hoffman et al, 2007).

Second, the concept of peer-to-peer learning refers to a reciprocal, at least 'two-way', learning approach between equals. Important and characterizing is what Cooper (2002, p.54) explains: 'Peer learning represents a major shift in focus from what is being taught to what is being learned, and transfers great responsibility for knowledge acquisition, organization, and application from the traditional teacher role to the student". It requires initiative, active participation and engagement of the learner towards the own learning process, and emphasizes learners learning from and with each other (mutual learning). Roles of teacher and learner are not necessarily defined and can alternate throughout the learning experience (Boud et al., 1999). Research has indicated consistently to the fact that farmers put great value to peer learning experiences (e.g. Oreszscyn et al., 2010; Hamunen et al., 2015).

As a final element of the learning approach, we would like to highlight the importance of competency development. It has been argued that education should be aimed more at developing specific competencies in farmers, focusing on e.g. rich observation, creativity, and critical reflection (Lieblein, et al 2012; Debruyne et al, 2016), rather than merely "providing" knowledge, when considering agroecological farming systems, like AF, where a holistic view on farming is crucial (Francis, 2004). Developing such competencies also requires specific educational methods, requiring a good balance between experience, theory, and the acquisition of practical skills, with learners being embedded in the context of the farming system (Lieblein et al., 2004; Hilimire et al., 2014).

These various aspects are the foundation for the format of the masterclasses: a series of meetings, in relatively small groups, ideally with at least a core groups of steady participants, expertise being provided as much as possible by peers, with sufficient space for interaction, hands-on experience, and peer-to-peer discussions, and with learners taking responsibility for what is being learned. As such, the idea is to develop a community of practice through the masterclass programme, bringing together (future) AF farmers and other societal actors in Flanders.

Methodology

Case description: developing the masterclass programme in Flanders

In Flanders, the first set of 18 masterclasses has been organized between September 2018 and March 2020. This first set consists of three main 'types' of masterclasses. First, a set of 3 exploratory masterclasses was organized, followed by two parallel sets of masterclasses: a first 'general' set of 9 masterclasses, focusing on a range of diverse, quite practical topics, and a second set of 6 so-called place-based masterclasses exploring the possibilities of AFs in a specific area in Flanders (Bulskampveld). They are discussed in more detail below.

Identifying needs through exploratory masterclasses

We started with 3 "exploratory masterclasses", each with a specific aim. The first exploratory masterclass had 12 farmer participants with a clear interest and/or stake in AF (e.g. have an AF system implemented on their farm), and with clear pre-existing knowledge on the topic.

In a previous research project, a list of interests and needs were already compiled. Our aim for the first masterclass (MC1) was i) to validate and confirm that the interests and needs were relevant, and ii) to identify possible other actor types which influence decision making around AF. This was done through a network mapping exercise for 3 participating farmers, identifying societal actors (i.e. specific organizations, institutes and actors, other than farmers) who had played a part (either positive or negative) in the development of the AF system on their farm.

This input was used to organize a second exploratory masterclass (MC2). Since the aim of the masterclasses is not only to engage farmers, but also other societal actors, the latter was the target audience. Based on input from MC1, and own expertise, societal actors deemed as relevant and/or having an impact on the AF implementation in Flanders including policy makers, from different policy levels (regional/Flemish; provincial; local), and from different policy domains (agriculture and forestry; environment, heritage), advisory services (both public and private), and companies/industry representatives (from the demand and supply side) were invited. The aim of MC2 was twofold. First, identify their views about the potential of AF in a Flemish context, and if and how AF can contribute to achieving their own (organization/institute/company) objectives. Second, identify their needs for a masterclass programme. The MC2 had 22 participants, and resulted in 5 main topics to be considered for the masterclass trajectory: 1) AF business models, 2) place-based approaches for AF, 3) choice of suitable species and cultivars, 4) existing barriers for AF implementation and 5) chain organization.

A third masterclass (MC3) was organized for a wide audience. The main aim of MC3 to broaden the potential masterclass audience also including people with little or no knowledge on AF. The MC3 was organized at AgriFlanders, the main agricultural fair in Flanders, and attracted 62 participants, with diverse profiles (policy makers, researchers, advisors, active farmers and foresters). During this masterclass an introductory presentation was given about the concept of AF, and what it could mean in a Flemish context followed by a testimony of 4 AF farmers and a discussion.

Finally, a fourth masterclass was organized with a focus on the current and future policy around AF in Flanders, with a selected group of participants, active in policy, but also including 3 AF farmers, specifically to capture their experiences, and possible shortcomings or points of improvement for the current AF policy.

Developing a general and place-based series

Based on the input of the 3 exploratory masterclasses (and previously identified needs of the AF farmers), a programme for the remainder of the first set of masterclasses was proposed.

One of the main elements emerging from the exploratory masterclasses, was the fact that a transition towards more climate-adaptive AF systems would be well served by following a place-based approach. The latter is defined as "integrated management of the full suite of human activities occurring in spatially demarcated areas identified through a procedure that takes into account biophysical, socioeconomic, and jurisdictional consideration" (Young et al., 2007). In such an approach, local actors are brought together to develop a shared vision on the potential of AF for their specific area, taking area-specific characteristics and conditions into account. The idea being that the space shapes the potential for development of territories, and the individuals who live in them (Barca et al, 2012; Reed et al, 2017).

We thus developed two parallel trajectories: i) a series of general masterclasses, open for all interested, and ii) a series of place-based masterclasses, targeting specifically local actors within a specific area. Topics for the general series cover a wide range of elements, based on both farmers' and societal actors' needs, identified during MC1 and 2 (Table 1).

Table 6: overview of the masterclass programme

Exploratory masterclasses	
10/18 – Validation farmers' needs + inventory societal actors 11/18 – Identification societal actors' needs 12/18 – Reflection on AF policy in Flanders 01/19 – AgriFlanders information session: AF for a wider audience	
Place-based series	**General series**
01/19 – exploration Bulskampveld (meeting with regional coordinator and administration)	03/19 – Winter pruning of fruit trees
04/19 – meeting with the local working group (programmateam) agriculture	04/09 – Food forests
09/19 – meeting with different management authorities	05/19 – Holding pigs in AF systems
11/19 – meeting with public/private advisors active in the area	06/19 – Designing an AF system on your farm
TBD further	07/19 – Choosing suitable planting materials
	09/19 – Summer pruning – processing and marketing of fruits and nuts
	11/19 – Creating added value for AF products

	02/19 – Short chain marketing of AF products 03/20 – Wood products from AF (high quality & biomass)

For the general series, a list of topics was proposed for the whole series, based on the input obtained during the exploratory MCs, with a best suggested time for each masterclass. Some flexibility was still possible, depending on availability of experts, and participant questions during the masterclass series. Masterclasses in general followed a similar set-up: the masterclass included one or more presentations (e.g. farmer offering a testimony about AF on their farm; expert[30] providing background to the topic of the day) and one or more interactive sessions (e.g. farm walk, field visit, Q&A session, workshop). Participants registered beforehand, and at the time of registration had the opportunity to indicate specific questions they had regarding the topic of the masterclass. These questions were shared between facilitator and speakers, and were, whenever possible, integrated in the presentation and/or discussion during the masterclass. The number of participants varied between 16-47. In total, we had 185 participations for the 6 masterclasses which had taken place at the time of writing. Of those 185, 107 were individual participants. A core group of 15 people attended 4 or more out of 6 masterclasses, and 57 participants only attended one masterclass.

For the place-based series the area 'Landschapspark Bulskampveld' (BKV) was selected. This area is situated on the border of the provinces of East- and West-Flanders, and covers a surface of approx. 100 km² (Figure 1). This area was designated in 2012 as a development area by the Province of West-Flanders, with a focus on the themes of culture, landscape, nature and recreation.

Figure 7: Location Landschapspark Bulskampveld (delineated in red) within Flanders. Source: www.agiv.be

We selected this area for several reasons: first, because of the aforementioned ongoing developments within the area, there is already a quite strong interaction between actors in the area, so we can build on a pre-existing network, which is an important consideration considering the time constraints of the project. Second, agriculture has historically played an important part

[30] experts had different profiles, and could either be farmers, researchers, advisors, etc., but all with a strong practical experience in AF.

in the area (Demasure, 2013), so there is a clear interest in developments where agriculture can contribute to the aforementioned focus themes. Third, a short visionary document regarding opportunities for AF in the region, has been developed by mainly the regional administrators, which needs to be aligned with the other actors active in the area. So, one of the main objectives of the place-based masterclasses is to develop a shared vision with all main local actors on what AF could mean for them in the area, and identify how an integrated vision on the implementation of AF in BKV can assist them in achieving their own (personal/organizational) objectives (e.g. diversification of farm income, creating corridors for bats, restoring cultural-historical landscapes, etc.). At the same time, the potential of AF implementation on approx. 5 farms within the area will be explored more in detail.

Evaluation set-up

We included 3 main elements in our evaluation: i) creation of a supportive learning environment for famers and other actors, including aspects on the learning approach that was followed (demand-driven, interactive & flexible); ii) creation of opportunities to engage with various societal partners; and iii) elements for improving the practical organization of the masterclass (less specifically linked to the objectives). We developed a stepwise evaluation approach, which differs for the place-based and general series, considering the different focus and approach of both.

For the general series, experiences of masterclass participants were captured through a short questionnaire sent to all participants within one month after each masterclass, and a short focus group towards the end of the first series of general masterclasses. The short questionnaire is structured similarly after each masterclass, and has a number of open and closed questions (Table 2). Questions are designed to mainly evaluate item 1 (learning, focusing on short-term outcomes of masterclass participation) and 3 (practical evaluation). Out of 185 possible responses, we collected 56 completed questionnaires after 6 general masterclasses (response rate 30.3%). The focus group was held in Nov. 2019, and had 18 participants, and followed a world café approach. The focus group covered all 3 aforementioned elements (learning, networking opportunities, practical organization).

Table 7: Evaluation questionnaire general masterclass series

Section 1: masterclass announcement	
How did you find out about this masterclass?	Personal invitation Website AF Vlaanderen Social media Agricultural press During a previous masterclass Other
What triggered your interest to participate?	Open question
Section 2: practical organization	
How would you evaluate the different sections of the masterclass	(Per session) very useful useful

	neutral not useful
What did you find the most interesting element in this masterclass?	Open question
What was well organized about this masterclass? Why?	Open question
What was not well organized about this masterclass? Why not, and how could it be improved?	Open question
Which aspects of the masterclass are applicable to your company or within your organization and field of work? Why?	Open question
Section 3: learning	
Do you intend to apply what you learned during the masterclass in practice?	Yes no maybe
If your answer is yes or maybe, what would you apply in practice?	Open question
What are (possible) barriers to applying what you learned to your company?	Open question

For the place-based series, we included a short evaluation round at the end of each masterclass, based on which the next masterclass was planned. However, since the process in BKV will continue in the second series of masterclasses, the process is in a too early stage to have a more in-depth evaluation of process outcomes.

Results and discussion

Masterclasses as a valuable learning approach?

According to the questionnaires completed after the general masterclasses, the sessions were considered as either very useful or useful (45.5% and 42.5%, respectively), only one participant indicated that one of the sessions within a masterclass was not useful (0.4%). Elements which participants considered as most interesting included i) a good balance between theory and practice and the strong link between both, ii) the opportunities for hands-on practice (especially during the pruning masterclasses), iii) the focus on practice through e.g. farm walks and field visits, iv) having open and realistic testimonies of people with years of AF experience, and v) the contacts made with not only the experts, but also the other participants. While the first three are more related to the educational methods, with opportunities for practical experience, the latter two specifically refer more to the networking aspect, and peer-to-peer learning opportunities. When discussing the value of the masterclasses during the focus group, the networking aspect became even more prominent. Several participants considered this as the most valuable aspect of the masterclasses, and indicated that they had broadened their network significantly, and also had contact with participants outside of the masterclass programme. Participants had more problems indicating what they had learned specifically from the different masterclasses, and indicated that some of the topics lacked sufficient depth, and that they still need more

information, to steer their decision making. This is also in line with results from the questionnaires, where the majority of participants indicated that they considered applying what they learned in the masterclass in practice (78% yes, 18% maybe), but still experience barriers to the actual application. Main recurring barriers that were mentioned were legislative and regulatory aspects, insufficient knowledge available, and insecurity about financial return (also linked to scale). Finally, as also indicated in the questionnaires, the combination of theory and practice was crucial for most participants, and wanted to see this expanded in the second series. The importance of having a specific hands-on exercise as part of the overall learning experience was highlighted by one of the participants: *"the combination of the theory, followed by the opportunity to apply that theory immediately afterwards in practice, gives me sufficient confidence to also apply this back home"*. However, including hands-on experiences in the interactive sessions of the masterclasses was not always straightforward. In some cases, the topic was not entirely suitable (e.g. food forests), but also the group size was often a limiting factor. While we limited the number of participants, some participants indicated that an even smaller group could have been beneficial. The importance of group size was also emphasized by Marchand et al. (2019), in the context of on-farm demonstrations, and should be carefully considered for the second series.

So far, the evaluation approach we followed mainly focuses on the short term effect of participating in the masterclasses. Such a short-term evaluation tends to focus more on what participants take home after the masterclass, and does not assess what participants do with what they take home. The focus group close to the end of the first series tried to tackle this to some extent, but still the time lag is relatively short, especially considering the complexity of decisions that need to be made in some cases, and the influence of other factors on the decision-making process (e.g. Edwards-Jones, 2006; Fountas et al., 2006). The value creation framework, developed by Wenger et al. (2011), which distinguishes 5 cycles of value creation – i) *immediate* value considers that networking activities and interactions have value of themselves; ii) *potential* value refers to 'knowledge capital', whose value lies in its potential to be realized late; iii) *applied* value refers to the adoption and application of the knowledge, practices and results learned in one's personal life or professional context; iv) *realized* value goes further than only application. It looks at the effects and successes of the novel practices, both for farmers and other stakeholders; and v) *reframing* value reflects on changed understandings, strategies or goals and changes in the definition of what matters, at individual, collective and organizational level – could be useful to assess this in more detail.

Finally, we would like to emphasise the value of the exploratory masterclasses and the pre-event registration in guiding the overall masterclass programme. While we have to deliver approx. one MC per month, at the same time it was expected that they were demand-driven. The exploratory masterclasses allowed to consider more in general the end-user needs, while more specific questions and considerations were captured by the pre-event registration.

Masterclasses to increase AF implementation?

We believe that the masterclasses have the potential to contribute to the pathways for AF in Flanders, as proposed by Borremans et al. (2018) in several ways.

First, there is the development pathway on education and organization, addressing the limited knowledge of farmers and the agricultural sector in general of AF. Borremans et al. (2018) proposed the following actions for this pathway: (1) to coach teachers in education of agroecology and agroecological competences to introduce AF in the formal education; (2) to create learning networks of farmers on the practical aspects related to AF; (3) to create an action plan for AF development in Flanders that defines where and in which contexts AF systems can

deliver maximal benefits and minimal drawbacks. The general series of masterclasses feed directly into the second action, which seems to be confirmed by the preliminary evaluation results of the general series. Also the place-based series have the potential to contribute to this pathway, in line with action 3, although on a smaller spatial scale, however it is too early to assess at this stage in the process.

Second, we also believe that the masterclass series have the potential to contribute to the pathways on social and behavioural aspects, and the creation of an enabling institutional and policy environment. The first pathway reflects on the different discourses, and how the more dominant neoliberal-productivist discourse, held by for instance farmer organisations or colleagues can act as a barrier for AF implementation. Possible actions for this pathway included (1) the facilitation of communication between farmers and extension agents, and between farmers and AF pioneers, and (2) the connection of local authorities, farmers, landowners and local residents around specific topics (Borremans et al., 2018). By inviting AF pioneers to share their experiences during the general masterclass series, we potentially facilitate the first action, however with two important restrictions. First, considering the format, this is done only on a relatively small scale. Second, most participants of the general masterclass series do not follow the dominant discourse, but have a critical view towards it. Considering this, the impact of the general series may be rather limited. The place-based series is a good example of the second action, but again it is too early to assess in this stage of the process

Finally, there are the development pathways of science and technology, and market and finances. The first one advocates a.o. for more participative and transdisciplinary research projects, of which the FarmLIFE project as a whole is a good example. The pathway on market and finances focuses on economic instruments that allow AF to be a more profitable option for farmers. While masterclasses often focused on the economic aspect of AF, we have no intention to develop specific economic instruments for increased AF farm profitability, and as such little impact is expected regarding this aspect.

Conclusion

To conclude, evaluation results so far suggest the masterclass approach has merit, especially regarding the aspect of network formation, and thus shows potential for overcoming some of the barriers for AF implementation in Flanders. It is important to highlight in this respect that FarmLIFE is just one of various other projects on AF in Flanders, and it could be relevant to assess the complementarity of these projects in their contribution to the development pathways identified by Borremans et al. (2018).

Furthermore, we think it is necessary to include an additional evaluation step at a later stage, once the full series of masterclasses has been finalised (expected June 2021), separately for the general and place-based series, to allow for a more extended time lag. The evaluation could focus specifically on two main aspects: i) the development pathways, to assess more in detail if and how both the general and place-based masterclass series have contributed to them; ii) the value that was created in the different networks put in place, guided by the value creation framework proposed by Wenger et al. (2011) for CoPs, incorporating more clearly aspects of knowledge sharing and competency development.

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PHOTOVOICE: A RESEARCH METHOD FOR FARMER-DRIVEN KNOWLEDGE PRODUCTION

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Abstract

This paper argues that there is an imperative for researchers and agriculture sector stakeholders to adopt research methods that place smallholder farmers at the centre of knowledge-creation processes. Although they are custodians of local agricultural and environmental knowledge systems, farmers are often not considered to be part of the 'community of practice' when it comes to enhancing the sustainability of agricultural production systems. Using cocoa farmers in Ghana as a case study, this paper demonstrates that Photovoice is a useful research method for co-generation of knowledge in the context of climate change adaptation and mitigation.

Photovoice recognises that farmers are producers of knowledge and is a method that does not look to prescribe what knowledge farmers should capture, or how they should present it. In the context of this case study, photovoice was used to elicit information on the impact of climate change on cocoa production and farmers' livelihood security. Farmers selected to participate in the study were provided with integrated flash-equipped disposable single-use cameras, brief instructions on how to operate the cameras, and asked to go to their farms to capture and communicate their lived experience of climate change through the medium of photography.

Farmers were enthusiastic in sharing why they captured a particular image or a series of related images, during a subsequent feedback session. Recognising that 'a picture is worth a thousand words', many of the farmers entrusted with cameras reported that they had allowed neighbours to also take photographs on their farms. They justified doing so by stating that if the objective was to gain insight into the impact of climate change on cocoa production and farmers' livelihood security, then it should capture the diversity of lived experiences. Moreover, they argued, if the exercise was farmer-led, they should be allowed to adapt the research method to suit their circumstances.

Photovoice increases farmers' agency in knowledge-creation processes. As it can provide insight into the impact of climate change on agricultural production and livelihood security in a way that allows farmers to shape their own narrative, photovoice is a powerful tool for researchers and agricultural stakeholders interested in identifying opportunities for intervention in the arena of climate change adaptation and mitigation.

Introduction

Smallholder farmers have a wealth of agricultural and environmental knowledge. Acquired through lived experience and experimentation, however, it is implicit rather than explicit knowledge, embedded in practices, processes, routines and norms (Bolisani and Bratianu, 2018; Girard, 2015; Stuiver et al., 2004; Tress et al., 2007). Reflecting local and historical availability of socio-material resources, and resource allocation or use under conditions of uncertainty, farmers' knowledge is action-oriented or procedural and constitutes a combination of skills or know-how, derived from a learning process which involves continuous re-interpretation and evaluation of situational information accumulated. This process is stimulated by farmers' interaction with their

natural and social environment during engagement in regular and/or experimental production-related activities (Bolisani and Bratianu, 2018; Stuiver et al., 2004). Farmers monitor and evaluate decisions and adjust production practices to account for contingencies and in response to unintended effects; they learn by doing and do through learning (Goulet, 2013; Stuiver et al., 2004).

Although they are custodians of local agricultural and environmental knowledge systems, smallholder farmers are often not considered to be part of the 'community of practice' when it comes to enhancing the sustainability of agricultural production systems (Magni, 2017; Raymond et al., 2010). Scientific or technological knowledge and expertise are instead given primacy in debates over sustainability, as are technocratic interpretations of sustainability (Feola, 2015; Van Assche et al., 2017). Scientific or technological knowledge is reductionist, however, and does not encourage communities of practice to take a holistic view towards realising the sustainability of agricultural production systems, which are essentially complex social-ecological systems (Fischer et al., 2015; Girard, 2015; Stuiver et al., 2004). As farmers' knowledge recognises complexity, it constitutes a useful resource in understanding how ecosystems can and cannot be transformed and managed, and social systems can be designed to better fit with ecosystems (Stuiver et al., 2004).

Social-ecological sustainability can only be realised through transformational change (Fischer et al., 2015; Termeer et al., 2017). Knowledge that is useful for transformational policy-making can only emerge where conflict between expert and stakeholder knowledge is encouraged and the knowledge creation process involves facts, interpretations, assumptions and causal relations from different knowledge domains being exchanged, combined and harmonized (Bathelt et al., 2004; Buuren and Edelenbos, 2004; Edelenbos et al., 2011; Girard, 2015). If debates on sustainability are underpinned by scientific or technological knowledge alone, it can result in the sustainability of a social-ecological system being undermined rather than enhanced (Smith and Stirling, 2008; Stuiver et al., 2004). The incorporation of farmers' knowledge in debates on sustainability increases the likelihood that resultant intervention strategies are not only scientifically valid, but also, socially valid, and therefore, importantly, do not maintain the status quo at the expense of transformational change (Folke et al., 2010; O'Brien and Sygna, 2013; Pelling, 2011; Termeer et al., 2017).

Photovoice is a community-based, participatory visual research method which initiates a knowledge-creation processes which not only contributes towards fostering critical dialogue between stakeholders with an interest in enhancing the sustainability of agricultural production systems against a backdrop of climate change, through adaptation and mitigation; but importantly, as it is inclusive of smallholder farmers' perspectives on sustainability, it can generate knowledge which is socially valid and thus useful for policy-making. Recognising the need to incorporate knowledge produced outside the formal systems of agricultural research and development into debates on sustainability, this paper outlines how Photovoice can be used to capture and transform farmers' implicit knowledge into explicit knowledge. Using cocoa farmers in a small community in Bodi District, Western North Region, Ghana as a case study, this paper explores farmers' perceptions of the impacts of climate change, and soil- and water-related challenges faced in pursuing cocoa production as a livelihood strategy; and farmers' adaptation and adoption of coping strategies, and factors constraining their adaptation and adoption. In addition, the paper discusses the limitations of the method, and the extent to which farmers can be empowered during and as a result of a Photovoice-based research process.

The Photovoice Method

Photovoice is a research method which is underpinned by feminist and critical consciousness theory, and the principles of participatory documentary photography (Novak, 2010). It aims to engage individuals and communities as active rather than as passive participants in exploring lived experiences, and documenting and analysing socio-ecological phenomena (Cook, 2015; Cook et al., 2016; Liebenberg, 2018). Recognising that there is a need to address the power imbalances which have traditionally existed between researchers and research participants, Photovoice takes into consideration historical, economic and political structures responsible for the marginalisation and oppression (Liebenberg, 2018). It looks to demystifying contexts and structures which maintain oppression, and revealing how assumptions and behaviour lead to oppressive systems being maintained (Plunkett et al., 2013; Sanon et al., 2014). Premised on the idea that research participants should determine the research focus, be involved in the data collection and analysis process and sharing of findings (Liebenberg, 2018); Photovoice engages marginalized individuals and communities throughout the research processes.

Recognising the interplay between knowledge creation and agency (Suffla et al., 2012), one of the main objectives of Photovoice is to promote social justice and empower. Encouraging research participants to assert their voice and their capacity for sense-making, knowledge-creation and knowledge-management (Nonaka and Toyama, 2015), the research method encourages research participants to contest their marginalization and exclusion from mainstream discourse, policy debates and interventions (Girard, 2015; Stuiver et al., 2004). As socially-acceptable, context-specific solutions to issues can only be identified where individuals are self-aware, willing to leverage their social capital, and advocate for their own and their community's well-being (Hergenrather, Rhodes, Cowan, Bardhoshi, & Pula, 2009; Wang and Burris, 1997); Photovoice encourages research participants to engage in collective reflection, introspection and discussion.

Similar to other visual research methods such as photo-interviewing, photo-elicitation and reflexive photography, Photovoice encourages individuals to communicate their story through the medium of photography, and does not prescribe what photographs should be captured, or how photographs should be presented (Leung et al., 2017). Detecting issues that would likely remain hidden if a top-down, quantitative rather than bottom-up, qualitative approach was taken to data collection (Wang and Burris 1997; Wang, 1999; Budig et al., 2018; Cook, Brown, & Ballard, 2016), Photovoice constitutes a research tool that can be used by researchers to explore the social, economic and/or environmental issues undermining sustainability of complex social-ecological systems, and therefore, adversely impacting research participants' everyday lives (Budig et al., 2018; Jaiswal et al., 2016; Leung et al., 2017).

Although Photovoice emerged from and was initially used primarily in the context of public health research, it is today used in many other research disciplines (Budig et al., 2018; Jaiswal et al., 2016; Leung et al., 2017). There are, however, still only a handful of studies relating to agriculture and climate change. Notably, Photovoice has been used to asses ecosystem services and human wellbeing in Costa Rica (Berbés-Blázquez, 2011); to determine social and environmental change in coastal communities in Thailand (Bennett and Dearden, 2013); to understand social constructions of climate change and rising sea levels (Baldwin and Chandler 2016); to examine water use and needs in Western Kenya (Martin, 2019); enhancing female farmers' active participation in agricultural development programmes (Gervais and Rivard, 2013); and to explore perceptions of climate change in small family farms in the USA (Bulla and Steelman, 2016).

As far as we are aware, this is the first study that uses Photovoice to explore smallholder farmers' perception of the impacts of climate change on cocoa production, and specifically, the soil- and water-related challenges which farm households and communities face in pursuing cocoa

production as a livelihood strategy. This study, therefore, contributes to addressing the current gap as regards the use of participatory visual research methods such as Photovoice in the context of the research discipline, which is cocoa research, but also contributes to extending the use of the research method to farmer-driven research relating to the management of soil and water resources.

Methods

2.1. Study location

The case study outlined in this paper stems from the results of a larger study focusing on soil and water management in cocoa production systems, which involved the use of a wide range of qualitative research methods over a period of six months of fieldwork (April-September 2018) in the cocoa-producing regions of Brong Ahafo, Western North and Central Region of Ghana. Ethical clearance for this study was obtained from De Montfort University prior to the start of the study. The Photovoice component of the study took approximately two months to complete (July-August 2018) and involved providing farmers in Bodi District, Western North Region with disposable single-use cameras so that they could capture their lived experience of producing cocoa against a backdrop of climate change. The study location was chosen due to the importance of cocoa production, farmers' enthusiasm to voluntarily participate in the study, and COCOBOD's willingness to provide logistical support in reaching out to the community.

2.2. Sampling strategy

A purposive sampling strategy was used to select farmers for the Photovoice component of the prior mentioned larger study which looked specifically to explore to what extent farmers' perception of climate change, and their knowledge relating to soil and water management could be key to enhancing the sustainability of cocoa production systems, against a backdrop of climate change. This choice of sampling strategy ensured that farmers who took part in the study were: (a) cocoa farmers; (b) had lived in the area/region for more than one year; (c) were willing to learn how to use a disposable single-use camera; (d) agreed to voluntarily participate in the initial group session to learn how to use the camera and receive instructions as regards undertaking the Photovoice activity; and (e) agreed to participate in a follow-up, afternoon-long group session where the pictures taken would be categorized, discussed to elucidate their meaning and significance, and a final selection of photographs made.

2.3. Photovoice procedure

A meeting was organised with the help of the COCOBOD extension officer responsible for providing extension to the community. A total of 15 disposable single-use cameras were provided by the researcher for use by the farmers who agreed to participate in the study, with cameras distributed on a first-come-first-served basis. As a large number of farmers expressed their interest in participating in the study, farmers who had a phone with a camera were encouraged to take part, using their phones to capture images which could then be copied or sent to the researcher's phone to allow for their printing and inclusion in the follow-up group discussion. Farmers who did not have a smartphone, or the capacity to take a photograph using their smartphone, were prioritised in the distribution of cameras. In total, 38 farmers participated in the study: 8 farmers used their smartphones and 15 farmers used disposable single-use cameras. The latter group of farmers shared the cameras received with an additional 14 farmers (i.e. neighbours, friends and family) who also wanted to participate in the study.

The concept behind Photovoice - as outlined by Wang and Burris (1997), Novak (2010) and Bennett and Dearden (2013) - was explained to the 5 female and 19 male farmers who were

present at the initial one-hour long group session and agreed to participate in the study. Farmers were informed that - unlike a paper-based survey or an interview involving the use of a dictaphone and note-taking materials, where the research was in charge - they would be responsible for the data collection process. Moreover, they were informed that the objective of Photovoice was to give them the opportunity to influence the research process and the process by which knowledge is created, captured and used, in this case by collecting visual data. The ethics of taking photographs was explained and discussed, and farmers who agreed to participate in the study were asked to give their consent for photographs taken to be used in the follow-up group discussion, and in the larger study focusing on soil and water management in cocoa production systems.

Farmers were instructed to take photographs over a two-week period, while or after undertaking regular day-to-day activities on their farms. They were shown how to use the disposable single-use cameras during the initial one-hour long group session. Although each camera was equipped with an integrated flash and its use was demonstrated, farmers were encouraged to take photographs during daylight hours rather than during low light conditions (i.e. at dusk or dawn), to ensure that the exposure would be adequate, given the fixed aperture and shutter speed of the cameras. Farmers were reassured, however, that it was not a problem if they wanted, for a particular reason, to take a photograph in the early morning or early evening (as long as the integrated flash was used). To verify that farmers understood how to use the cameras, a self-appointed leader of the group of the 23 farmers was invited by the researcher to take a photograph of the group and asked to assist farmers who subsequently faced difficulties in taking photographs on their farms.

The aims and objectives of the Photovoice exercise were explained, and farmers were given the opportunity to raise questions as regards the process. Farmers were asked to communicate their perception of the impacts of climate change, and the soil- and water-related challenges faced in pursuing cocoa production as a livelihood strategy. They were informed that it was not a problem if the disposable single-use camera was used to take photographs on multiple farms and/or by more than one farmer, given the interest in taking part in the study. Moreover, they were informed that there was a limit, however, as to how many photographs could be taken with the cameras, with each camera having the capacity to take a maximum of 27 pictures only. Finally, they were informed that it was necessary to take the photographs within the agreed two-week period as the cameras would have to be collected by the COCOBOD officer on behalf of the researcher, so that the film-roll could be sent away for development and the photographs printed in anticipation of the follow-up group discussion.

2.4 Participatory data analysis

This study followed guidelines outlined by Wang and Burris (1997), Novak (2010) and Bennett and Dearden (2013) as regards ensuring that the analysis of the data (i.e. photographs) collected by farmers was undertaken in a participatory manner. As the analysis was undertaken in an outdoor environment, farmers were asked to arrange photographs based on their similarity to other photographs (i.e. thematically) on A3-size paper sheets laid out and weighed down with stones, to reduce the likelihood of water damage. This arrangement of the photographs enabled farmers to more easily follow the three-stage process of (a) selecting the photographs that they felt most accurately reflected their individual and collective lived experience in producing cocoa against a backdrop of climate change; (b) contextualising the photographs by providing an explanation or reason as to why specific photographs relating to the impacts of climate change on production were taken, to determine their meaning and significance in the context of the individual and collective lived experience; and (c) codifying the photographs by identifying emergent issues, themes and/or theories. At the end of the group discussion, the 38 farmers who took part in the Photovoice exercise were asked to choose a final set of 20 photographs and state

by means of a single sentence (i.e. a caption) what message they wanted to convey to the researcher and/or policy-makers.

Results

The farmers who received the disposable single-use cameras took a total of 405 photographs, as each camera had the capacity to take 27 photographs. Of the total the 405 photographs developed for use in the follow-up group discussion developed, farmers selected to use 105 photographs which they judged to be in-focus and correctly-exposed based on training given prior to the photo-taking exercise. The farmers who used their smartphones to take photographs took fewer out-of-focus and under- and overexposed photographs. Consequently, 50 of the photographs which they shared with the researcher were also printed for use in the follow-up group discussion. This resulted in a total of 155 photographs being discussed by farmers during the follow-up group discussion held over the course of an afternoon, approximately a month-and-a-half after the photographs were taken.

Farmers were enthusiastic about sharing why they captured a particular image or a series of related images during the follow-up group discussion. Recognising that *'a picture is worth a thousand words'*, many farmers remarked that they had allowed neighbour farmers, with whom they shared boundaries, to use the disposable single-use cameras to take photographs on their farms. They justified doing so by stating that if the objective was to gain insight into the impact of their and the community's climate change on cocoa production and farmers' livelihood security, then it should capture the diversity of lived experiences.

Using the photographs taken as a starting point for discussion, farmers determined that climate change impacted on cocoa production by influencing pest and disease incidence, drought stress in cocoa trees as reduced soil water availability undermined soil fertility and uptake of nutrients, and/or inducing flooding stress as excess soil water led to soil waterlogging, erosion and reduced soil fertility and uptake of nutrients. This led farmers to conclude that it was necessary to plant economic trees (while at the same time, regulating the level of shade provided by cutting), and respond to the impact of tree death by planting alternative food crops to compensate for income foregone, and/or plant food crops providing temporary shade below which cocoa seedlings could be established. Moreover, it was important to regulate competition for water and nutrients, by removing crops and non-economic trees competing with cocoa trees and controlling weed growth. Finally, it was important to efficiently use available water resources (for spraying, drinking and cooking) during periods of reduced water availability, and conversely, manage the impact of excess water during the rainy season which resulted in soils becoming waterlogged and/or eroded by water movement, and therefore, less fertile.

Insect pest and disease incidence

Farmers reported that insect pest and disease incidence was influenced by the weather patterns, with higher incidence observed during the rainy season compared to the dry season. The majority of farmers stated that they found it difficult to control insect pests such as akate (mirids) and atee (stink bugs) (Figure 1), and were worried about the impact of black pod disease (*Phytophthora spp.*) on yields (Figure 2).

Figures 1 and 2 (from L to R): Pod damage caused by akate (mirids) and/or atee (stink bugs) and black pod disease (Phytophthora spp.)

Drought stress

Farmers reported that one of the biggest impacts of a change in the rainfall pattern and the duration and intensity of the dry season, was that their cocoa trees were subject to drought stress. They noted indicators of drought stress: a change in leaf colour (from dark green to yellow and red), reduced pod production, dieback (i.e. death of twigs and branches) and leaf loss, and ultimately, tree death (Figures 3 and 4).

Figures 3 and 4 (from L to R): Indicators of drought stress - leaf colour change, dieback and leaf loss

Observing that cocoa tree death led to a canopy gap and the creation of clearings (i.e. large empty spaces) (Figure 5), farmers explained that, in some cases, they tried to re-establish cocoa seedlings and in other cases, they planted crops other than cocoa in the clearings on their farms.

Figures 5: Tree death resulting in a canopy gap and the creation of clearing

Importance of shade

Farmers reported that it was important to plant economic trees (Figure 6) - such as emere (*Terminalia ivorensis*), ofram (*Terminalia superba*), odum (*Milicia excelsa*) - which could provide shade for their cocoa trees.

Figures 6: Economic trees providing shade for cocoa trees

Importance of regulating competition for water and nutrients

Farmers observed that it was important to regulate the availability of water and nutrients in the soil by removing competing crops (i.e. oil palm) and controlling weeds (Figures 7 and 8).

Figures 7 and 8 (from L to R): Oil palm trees and weeds competing for water and nutrient resources

Impact of climate change on soils

Farmers observed that climate change was impacting the quality of the soils on their farms, particularly where cocoa trees had died and the soil was not protected from the 'harsh' sunshine (Figure 9) by the canopy of the cocoa and economic trees, food crops or a layer of leaf litter.

Figures 9: 'Harsh' sunshine directly hitting soil surface

Importance of water

Farmers explained that they had taken photographs of rivers and streams passing through their farms to communicate the importance and benefits of having access to a source of water for chemical application (i.e. spraying pesticides, fungicides and herbicides) and household use (i.e. cooking and drinking), particularly during the dry season (Figure 10).

Figures 10: Streams provide water for spraying, cooking and drinking

Soil erosion and flooding stress

Finally, farmers reported that they had taken photographs to communicate the impact of heavy and/or continuous rainfall, particularly during the rainy season, and the extent to which water movement led to soil erosion (Figure 11) and impacted on soil fertility, and flood events resulted in soils becoming compacted and/or waterlogged (Figure 12).

Figures 11 and 12 (from L to R): Impact on soils of erosion due to water movement and waterlogging

As a consequence of the limited time and resources allocated to the researchers in undertaking this study, it was not possible to organise a photo exhibition. The final stage of the research process – translating and disseminating knowledge to policy-makers – is scheduled to take place at a later date; as noted earlier, the case study outlined by this paper is part of larger, still ongoing, study focusing on soil and water management in cocoa production systems.

Discussion

The results of this study indicate that smallholder farmers are aware of climate change and its adverse impact on cocoa production, by way of its impact on soil and water resources. This knowledge led farmers to adapt and adopt coping strategies to control pest and disease incidence, drought stress, competition for water and nutrients, flood stress, soil waterlogging and erosion, and enhance soil fertility. By planting seedlings to replace mature trees that had died, while ensuring that their mature trees remained productive, farmers sought to manage both the short- and long-term impacts of climate change. They also planted alternative food crops to compensate for income foregone as a result of tree death and replanting.

The study findings are in agreement with previous studies which explored cocoa farmers' knowledge and coping strategies relating to climate change and its impacts on cocoa production, such as Codjoe *et al.* (2013) and Ehiakpor, Danso-Abbeam and Baah (2016), soil fertility management (Dawoe et al., 2012), the benefits of producing cocoa under agroforestry conditions (Isaac, Dawoe and Sieciechowicz, 2009) and selecting appropriate shade tree species for incorporation in production systems (Anglaaere et al., 2011; Graefe et al., 2017), and perceptions of mirid control and willingness to use forecasting systems (Awudzi et al., 2016). Although these studies involved researchers adopting a quantitative, qualitative or mixed methods approaches to data collection, they were not necessarily conducted in a farmer-led, participatory manner.

Moreover, the study findings reveal that farmers appreciate being given the opportunity by the researchers to share their agricultural and environmental knowledge with the wider 'community of practice' focused on enhancing the sustainability of agricultural production systems against a backdrop of climate change. Similar to the findings of Beilin (2005) and Kong et al. (2015), this study confirms that individuals feel empowered when asked to document and explain their lived experience using a community-based, participatory visual research method such as Photovoice, and that they are willing to reveal their relationships to the natural and social environments in which they are operating. The farmers who participated in this study critically reflected on the photographs taken and their meaning, and were at ease sharing their perceptions of climate change and knowledge relating to the management of soil and water resources. Aware that they were in the position to drive the data collection, analysis and resultant knowledge-creation process, they felt ownership over data collected.

The study findings indicate that individuals are positively influenced to engage in research which employs a community-based, participatory visual research methods such as Photovoice, similar to Kong et al. (2015). It is worth noting, however, that Photovoice - like all research methods - has its limitations, as outlined in detail by Novak (2010). Firstly, where integrated flash-equipped disposable single-use cameras are used, it is a method which can be logistically challenging to implement. There are few printing shops which offer to develop film-roll, particularly in transitioning countries such as Ghana, and the method thus relies on the researcher being able to travel from rural areas where the research is undertaken, to larger cities to develop and print the photographs. It would be preferable to use digital cameras; however, this would increase the cost of undertaking the research. Moreover, the use of digital cameras would necessitate more training to avoid influencing farmers' actions and the research process, as reported by Änggård (2015). Secondly, the extent to which Photovoice promotes social justice and empowers research participants is entirely contingent on the involvement of individuals and communities throughout the research process (Johnston, 2016). In the case of this study, while farmers were involved in determining the research focus, and in the process by which data was collected and analysed, they were not involved in the sharing of findings in a research environment beyond the follow-up group discussion (i.e. a photo exhibition). Farmers' only engagement with stakeholders beyond their community was with COCOBOD extension officers who were present during the initial and follow-up group discussions. Consequently, the objective of 'giving voice' to farmers and enhancing their empowerment as individuals and as a community through the use of the Photovoice method was only partially realised.

Conclusion

This paper has outlined the case for researchers and agriculture sector stakeholders to adopt research methods which place smallholder farmers at the centre of knowledge-creation processes. Using cocoa farmers in Ghana as a case study, it has highlighted the extent to which community-based, participatory visual research methods increase farmers' agency, and provides insight into the impact of climate change on agricultural production and livelihood security in a way that allows farmers to shape their own narrative. Photovoice is a powerful tool which allows

farmers' perspectives and knowledge to be captured, incorporated and shared within a 'community of practice' focused on enhancing the sustainability of agricultural production systems against a backdrop of climate change. Bringing scientists and farmers together to form a more inclusive 'community of practice', Photovoice increases the likelihood that knowledge that emerges from research is not only useful for policy-making, but ensures that resultant intervention strategies are scientifically valid, socially valid, and do not maintain the status quo at the expense of transformational change.

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ON-FARM DEMONSTRATION AS A POTENTIAL PEER LEARNING AND TACTILE SPACE TO FOSTER SUSTAINABLE AGRICULTURE: A VIDEO STUDY

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Abstract

Tactile spaces, based on Carolan (2007), as learning environments are assumed to have the potential to raise rate of adoption of innovative agricultural and environmental practices. They influence individuals' attitudes through social embeddedness or interconnections among people, and physical embodiedness or physical negotiations with environmental surroundings. Learning in a tactile space requires that individuals can use all their senses to assimilate their surroundings, and thus to construct and convey not only representational knowledge, but also nonrepresentational knowledge. Such learning environments advocate a more participatory and experiential manner than top-down transfer of technology approaches. Through reflecting upon on-farm demonstrations as potential tactile spaces, we aim to gain clarifying insights in how learning processes and outcomes take place when attendees of on-farm demonstrations interact with the environment the on-farm demonstration offers, including other attendees.

To investigate on-farm demonstrations as tactile spaces and places for peer learning, we introduced video analysis as a part of a mixed methods approach. We developed a new video guideline for analysis as a set of targeted video shots related to learning activities, communication initiation and interactive knowledge creation, and to concepts underlying a tactile space, physical embodiedness and social embeddedness. We complemented this video analysis with post demonstration surveys and longitudinal telephone interviews to grasp farmers' reflection and adoption processes.

We reflect upon this methodology through the lens of one Belgian on-farm demonstration on mechanical weed control as a potential tactile space.

We found that farmers reflected and thought actively about opportunities for their specific situation through attending this OFD. Prices of the demonstrated machines seemed to be the biggest barrier for adoption. Farmers also seemed to think actively about alternatives as for example found in contract workers, working together and sharing a machine, and changing parts of the machines. This study also resulted in suggestions for amelioration of both the video analysis guidelines as the telephone interviews. In addition we formulated suggestions for further research investigating what triggers reflection and learning: 1) the need for formally organised discussions and 2) organising OFDs which elaborate on physical experiences both in amount of time, deliberate organisation and variation.

Overall, our study shows that with some enhancements, this mixed methods approach seems promising to grasp an OFD as a tactile and peer learning space triggering reflection, a first step in deciding on adoption. Additionally this method assists in defining strengths and weaknesses of an OFD in terms of aplied learning activities. We conclude that more research is needed, but we suggest it is beneficial to organise OFDs more as tactile and peer learning spaces to foster sustainable agriculture, using its' potential as a rich learning environment more effectively.

Introduction

Our fast changing context, characterised by climate change, the need to address complex, often local, problems related to sustainable resource management, and the globalised markets based on technology and knowledge, has initiated a more complex system of knowledge exchange compared with the past (Swanson, 2010). Therefore, to address these complex challenges related to the aspiration of a more sustainable future, innovation should be more 'co-produced' through interactions between all stakeholders (EU SCAR, 2012). Participatory, more bottom-up approaches in agricultural extension, represent this recent trend, associated with a number of benefits including higher rates of adoption and practice change, positive effects on yield, income and productivity; greater well-being, increased knowledge and skills associated with empowerment; and the availability of peer support (Davis et al., 2012; Ingram et al., 2018; Prager & Creaney, 2017; Swanson, 2010).

We argue that on-farm demonstrations (OFDs) as an agricultural knowledge exchange activity (Leeuwis & Van den Ban, 2004) fit well in this shift in approach towards more participatory agricultural education activities. We define an OFD, based on the interpretation found in the analytical framework of the recently finished AgriDemo-F2F project (2017-2019; Koutsouris et al., 2017; Burton et al., 2017 (related PLAID project)): as a demonstration activity for providing farmers with "an explanation, display, illustration, or experiment showing how something works" (Collins English Dictionary). OFDs take place preferably on actual working farms so the demonstration can be visualised in real life conditions. OFDs can thus provide the opportunity for farmers to physically gather, discuss together with both peers and experts, jointly solve problems, monitor experiments, observe and compare practices in similar contexts to their own, as well as experience hands-on activities (Ingram et al., 2018). Therefor it is not surprising that OFDs have become an established practice in a number of advisory and extension systems (Vanclay, 2004). It's a versatile practice that can be used for a great variety of advisory and extension strategies (e.g. supporting horizontal knowledge exchange; generation of policy and/or technological innovations; and supporting organisation development) and functions (raising awareness and consciousness; exploration of views and issues; communication on innovations) (Leeuwis, 2004). Another reason for our focus on OFDs are the multiple studies confirming demonstrations as a preferred way to learn by farmers. Franz, Piercy, Donaldson, Westbrook, & Richard (2009) for example summarised the most preferred learning methods by farmers, of which the first five were: hands-on, demonstration, farm visit, field day and discussion. We believe that OFDs as learning spaces have the potential to combine multiple of these preferred methods, for example by including hands-on activities and discussion sessions during an OFD.

In this paper, we aim to go beyond studying only interactions between people by also articulating influences of the environmental surroundings an OFD can offer. The relevance of the introducing the concept of 'tactile space' for our objectives we found in a statement made by Cowan et al. (Cowan, Goldberger, Miles, & Inglis, 2015): 'Tactile spaces can serve as participatory, experiential, and compelling counterpoints to traditional "top-down" approaches to diffusing information about innovative agricultural and practices.'

In his primary writings on tactile space, Carolan (2007) who introduced the concept does not mention the classic diffusion-of-innovations model (Rogers, 2003), a longstanding well-known model in research on adoption and diffusion of innovation in agriculture. However, these two approaches overlap in noteworthy ways (Carolan, 2016), confirming even more the relevance of this concept for our research. First, both emphasize the importance of interpersonal communication channels and social networks. Second, both acknowledge the importance of physical engagement with one's surroundings. Third, both argue that interpersonal relationships

and physical engagement can change individuals' attitudes about new technologies, practices, and ideas. Thus, one can conclude that tactile spaces have the potential to influence the rate of adoption of an innovation.

The concept of 'tactile space' refers not simply to a space for seeing and/or touching, as a literal interpretation of the term 'tactile' might suggest. Rather, it influence individuals' attitudes about new technologies, practices, and ideas through both 'embeddedness and embodiedness'. Thus, it involves interconnections among people (i.e., social embeddedness) and physical negotiations with environmental surroundings (i.e., physical embodiedness). This implicates that individuals can see, taste, touch, smell and hear for themselves the phenomena around which knowledge claims and constructs are made (Carolan, 2007). This goes beyond learning of representational knowledge, but stimulates the learning of nonrepresentational knowledge (an embodied, or practice-based, learning, wherein the knowledge obtained is not represented easily through language only, but involves assimilating stimuli through the use of multiple senses) (Cowan et al.,2015). Carolan (2007) says that those involved in these spaces are encouraged to see problems as more than mere 'puzzles' which can be resolved through quick technological fixes. This nurtures a systemic view, where connections are highlighted between people, social structures, and the environment. According to our point of view, this could be a stimulating and effective way to learn about wicked problems encountered through striving for more sustainable agriculture.

A relevant practice example is that of a tactile space as a sustainable agriculture field day (Carolan, 2008). In general, agricultural field days bring together "experts" (i.e., agricultural scientists, extension educators,) and farmers on site to engage in not only unidirectional knowledge transfer (expert to farmer) but also knowledge coproduction (Carolan, 2008). Knowledge coproduction by experts and farmers involves the open discussion and debate of knowledge claims. When the physical space (e.g., the field) becomes the physical representation of conveyed knowledge, the space is considered a tactile space. As Carolan (2006b) explains in reference to the field days organised by a sustainable agriculture organisation in Iowa: "those in attendance did not merely stand idly by and absorb information. Rather, they listened, touched, walked through, and discussed the knowledge claims." "Growers could engage the knowledge claims directly, via active engagement in sensuously rich tactile space, and decide for themselves which farming techniques and practices to adopt or not" (Carolan, 2006a). This example demonstrates that agricultural field days, when set up as tactile spaces, can influence the adoption process (Carolan, 2006a). Comparing OFDs with agricultural field days is not a far stretch, since a field day could be a type of OFD.

Showing similarities in underlying conceptual constructs, our previously presented conceptual framework to reflect upon on-farm demonstrations as farmer-to-farmer learning environments for sustainable agriculture (Cooreman et al., 2018) puts forward learning processes of communication initiation by farmers and interactive knowledge creation between all attendees. The importance of for example open discussions but also negotiation of conflictual points of view underlying the core process defined as interactive knowledge creation are already specifically defined learning activities playing a valuable role in contributing to a tactile space. The same is true for activities such as specifically sharing own knowledge and values and formulating questions, which underlies communication initiation in the framework. Therefor we consider these concepts in this research.

A broad range of work in educational sciences has shown that to fully understand how people learn, it is important to look beyond the individual, pointing also to the importance of understanding interactions between individuals and artefacts (Ramey et al., 2016). Therefor we decided to use video as data gathering tool and consequently a comprehensive data source, capturing talk, gaze, gesture, movement, and interactions in a format that is available for

repeated viewing. These features make video an ideal source for capturing and analysing context (Ramey et al., 2016), which plays a crucial role in tactile space, communication initiation and interactive knowledge creation.

As a measure of effectiveness of an OFD, we evaluate attendees' reflection and adoption regarding the demonstrated agricultural practices. We ask ourselves the question if and how it would be beneficial for farmers' reflection and adoption to stimulate the design of OFDs as peer learning and tactile spaces, in which participants' experiences and knowledge constructs may be enriched by the environment and those negotiating the environment with them.

Methodology

We used a mixed methods approach to investigate the prevalence of key aspects underlying interactive knowledge creation, communication initiation, physical embodiedness and social embeddedness. As a learning outcome and measure of effectiveness, we aim to investigate attendees' reflection and adoption regarding the demonstrated agricultural practices. Therefore, we complemented the qualitative method of video analysis (a) to grasp the concepts stimulating learning processes with quantitative post demonstration surveys (b) and qualitative longitudinal telephone interviews with attendees (c), conducted about 6 months after the OFD, to grasp the learning outcomes in terms of reflection and adoption.

Materials

Video analysis guideline

We deemed the use of video for data gathering and analysis necessary and appropriate to grasp concepts as physical embodiedness in terms of engaging with different senses with the environment and social embeddedness in terms of interconnections and network building (Carolan, 2007). Therefore, presented as a first data collection source in this research, we developed a video analysis guideline. We added an additional focus on the prevalence of the concepts related to interactive knowledge creation and communication initiation by participants as represented in our previously constructed conceptual framework (Cooreman et al., 2018). Since we knew from our experience in the AgriDemo-project that most OFDs take about half a day, but we did not have any idea on the general focus of an OFD on our elements of interest, we decided to aim for an amount of minutes of video as a starting point. Thereby we kept in mind that the goal of the video analysis guideline is to be generally applicable during OFDs. The use of minutes as metrics is also subject of reflection in this paper. This video analysis guideline was not an official method constructed and utilised in the AgriDemo-F2F project.

Video analysis guideline to conduct during an OFD:

Physical embodiedness, if present focus on for at least 10' video each:

engaging with different senses with the environment (smell, touch, hearing, taste, and sight)

hands-on opportunities

Social embeddedness, if present focus on for at least 10' video each:

interconnections and network building

informal conversations between participants

Enriching peer learning framework, if present focus on for at least 5' video each:

Interactive knowledge creation:

Knowledge scaffolding by the main demonstrator

Open discussion & negotiating conflict

Communication initiation by participants:

Sharing own knowledge; formulating own values

Formulating questions

Post demonstration surveys

The second data collection source used was the post survey for attendees, designed to measure learning processes stimulated by the attended OFD within the AgriDemo-F2F project. We handed out this self-administered survey right after the OFD. This complete survey consisted of four closed questions asking for the answer 'yes' or 'no', 46 closed 4-point ordinal scale questions from 'strongly disagree' to 'strongly agree', with the extra possibilities to answer 'not applicable' and add remarks. Three open questions were also included. To grasp the reflection on implementation and the adoption of agricultural practices, we investigated answers to three 4-point ordinal scale questions: 'I thought about how I could implement some of the ideas and practices on my own farm.'; 'I feel motivated to undertake some sort of action towards sustainable agriculture' and 'I'm thinking about an action I could undertake myself, because of the demonstration.'

Telephone interviews

Approximatly 6 months after the OFD was held, we conducted telephone interviews with OFD attendees. The telephone interviews where designed as a follow-up on the post surveys, also constructed and conducted within the AgriDemo-F2F project. In this paper we will focus on the questions what they learned and what could have made the OFD more interesting for them, to grasp their reflection process. Secondly, to grasp attendees thinking on adoption, we investigate their answers to the question 'Did the demonstration event result in you doing something new or differently (on your farm), or do you plan to change something?' and the answers to the elaborating open questions 'What exactly?' or 'Why not'.

Case description

We gathered data for this paper using the video analysis guideline during a Belgian on-farm demonstration as part of the AgriDemo-F2F project (January 2017- June 2019). This OFD took place on the 8th of June 2018 and focused on mechanical weed control in maize. About eight machines were shown on a part of the maize field of a willing farmer who recently turned to organic production. An advisor guided the demonstration of the different machines by explaining them and showing the difference between them one by one. He let the demonstrators of each machine speak, after introducing them and their machines. Afterwards, there was room and time available for the attendees to have an informal chat over a drink. About 100 attendees showed up, of which 17 farmers correctly filled in the post survey. We eliminated answers of four other stakeholders who were not farmers from the analysis. Subsequently, we interviewed 9 out of 17 by telephone approximately six months after the OFD took place.

The researcher filming during the OFD wore an action camera under the chin with an additional audio recorder, to be as less intrusive as possible. The researcher asked permission to everyone attending the OFD to use the video for research, stating that the images would not be published. One other accompanying researcher was taking field notes wearing an additional audio recorder, mainly as back up for the first recorder. Due to a lack of means in terms of camera's and available researchers in combination with the explorative nature of this study, only the mentioned audio and video recordings were done.

Data analysis

We analysed the data of the video using Nvivo Pro 11. Each time slot representing another concept was separated and coded. Some time slots were to hard to seperate in concepts thus capture more then one. First the occurrences during the time slot were written out. Next, each time slot was categorised into one or more of the targetted concepts described in the video analysis guideline. The answers given during the telephone interviews were also structured and coded using Nvivo Pro 11. Data obtained through the post demonstration self-administered surveys were analysed in Excel 2016.

Reflection on the video analysis guideline: physical embodiedness and social embeddedness

Regarding our methodological approach, we noticed during the coding process that it was hard to make an objective distinction between categories. More precisely, between the two categories we defined for physical embodiedness: 1) engaging with different senses with the environment and 2) hands-on opportunities. We realised that hands-on opportunities for experimentation are usually combined with 'engaging with different senses with the environment'. We experienced the same overlap for social embeddedness, for which the categories interconnections and network building (1) and informal conversations between participants (2) appeared hard to distinguish. Here the first category could be defined as a part of the second one. This overlap could be solved by either defining the categories more specifically, or merge the categories into their umbrella concepts of physical embodiedness and social embeddedness.

Tabel 1: Video analysis on physical embodiedness and social embeddedness of one Belgian on-farm demonstration

Conceptual category	Physical embodiedness	Social embeddedness
Video target	10' engaging with different senses with the environment (smell, touch, hearing, taste, and sight) + 10' hands-on opportunities	10' interconnections and network building + 10' informal conversations between participants

Exemplary written out video sequences	1) The machine starts driving and working the soil. Attendees are walking right behind the working machine and look very closely at the soil, lokking at the effects of the machine on the maize and the weed, some attendees are touching the soil for examination. 2) The second machine starts driving. As with the first machine, attendees closely follow the machine and some touch the soil and discuss the soil together. 3) Walking to the next machine: attendees touch the soil and discuss together lively. 4) The third machine starts driving. Again attendees follow immediate after the machine and investigate the machine and the soil closely. A lot of them also touch the soil.	1) A few people are listening to the advisor. Most of the attendees stand further away, talking to each other and looking at the soil. 2) The second machine starts driving. As with the first machine, attendees closely follow the machine and some touch the soil and discuss the soil together. A lot of them stay a little behind to talk to one another. 3) Walking to the next machine: attendees touch the soil and discuss together lively during the walk. 4) While the advisor is explaining the third machine, about half of the participants are talking to each other.
Video sequences	32'29''-33'39''; 35'14'' - 36'31''; 37'42'' -38'46''; 43'16'' - 45'46''; 51'56'' - 54'45''; 58'58'' -1h03'19''	33'39'' - 34'28''; 35'14'' - 36'31''; 37'42'' -38'46''; 38'46'' - 43'16''; 55'19'' - 58'58''
Part of total time video: 1:03:19	about 13'	about 10' on video, but happend during the whole visit, except during the 22' introduction

We witnessed for this OFD physical embodiedness in terms of farmers watching the machines working in the field and taking the opportunity to immediately examine the soil worked by the machines through touching, feeling and even smelling the soil. While examining the video, these opportunities of sensory experiences seemed to fuel informal conversation between farmers. Consequently, there is an overlap in video sequences categorised as physical embodiedness and social embeddedness.

With about 13’ of observed moments of focus on physical embodiedness of 1h 3min total video time trying to grasp what the biggest part of attendees was doing, we believe this provided strong learning opportunities. However, there is room to elaborate on this type of physical experiences, both in amount of time and in variation. For example a more structural and formal introduction of this type of experiences could be applied, instead of counting strongly on the personal initiative of farmers to engage in these opportunities as was the case in this OFD.

Examining what we observed in relation to social embeddedness, we believe this OFD provided a strong context. After the 22’ min introduction during which most participants were silent, attendees felt free to stay behind and talk in the field during the rest of the duration of the OFD. However this meant for attendees a trade-of between listening to the advisor, who talked during almost the complete 1h 3min except for when the machines were working (less than 13 min), and talking to each other.

After the demonstrations in the field, many attendees stayed behind talking over an informal drink. This was not part of the video, but entailed an important opportunity enhancing social embeddedness, reinforced by about a 100 attendees.

In retrospect, more audio excerpts of informal talks between farmers could have been an additional valuable information source to grasp reflection processes.

Reflection on the video analysis guideline to enrich the peer learning framework (Cooreman et al., 2018)

Tabel 2: Video analysis on communication initiation and interactive knowledge creation of one Belgian on-farm demonstration

	Communication initiation		Interactive knowledge creation	
	5' Sharing own knowledge in formal group + 5' Formulating own values in formal group (participants)	5' Formulating questions in formal group	5' Open discussion in formal group + 5' Negotiating conflict in formal group	5' Knowledge scaffolding by the main demonstrator
Original video target				
Exemplary written out video sequences	Not observed	Question from the public: is this machine available through a contract worker? - Yes, here in the neighbourhood. Question 2: And renting? - No, not structurally, just colleagues sharing amongst each other. ; The demonstrator is adjusting his machine, while the advisor keeps talking about the machine. Another attendee asked about the benefit of a certain specificity of the machine, which the advisor shortly answers. The advisor answers a question of an attendee on the specific benefit of a type of machine in comparison with	Not observed	23' min of introduction on the theme of mechanical weed control.; +-3 times 5' of the advisor explaining the specifications of the machine while sometimes pointing at the specific parts of the machine.; The advisor explains the specificities of the third machine. A handful of attendees meanwhile touch the machine. The advisor explains a lot about the springs on the machine. Now more attendees touch the machine (about 20 during his explanation). Still, more than half of the participants are not really listening to the explanation of the advisor anymore, but stand a bit further in the field, investigating the soil and

		another machine. The advisor elaborates on this.		talking to each other; More explanation on the springs of the 4th machine. The advisor points to the part of the machine while explaining.
Video sequences		31'21''- 32'29''; 34'28''-35'14''; 47'37''- 49'14''		0-19'01''; 22'14''- 26'53''; 26'53''- 31'21''; 38'46''-43'16''; 45'46''-46'44''; 49'14''-51'56''; 54'45''-55'19''
Part of total time video: 1:03:19		+- 3'30''		+-36' 30''

Underlying the process of 'interactive knowledge creation' in the peer learning framework (Cooreman et al., 2018), we observed knowledge scaffolding by the main demonstrator during about half of the complete time of the OFD (+-36' 30''), but we did not observe any 'discussion or negotiating conflict' in a structured manner or in formal group.

With respect to 'communication initiation' by participants, we also did not observe any sharing of the own knowledge or formulating own values by farmers in the formal group. Probably this happened during their informal talks in smaller groups, but this did not happen in an organised way. We did observe about 3 min 30 sec of questions asked by farmers and answered by the adviser, which is only a small part of the total time of 1h 3min.

Reflection on OFD attendees learning outcomes as ideally fostered by a tactile space: reflection and adoption

Tabel 3: Post demonstration survey answers on questions related to reflection and adoption

	I thought about how I could implement some of the ideas and practices on my own farm.	I feel motivated to undertake some sort of action towards sustainable agriculture.	I am thinking about an action that I could undertake myself, because of the demonstration.
% Farmers (17) agreed or strongly agreed	94%	80%	54%

Considering the answers farmers gave on the post demonstration survey (Table 3), it seems that the OFD was succesful in stimulating reflection, and more specifically thinking about implementation. These numbers show that it is not because farmers don't think about undertaking a specific action towards implementation (54%), that they didn't reflect about the possibility (94%). They might just decide, after some reflective thinking, that implementation is not the best option for them.

Providing more in-depth information, we additionally investigated telephone interviews conducted 6 months after the OFD took place. More specifically, we are itnerested in answers to what they learned and what could have made the OFD more interesting for them, to grasp their reflection process. Secondly, to grasp their thinking on adoption, we investigate their answers on 'Did the demonstration event result in you doing something new or differently (on your farm), or do you plan to change something?' and the answers to the elaborating open questions 'What exactly?' or 'Why not'.

Seven out of nine farmers stated they learned something because of the attended OFD. One farmer that didn't learn something also couldn't give an answer when asked what could have made the OFD more interesting for him. The other said: 'I looked a lot at the camera-controlled machines, but if I specifically learned something? Not really.'

Of the seven farmers, three mentioned they learned about the new developments in the technical automation of the machines. Two of these three farmers added a reflective thought, for example:

Well it confirms for me that everything is gradually becoming more and more automated regarding control, GPS, follow up. I just think that here, we do not have enough space to put in practice what is possible. I just read in a magazine that in the UK, they have farms covering about 5000 hectares. More becomes possible then, compared to what is possible here.

Three other farmers mentioned learning specifically about the difference in application between machines regarding type of soil and type of crop, including the difference in price.

It was very informative to see that not everyone's situation is similar in terms of his or her soil. These machines will work better on one soil compared to another. It was nice to see that there was such a big interest and that it was very well organised. However, I wish there was a machine that could be applied to 'lighter' types of soil.

One farmer mentioned networking and exchanging of opinions on problems with other farmers as his main focus of the day.

I went there out of interest. We were not looking to buy new machines. We mostly went to see what is new on the market and actually mostly to meet with colleagues to exchange opinions on problems of the moment of the year.

When asked 'Can you think of a way that the event could have been (even) more interesting for you?' four out of nine farmers could answer the question. Two of them wanted to see the application of the machines on fields with different crops.

This demo specifically focused on weeding in maize. It would have been nice to see the machines working on fields with different crops.

Another farmer thought the demonstrator could have been more informed but was happy with the attendance rate, probably for networking possibilities. The fourth farmer reflected on the value of contract workers and working together. Also, he mentions the advantage the machine can have regarding the structure and moisture balance of the soil, which refers to knowledge that can be gained and strengthend through touching the soil during the demo.

I have two types of new weeding machines, and if you know how many hours a year I actually use them, it is hard and actually not cost-effective. Contract workers could be a solution for that. I have these machines because I farm organic, but if I use these machines at conventional farms, you notice that they have an advantage regarding the structure and the moisture balance of the soil. I think we should aim more at working together.

Secondly, three out of nine farmers answered 'yes' when asked if the OFD resulted in doing something new or differently on their farm or in planning to change something.

Our farm has always been a conventional one, now we want to transform to organic, so now we are looking with our son to convert our machines to mechanical weeding ones.

Yes, I am more interested in the machines, but the new techniques are going very fast, with for example colour recognising and so on. I think the contract workers are not involved enough. They are normally the leaders when it comes to changing practices.

It stimulates me to work differently, maybe just changing the elements on the machines, instead of buying a new machine is already an idea.

When asked 'why not', two farmers stated they were too close to their retirement to invest in the machines and one just bought new machines. One farmer already had a lot of experience with the mechanical weeding machines and one is still making up his mind.

Not yet. Probably in a couple of years. I have ideas on what I want to do but I am not a 100 percent sure yet. These demo's inform me and add information when thinking about my ideas, but I did not make a decision yet.

Conclusion

We aimed to investigate on-farm demonstrations (OFDs) as tactile spaces and places for peer learning through video analysis as a part of a mixed methods approach. To do so, we developed a new video guideline for analysis as a set of targeted video shots related to learning activities (communication initiation and interactive knowledge creation) and to the concepts underlying a tactile space (physical embodiedness and social embeddedness).

Tabel 4: Summary of the results

Suggested ameliorations of the data gathering tools	OFD as a potential peer learning and tactile space
Video analysis guidelines: more specifically defining categories underlying a concept or merging the categories into their umbrella concepts more audio excerpts of informal talks between farmers more people recording video and audio	94% reflected about implementing 54% thought about undertaking an action Barriers: machines should be seen working on fields with different crops, prices of the demonstrated machines Farmers seemed to reflect and think actively about opportunities for their specific situation
Telephone interviews: Add specific question on learning methods related to video analysis guidelines	Future research needed: A lot of time and effort to knowledge scaffolding by the advisor, but no formally organised discussions or negotiating conflict Maybe knowledge shared by the demonstrator in combination with sharing and discussing in smaller informal groups is enough to trigger reflection?

	Small but present focus on physical embodiedness and an observed rich learning environment Similar OFDs could elaborate on physical experiences, both in amount of time, deliberate organisation and variation.

Reflecting in retrospect on this video analysis guideline applied to one Belgian OFD, we suggest enhancements for future use. This mainly to solve overlap in time slots belonging to more than one concept, either by more specifically defining categories underlying a concept (by for example distinguishing between formal and informal groups), or by merging the categories into their umbrella concepts of physical embodiedness and social embeddedness. In addition, more audio excerpts of informal talks between farmers could have been an additional valuable information source to grasp discussion content and reflection processes. Therefore, more people recording video and audio could be necessary, when it concerns a big group as in this exemplary case. Then, the concepts presented in this paper could be divided between people recording, providing a possible solution regarding the rather arbitrary goal, now specified in minutes.

We complemented this video analysis with post demonstration survey questions and longitudinal telephone interviews to grasp farmers' reflection and adoption processes. These results from the post demonstration survey show that it is not because farmers don't think about undertaking a specific action towards implementation (54%), that they didn't reflect about the possibility (94% did). In fact, it seemed almost all of our participating farmers thought about implementation of the ideas and practices on their own farm, which is a very important first step and goal of this OFD. Taking it a step further, apart from requests to see the machines working on fields with different crops than maize, prices of the demonstrated machines seemed to be the biggest barrier for adoption. However, farmers seemed to reflect and think actively about alternatives as for example found in contract workers, working together and share a machine, and changing parts of the machines without buying a whole new machine.

The video analysis resulted in a clear overall picture of how the OFD stimulated learning processes underlying concepts of a peer learning and tactile space. For example regarding interactive knowledge creation, a lot of time and effort went to knowledge scaffolding by the advisor, but no time went to formally organised discussions or negotiating conflict, although we know from literature this aids the reflection and learning process (Cooreman et al., 2018). With respect to 'communication initiation' by participants, we similarly did not observe any sharing of the own knowledge or formulating own values by farmers in the complete formal group. This could mean that the knowledge shared by the demonstrator in combination with sharing and discussing in smaller informal groups is enough to trigger reflection. The opportunities of sensory experiences seemed to fuel informal conversation between farmers. Future research could elaborate on this finding, as could related in-depth questions additionally included in the telephone interviews.

With a small but present focus on physical embodiedness and an observed rich learning environment and set-up of the OFD, we suggest (Franz et al., 2009; Cooreman et al., 2018) for similar OFDs to elaborate on physical experiences, both in amount of time, deliberate organisation and variation. Additionally, the observed OFD provided a strong learning environment for informal social embeddedness because of the large amount of participants and the seemingly flexible field walk during which informal talking groups arose, even when the adviser was explaining. However, it meant for attendees a trade-of between listening to the advisor and talking to each other.

Overall, our study shows that with some enhancements, this mixed methods approach seems promising to grasp an OFD as a tactile and peer learning space triggering reflection, a first step in deciding on adoption. Additionally this method assists in defining strengths and weaknesses of an OFD in terms of aplied learning activities. We conclude that more research is needed, but we suggest it is beneficial to organise OFDs more as tactile and peer learning spaces to foster sustainable agriculture, using its' potential as a rich learning environment more effectively.

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THE ROLE OF FACILITATOR IN FARMERS' DISCUSSION GROUPS

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Abstract: The necessity for sustainable recourses management and preservation of farms' competitiveness is widely recognized as a challenge to be met on an ongoing basis. This gave rise to communication models emphasizing on the multi-actor character and the complexity of transforming knowledge into effective practice. In such environments, knowledge seekers and knowledge providers often find themselves in alternative roles, while complexity hinders the dissemination of knowledge. Overcoming these difficulties brings to the fore non-instructional learning activities and knowledge brokers, aiming at facilitating the linkage among the actors involved in the creation, sharing and use of knowledge.

This study employs an action research approach to explore the formation of farmers' discussion groups in stables and participants' interconnections and experiential peer-to-peer learning processes. The study carried out in Karditsa Prefecture, Grecce, the period from September 2015 to January 2018 and focuses on the role of the facilitator and the activities undertaken. Data were collected through individual open interviews with participating farmers and the discussions during the groups' meetings. Data were analyzed on the grounded theory principles. The results indicate that the role of facilitator concerned: a. activities focused on farm programming and management (individual farm level), b. developing interactions and connections among the members of discussion groups (group level) and c. developing interactions and connections within the local AKIS (system level). Among the problems identified were unwillingness for collaboration, difficulty in following common rules and lack of knowledge and experience on the part of facilitator. The study concludes that the role of the facilitator was critical and multifaceted. Success depended on creating conditions conducive to learning and building trusted relationships among the actors involved. Prerequisites for success include participants' communication capacity, facilitator' methodological knowledge and readiness to apply it appropriately and the facilitator's engagement in a reflective learning process that goes beyond academic knowledge.

A DEEP DIVE INTO FARMER DISCUSSION GROUPS THROUGH THE LENS OF SOCIAL LEARNING THEORY

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Within the UK agricultural learning landscape, there are different collaborative mechanisms through which farmers can engage and learn from and with their peers. Farmer discussion groups (FDGs) are a longstanding example; they have been found to offer myriad benefits to participants, including economic, social, informational, capacity-building, etc. Building on the lack of understanding as to how learning happens in these contexts from an adult cognitive learning theory perspective though, Bandura's social learning theory was used to assess seven FDGs in the South West of England. The objectives were to determine 1) Is social learning occurring within FDGs, and if so, how and why? 2) Are there differences between types of FDGs with regards to promotion of social learning? And 3) should FDG learning processes be tailored differently in order to promote learning outcomes? The conceptual framework was comprised of the theory's critical elements: behaviour modelling, role modelling and critical self-reflexivity. An ethnographic methodology was chosen to gain deep insights into the dynamics, innerworkings and histories of the groups and gather rich empirical findings through participant observation, semi-structured interviews and feedback sessions. The results from a year of attending FDG meetings demonstrated that the elements of behaviour modelling and role modelling are present in all FDGs to varying extents. However, the element of critical self-reflexivity fostered through a proactive commitment to (facilitated) critical discourse was an emergent property amongst FDGs. It was largely absent from those which engage participants in one-way information flow rather than structured two-way knowledge exchange with deep sharing and challenging of tacit assumptions between members. Thus, social learning as understood according to Bandura's theory is not occurring within all FDGs. Collaborative learning processes that aim to promote social learning, therefore, should build capacity and skills, structure engagement and particularly train facilitators to be equipped to foster the critical discourse necessary to promote critical self-reflexivity and metacognitive development amongst participants.

FACILITATING TRUST FOR COLLABORATION IN SMALLHOLDER VALUECHAINS: A CASE FOR DIGITALIZATION?

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Abstract: Organizing collaboration between value chain actors is seen as offering a means of addressing existing institutional failures in smallholder contexts. This is because the complex challenges faced often require a harnessing of the capacities of multiple actors through collaboration. Various value chain governance mechanisms (VCGMs) have been explored as approaches to enabling new institutions needed for such collaboration in smallholder value chains. These institutional changes have however often been unsustainable in informal contexts where trust is often the key condition for collaborative relationships. Understanding the functioning of such VCGMs from a trust perspective could therefore provide key insights on the process of facilitating sustainable institutional change for collaborative relations within smallholder value chain contexts. Thus we explore how trust influences institutional change, in the context of VCGMs, for collaborative interdependent relations in smallholder value chains. The study is conducted through a case study of an interdependent smallholder maize farming arrangement in Ghana, West Africa. Our study shows that different forms of trust are present and combine in various ways in relations between interdependent actors within a value chain network. Trust should therefore not be perceived as one dimensional but a spectrum with relational, calculative and institutional trust playing key roles in facilitating collaboration between network actors. It is therefore important to determine the form of trust which dominate at different points in the network so as to better understand the key conditions which need to be supported in order to sustain trust between actors collaborating at that point. In facilitating institutional change in the maize farming context in Ghana, we argue that VCGMs should aim to facilitate supportive conditions for calculative trust in particular in order to build sustainable collaboration in the highly uncertain context. Enabling calculative trust requires information on actor performance as well as quick evidence of failure or emerging problems in the short term. We argue that facilitating this form of trust would likely require and presents a key opportunity for adoption of new forms of digital communication in value chain collaboration in the rural smallholder context.

THEME 2 – THE INTERSECTION OF SCIENCE AND PRACTICE: FARMING SYSTEM PERSPECTIVES

Agricultural sciences have to operate at the interface between technological, economic, political, natural, social and different knowledge systems. At the farm scale, science also has to intersect with the complex decision making environment, which presents certain challenges, risk and responsibilities.

Agricultural science can provide benefits of systematic observation, measurement and experiments, rigorous replicable methods, large data sets and analysis, however, how to make the outputs relevant to different production and management/decision contexts is a persistent question. Criticisms of uncertainty, lack of transparency are particularly pertinent to science supporting climate change adaptation.

Given the increasing reliance placed on science advancements, the need to understand how science intersects with practice is becoming more pressing; whether with respect to sophisticated modelling and big data, the promotion of concepts such as smart farming, sustainable intensification and ecological modernisation, or supporting farmers' adaptation to climate variability and resource challenges.

ADAPTING VITICULTURE TO CLIMATE CHANGE: A PARTICIPATORY SCENARIO DESIGN WITHIN A MEDITERRANEAN CATCHMENT

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Abstract

In a context of climate change, water management is considered a determinant factor for the agricultural sector, including viticulture. Grape is highly climate-sensitive, regarding both quantitative and qualitative production, making consequently climate change challenging. In France, vineyards are usually rainfed, although irrigation tends to develop, particularly in the Southern regions. However, many concerns remain: sharing the resources between uses and users, water shortage, salinization, etc. Various growing practices contribute to the grapevine adaptation to water shortage under rainfed situations: plant material, planting density, training system, soil management, etc. Adaptation strategies may combine these adaptation levers, through considering current and future water resource, cropping and farming systems.

This paper lays out a methodology aiming at exploring the following hypothesis: "the *combination of growing practices at the plot and farm level, and their spatial distribution in a catchment could give significant leeway to adapt a perennial crop such as grapevine to climate change".* In a typical Mediterranean catchment (Rieutort, 45 km²), a group of stakeholders, involved in viticulture and water management, is mobilized to design and evaluate adaptation strategies, built as alternative spatial distributions of cropping and farming systems. A chain of models is used for producing indicators, measuring the impact of the different adaptation strategies under future climate. The originality of this multidisciplinary approach lies in the coupling of (1) a participatory approach (data collection, scenario design, integrated assessment), and (2) modeling tools allowing multi-scale quantitative assessment (plot, farm, and catchment). The methodological framework is illustrated by the results of the first step: the initial local diagnosis, and a shared conceptual scheme of the studied systems. The two next steps, scenario design and quantitative modeling, will be based on these preliminary results.

Introduction

Climate change is one of the major sources of concern in the Mediterranean, as the hotter and drier climatic conditions threaten agricultural production (IPCC et al., 2015). A good example is viticulture as the growth conditions of the grapevine are moving away from the optimum (Jones et al., 2005). The increasing occurrence of extremes, such as drought and heat waves (Giorgi, 2006), threatens the grapevines quantitative and qualitative production (Schultz, 2010). As a perennial plant, grapevine production requires producers to plan far ahead when taking vineyard management decisions (Lereboullet et al., 2013).

Water resource management will be increasingly determinantal for the viticulture sector (Santillán et al., 2019). Despite the recent development of irrigation systems, many limitations and concerns remain. From sharing the resources among uses and users, to water shortage and salinization, the hurdles are numerous. However, various growing practices contribute to the grapevine adaptation to water shortage under rainfed situations (Medrano *et al.*, 2015): plant genetics (Duchene, 2016), planting density (Van Leeuwen et al., 2019), soil management (Bagagiolo et al., 2018), canopy management (Palliotti et al., 2014), etc. Local adaptation strategies should combine those technical levers, considering current and future water resources, cropping and farming systems (Nicholas and Durham, 2012).