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How to strengthen innovation support services in agriculture with regards to multi-stakeholders approaches

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Abstract

The new agricultural EU policy aims at strengthening actors' capacities for innovation by taking into account the complexity of innovation processes. This paper aims to characterise the key innovation support services (ISS) which are needed to support actors to innovate. In the EU AgriSpin project, we analysed 57 case studies describing innovation processes. We used a common grid to characterize ISS. Our results show that 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 to innovator). In the latter phases, there is a need for more conventional services (e.g. training, credit) both at farm level, value chain level and territory level. Brokering functions and new services are key in supporting actors to innovate by facilitating interactions for co-production of knowledge, co-design of technologies and, identification of new institutional arrangements.

INTRODUCTION

Innovation is a complex process analysed and supported by using different concepts such as the 'agricultural knowledge and information system' (AKIS) concept (Röling and Wagemakers 1998), the more recent 'agricultural and innovation system' version of the AKIS concept (EU 2012; 2013) or the 'agricultural innovation system' concept (World Bank 2006, Touzard et al. 2015). Common to these concepts is the understanding that innovation emerges as a nonlinear, social, institutional as well as a technical process, where interactive learning takes place around a common concern or impulse for change (Koutsouris 2014, Touzard et al. 2015). This systems approach to agricultural innovation may be described as 'a network of organisations, enterprises, and individuals focused on bringing new products, processes, and forms of organisation into economic use together with the institutions and policies that affect the way different agents interact, share, access, exchange and use knowledge' (Leeuwis and Van den Ban 2004). New ideas are developed and implemented by actors who engage in networks and make iterative adjustments in order to achieve desired outcomes (Van de Ven *et al*., 1999). A systems approach towards innovation emphasises processes in which knowledge and learning is constructed through social interaction (Knierim et al. 2015b).

However, the strategies and methods to support innovation within an AKIS framework remains a challenge (Toillier et al. 2018). More specifically, to support innovation there is a need to provide adequate services to actors. The required services are diverse (Albert, 2000; Leeuwis and 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-construction, participatory development, etc.) as well as by a variety of providers (public, private, NGO, etc.). In this context, the role of agricultural advisory service (AAS) providers has changed. Previously, they were viewed as the main actors to support innovation processes through technology and information transfer but this view is no longer valid. Other new actors have emerged, promoting and enhancing innovation processes by providing new services offering innovation supporting activities and new methods to deliver these services. Examples of such services are: facilitating networking, facilitating access to financial resources, enhancing demand articulation of innovation actors, providing institutional support especially for niche innovations, strengthening capacities for new business skills, and providing general consultancy and backstopping (Mathe et al. 2016).

The services which are needed evolve along the innovation process and might require different actors to be involved in a particular stage of an innovation process, with the involvement aiming to transform or optimise the "system" or the problematic situation (Beers et al. 2014). The coordination (at a giving moment) or alignment (across the time) of these services is a key issue (Kilelu et al., 2013) because of the diversity of actors and their interactions and because of the progressive co-construction of the demand for, and supply of services along the complex and non-linear innovation process (Le Coq et al., 2010).

Hence, there is a keen interest to gain a better understanding of what makes innovations successful in the agricultural sector happen and how to better support innovation with public policy and especially to identify supportive actions and forms of cooperation that enhance multi-actor innovation processes in rural conditions. Based on empirical cases investigated in

the frame of the EU AgriSpin project[1], this communication aims at exploring the diversity and alignment of innovation support services (ISS) along the phases of the innovation process. The first part presents the theoretical framework and methodology, the second section presents the results including a cross-analysis of 57 case studies of innovation processes, the last part focuses on a discussion of the coordination of ISS.

1 THE FRAMEWORK

Relevant innovation support services (ISS) are needed to make innovation happen by fostering interactions and constructing knowledge. Within a multi-actor perspective, ISS may result in different kinds of products aimed at achieving a "wider intervention purpose" that is closely related "to the assumed nature of a problematic situation" (Leeuwis and van den Ban 2004). At first sight, the term ISS may be understood either as an organisational body (called a service provider[2]) or as an activity (Albert 2000). Taking a process perspective and following Gadrey (1994) and Labarthe et al. (2013), we consider ISS as activities. These authors propose to conceive a service as an activity based on 'the service relationship' between the supplier of a service and the client. They emphasized the joint involvement of the providers and the beneficiaries of the service in the production of the service through regular interaction. Based on the state of the 'service' discussion in economic and agricultural extension literature (Faure et al. 2012; Labarthe et al. 2013) Mathe et al. (2016: p 6) argue that *"……by its nature, an ISS is immaterial and intangible and involves one or several providers 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 innovate"*.

A comprehensive literature review on support services in agricultural innovation shows that farmers avail of numerous types of services. For example, Kilelu et al. (2013) identify 6 functions of ISS: [1] demand articulation (vision building, diagnosis, foresight), [2] institutional support (institutional change and boundary spanning), [3] knowledge brokering (connecting to knowledge and technology) [4] network brokering (match-making of partners), [5] capacity building (training, coaching, organisational development) and [6] innovation process management (aligning agendas and learning). From another perspective, Heemskerk et al. (2011) identify and discuss a slightly different set of functions: [1] facilitation (stimulating and assisting the process between stakeholders with the objective of improving the quality of interaction), [2] strategic networking (facilitation of network design and support), [3] mediation (conflict management between stakeholders), [4] technical backstopping (providing advice on economic, social or technical issues), [5] advocacy (informing policy makers and key actors for supporting policy change), [6] capacity building

[1] The EU AgriSpin project aims at strengthening European capacities for innovation in the agricultural sector by taking into account the non-linear, complex and context-specific innovation processes. AgriSpin: www.agrispin.eu

[1] Service providers provide immaterial services which are found under different labels in the literature such as advisory services, extension organisation, bridging organisations, intermediary organisations, etc. Service providers also provide tangible services such as credit, inputs, etc. In the following text, the term 'service provider' is used to take account of this diversity of situations.

(equipping stakeholders to play their roles) and [7] documenting learning (stimulating reflection on the innovation process. Based on this literature review we propose to use the ISS typology (Mathe et al., 2016; Faure et al. 2017) presented in Table 1 - even if the frontiers between ISS are not always clear.

Table 1: Revised generic ISS activities (based on Mathe et al. 2016)

ISS functions	Brief definition of function
1. Awareness and exchange of knowledge (ISS1)	*All activities contributing to knowledge awareness, dissemination of scientific knowledge or technical information for actors, hybridization of knowledge. For instance, providing knowledge based on information dissemination forums (website, leaflets), meetings or demonstrations and exchange visits.*
2. Advisory, consultancy and backstopping (ISS2)	*Advisory, consultancy and backstopping targeted supportive activities aimed at solving complex issues such as a new farming system or new value chain design. The provision of advice (technical, legal, economic, environmental, social etc.) during the innovation process based on demands of actors and the co-construction of solutions all fall in this category.*
3. Demand articulation (ISS3)	*This specially involves services targeted to help actors to express clear demands to other actors (research, service providers, etc.). This is targeted support to enhance the innovator's ability to express his/her needs to other relevant actors.*
4. Networks, facilitation and brokerage (ISS4)	*Provision of services to help organise or strengthen networks; improve the relationships between actors and to align services in order to be able to complement each other (the right service at the right time and place). It also includes all activities aimed at strengthening collaborative and collective action.*
5. Capacity building (ISS5)	*Provision of services aimed at increasing innovation actors' capacities at the individual, collective and/or ł organisational level. The services may comprise the provision of classical training and of experiential learning processes.*
6. Enhancing / supporting access to resources (ISS6)	*Provision of services for innovators aimed at enhancing the acquisition of resources to support the process. This could be facilitating access to inputs (seeds, fertilisers etc.), facilities and equipment (technological platforms, labs etc.) and funding (credit, subsidies, grants, loans, etc.).*
7. Institutional support for niche innovation and scaling mechanisms stimulation(ISS7)	*Provision of institutional support for niche innovation (incubators, experimental infrastructures, etc.) and for out scaling and up scaling of the innovation process. This refers to support for the design and enforcement of norms, rules, funding mechanisms, taxes, subsidies, etc. that facilitate the innovation process or the diffusion of innovation.*

Many actors could provide services to support innovation Services providers are commonly categorized according to their type: public sector, private sector (companies) and third sector (farmer-based organisations and NGOs).There are several viewpoints regarding this simple classification. For example, Knierim et al. (2017) argue that farmer-led organisations are hybrid organisations (public and/or private) and should be taken separately due the farmer leadership. In fact, service providers may constitute networks of practitioners with complementary skills to support innovations at territory level or value chain level. These networks form an innovation support system where providers interact in various ways: cooperation, competition, or 'coopetition' (Dagnino et al. 2007). On one hand, articulation of services and alignment of ISS with farmers' demands remains challenging (Kilelu et al. 2013). That is why the different classifications of ISS put emphasis on functions fulfilled by these services such as articulation of demand and networking facilitation. Some service providers fulfil the role of intermediaries to act as a bridge between the demand and supply side of agricultural knowledge infrastructure (Klerkx and Leeuwis 2008a, 2008b). On the other hand, according to its complex and dynamic nature, innovation processes should be described through different phases of development. Following Wielinga (2009, 2016) the innovation process may be analysed through phases, even if we need to avoid linear thinking and to focus on the continous feedback between the different phases (Leeuwis and van den Ban 2004, Faure et al. 2014). Taking such a perspective, ISS needs may vary depending on the phases of the innovation, something also put forward by Geels (2002), for example, who shows that the ISS needed depend on the degree of development of the innovation process.

2 THE METHOD

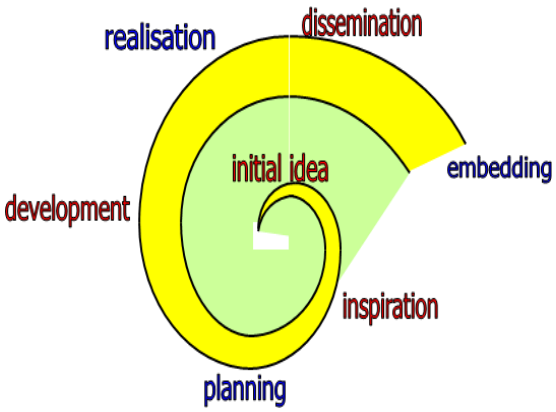
2.1 Data collection

Data for this communication is derived from an action research approach (Checkland and Holwell 1998, O'Brien 1998, Faure et al. 2014) where a specific exploratory case study method was used as part of the EU funded AgriSpin project. Following the design of the method (Wielinga 2016) a total of 13 Cross Visits to 12 European countries were conducted. A cross-visit typically lasted 3 to 4 days and involved a mixed team of between 7 and 12 project partner members drawn from science and practice. The aim of each Cross Visit was to analyse ISS in 3 to 5 concrete innovation cases proposed by the host organisation. The selection of the innovation cases aimed to provide a diversity of situations in terms of main topics addressed (agriculture sector, food sector, etc.), the scale of innovation (farm, value chain, territory) or in terms of main actors leading the innovation (Ndah et al. 2016a). Overall, 57 case studies were identified and analysed. Documents were prepared by the host partners to describe each case. The individual visits associated with each case included interviews of key actors, visits to farm and firms, and time dedicated to collective analysis. The documents elaborated after the cross-visit included information regarding analysis of the innovation process, provision of ISS and main outcomes achieved through the cross visit (visits reports, innovation case narratives, time-line and visualised 'spiral of innovation').

2.2 Data analysis: analytical frame and procedure

Guided by the principles of qualitative inductive content analysis (Thomas 2006, Punch 2005) we combined two tools to analyse the data: i) an innovation characterisation matrix and ii) an innovation support service matrix (Ndah et al. 2017). The innovation characterisation matrix contained information about the geographical scale of the innovation, main actors driving the

innovation, main issue addressed and the main ISS. The innovation support service matrix contained, for each case study, the type of ISS, the content of the ISS, the providers involved and the phases of the innovation process. There are different ways to describe the innovation phases. Beers et al. (2014) distinguish four phases: inventions, business case, adaptation/adoption by first movers, widespread adoption. In line with Wielinga (2016), we used the following phases to analyse the innovation process (Figure 1).



Initial idea phase: Actors get a new idea because of a problem or an opportunity.
Inspiration phase: Others become inspired and form a warm informal network around the initiative.
Planning phase: Initiators formulate plan for action, they negotiate space for experiments
Development phase: This is the phase of experimentation to develop new practices and to collect evidences.
Realisation phase: The innovation here goes into implementation at full scale.
Dissemination phase. Effective new practices are being picked up by others.
Embedding phase. The new practice becomes widely accepted. What matter is new rules, laws, subsidies, taxes, etc. to mainstream the innovation

Figure 1: The spiral of innovation with different phases (source: Wielinga, 2016)

To analyse service provision, for each phase of the innovation we observed how the services were provided in each specific situation. A situation regarding service provision was understood as 'a moment identified in the *spiral* where one actor (or a group of actors) was providing a service to other actors which is considered key to enhancing the innovation process. For each case study, the analysis was a common activity of all those visiting the target area, also assisted by the host team. An additional analysis was made by researchers to be able to compare the results of all the case studies. This analysis was carried out on 43 case studies with a full set of data.

3 RESULTS

In this part we present one Irish case study as an example. The case study is chosen because we were able to made an in-depth analysis of the innovation process due to the data collected by the Irish partners. Even if the innovation may be considered as incremental, we show the large diversity of ISS and their evolution along the innovation process. We have used the same analysis for the 57 case studies to generalize our results.

3.1 Innovation support services : the case of the "Economic Breeding Index"

The Economic Breeding Index (EBI) is a single figure profit index aimed at helping farmers identify the most profitable bulls and cows for breeding dairy herd replacements. It is a breeding decision support tool. EBI uses multiple animal traits which is converted to a € value of extra profit per cow, per lactation. Prior to the development of EBI in the 1990s, some Irish farmers were using a single trait breeding index to help in their decision making about sire selection, particularly in the dairy herd. Such an index had helped improve milk yield per cow. However, the single trait index did not help address fertility issues in the Irish dairy herd. . Improved fertility was needed to minimise the replacement cost of cows and also, through compact calving, to maximise the use of grass as part of a low input cost system and to optimise production. The EBI, through its multi-trait focus, translates the breeding choice incorporating both milk yield and fertility into a € value of extra profit per cow, making this a powerful breeding management decision tool. In the late 1990's Teagasc researchers visited New Zealand. They saw work on multi trait indices for genetic improvement that was being carried out there. Subsequently, an expert from New Zealand visited Ireland for a period of time. With the support of ICBF (Irish Cattle Breeding Federation), Teagasc researchers carried out various studies and then developed an economic model by using various criteria which underpins the economic breeding values intrinsic to EBI. EBI was tested with a few farmers to check its validity and the effects on cattle performance. The Teagasc Advisory Service heavily promoted EBI through inclusion in its Dairy Development Programme. Extension methodologies included farm visits and consultations, group meetings and a breeding competition held in 2004. This event was key to convincing other farmers that milk yields wouldn't fall at the expense of increased fertility. At the same time the Irish Cattle Breeding Federation worked in conjunction with Teagasc to identify young high genetic merit bulls by using EBI and for selection by private companies. At this stage, a formal consultation group consisting of farmers, breeding companies, beef industry, research & advisory and Teagasc, monitored and suggested improvement in EBI.

In order to extend the use of EBI, other competitions were also held in 2009, 2010 and 2011 organised by Teagasc and sponsored by the Irish Farmers Journal, ICBF and a Bank. Discussion groups, facilitated mostly by Teagasc staff and based on peer-to-peer learning, were critical to the dissemination of EBI. There were up to 10,000 farmers participating in such groups. To further embed EBI, Teagasc's advisory service has incorporated EBI targets into its advisory programme as key performance indicators of advisory activities and employed a wide variety of extension methodologies to promote it. Private companies largely promote high genetic merit bulls based on EBI. Banks help by providing credit to farmers to invest in dairy activities based on genetic improvements.

The table 2 highlights the various ISS according to the innovation phase.

Table 2: ISS according to the phase of innovation, the case of the "Economic Breeding Index"

Phase of the innovation process	**Innovation support situation/activity**	**Innovation Support Service**
Initial idea	Visit to New Zealand	Awareness and exchange
Inspiration	Visit of the researcher from New Zealand Support from the Irish Cattle Breeding Federation	Consultancy through research from New Zealand Brokerage (involving Teagasc and ICBF, informal)
Planning	Series of studies, carried out by Teagasc	Institutional support to niche innovation (within Teagasc organisation to help researchers taking risks) Access to funds (for experimentation)
Development	Teagasc developed the EBI model ICBF collected the data. Experiments with a few farmers to improve the cattle performances	Institutional support to niche innovation (to help researchers and advisors taking risks) Facilitation (from Teagasc to support the interactions between farmers, researchers and advisors) Advisory service to farmers
Realisation	Farm visits, discussion groups with farmers 2004 competition organised by Teagasc Involvement of private companies to select bulls based EBI results Multistakeholder consultation group	Awareness and exchanges (among farmers) Advisory services to farmers Capacity building of farmers Networking (multistakeholder consultation group)
Dissemination	Other competitions organised by Teagasc and sponsored by the Irish Farmers Journal, ICBF and RaboBank. Discussion groups with farmers	Capacity building Access to resources to invest in dairy activities based on the use of EBI (credit for farmers) Networking with media, banks, private companies
Embedding	Incorporation of EBI targets into Teagasc advisory programme private companies promote genetic improvements based on EBI Credit from banks Industry consultation group to monitors EBI process.	Institutional support by including new rules in advisory programmes Networking and brokerage

This case study clearly illustrates the diversity of ISS beyond the provision of advisory services to farmers to disseminate the use of EBI and highlights the importance of ISS related to 'networking, facilitation and brokerage' at different phases of the innovation process. Table 3 also shows that during the initial phases, the use of the classical definition of services (Labarthe et al., 2013) is not very useful. What really matters is not providing a well-defined service but to create space for innovation. That is why we decided to use the term 'innovation support service'. During the last phases, the classical definition of services remains appropriate.

3.2 Innovation support service and phases of the innovation process

In an attempt to generalize our analysis by taking into account the diversity of innovation processes, we conducted a quantitative analysis of 43 cases that crosses the ISS with the innovation phases. This analysis confirms a broad presence of all types of services across (almost) all phases (Table 3).

Table 3: number of times a specific ISS function was identified for each phase of innovation in 43 case studies

Innovation Support Service functions (interventions)	Initial idea phase	Inspiration phase	Planning phase	Development phase	Realisation phase	Dissemination phase	Embedding phase	
Awareness and exchange of knowledge	12	9	4	19	10	15	3	**72**
Advisory, consultancy and backstopping	4	7	14	17	7	1	1	**51**
Demand articulation	3	6	4	5	7	5	1	**31**
Networking, facilitation and brokerage	12	17	14	12	14	15	6	**90**
Capacity building	2	3	2	7	10	8	1	**33**
Enhancing / supporting access to resources	2	3	15	16	6	8	1	**51**
Institutional support for niche innovation and scaling mechanisms stimulation	3	2	5	12	2	2	3	**29**
Total	**38**	**47**	**58**	**88**	**56**	**54**	**16**	357

Data from 43 innovation cases in 10 countries: Netherland , Belgium , Denmark , Spain , Finland , Greece , Germany , Italy-Campania , Italy-Tuscany, Guadeloupe , Ireland.

First, table 3 shows that more services are provided in the development phase than in any other phase (88 counts). It reflects the fact that intensive activities and increased needs for support activites occur during this phase. Second, 'networking, facilatation and brokerage' ISS predominate (90 counts) and are allocated fairly evenly over each phase. This finding reflects our focus and interest in 'multi-actor approaches', which was one of our key selection criteria for case studies. Third, the high frequency of counts (72) for the "Awareness and exchange of knowledge" ISS in almost all the phases reflects a general needs for actors to acces, produce or exchange knowledge whatever the phase. This ISS was based on a mix of mechanisms (informal interaction, active role of key actors to look for and acces information etc.) and, still vivid, 'knowledge transfer' approaches - despite the widely promoted multi-actor and interactive discourse. Fourth, 'Enhancing / supporting access to resources' (especially financial) is key from the actors' perspective at the planning and development phase. Fifth, it is not surprising that 'Institutional support for niche innovation and scaling mechanisms stimulation' is key at the development phase.

As can be seen from table 4, all ISS seem to appear across the different phases of the innovation process. Such a result may be a consequence of how we analyzed and interpreted the cases, whereby the single, concrete services were ordered and assigned to an ISS following the descriptions from the case studies. Table 4 reflects this analytical procedure with examples of concrete services provided at each phase of the innovation process. It provides a more relevant picture of the ISS across the phases of innovation.

Table 4: Examples to illustrate ISS across phases on innovation (source: authors)

	Initial ideas	Inspiration	Planning	Development	Realisation	Dissemination	Embedding
Awareness and exchange of knowledge	Emergence of new ideas based on research findings, projects or initiatives	External visits and exchanges where innovative ideas are being practiced	Searching relevant information from outside to learn		Knowledge transfer based on experiences from the previous development phase	Information dissemination of technical or management practices regarding farming, processing or market opportunities	
Advisory, consultancy and backstopping at farm level	Key consultancies to generate new ideas at farm level				Advisory services for new agricultural practices and new management practices, consultancy based on stabilized knowledge		
Advisory, consultancy and backstopping at organisation level	Key consultancy to generate innovations for organisations Key consultancy to fine tune ideas Key technical or financial consultancy from outside the network (including research, consultants) to fine tune ideas				Consultancy based on stabilised knowledge		
Capacity building	Boosting individual competencies, to think outside the box, generate new ideas	Support to key individuals (pioneer, entrepreneur, change agent)			Training programme based on learning from the development	Capacity building at larger scale through regular training based on more or less participatory method to new comers.	
Demand articulation	Award to identify and valorize innovators. Call for innovative proposal in the organisation	Workshop to share experiences. Trips and cross-visits	Workshops for diagnosis and organising ideas. Workshop for coordinating actions (production, access to market)	Support to the creation of private firms to articulate demand and supply (provide inputs or market products) Support to new farmers' organisations (cooperatives, association, etc.) to articulate demand and supply (collect, process or market products)			Key consultation to further strengthen and improve demand, e.g. acquisition of a certification scheme to further improve demand by an organic farmer
Networking facilitation and brokerage	Facilitation for emergent informal networks aiming at generating new ideas as well as inspiration		Facilitation of informal network connecting people who matter (pioneer, entrepreneur, and	Strengthening of informal networks Building innovation	Strengthening networks to become more formalized	Facilitation for documenting and facilitating collective learning based on past	Connecting actors with outside to share their experiences and get new ideas (keep being

		others) or influential people able to move the idea forward. Support to temporary association of actors	platforms Organising permanent workshops Designing participatory monitoring and evaluation	Steering committee to monitor and evaluate. Negotiation with actors who are affected by the change.	experiences. Improving the multilevel governance at territorial or value chain level	innovative)
Enhancing / supporting access to resources	Provision of seed money. Implementing competitive grants	Implementing incubators to support start-ups and collective action Access to financial resources for experimenting.	Access to credit subsidies to invest especially for new comers Building alliance to be eligible for access to funding and support from national and international projects or programmes Short term financial support to boost the sustainability of the innovation			
Institutional support for niche innovation and scaling mechanisms stimulation	Endorsement of an initial idea from the start by institutions and key actors to encourage and protect the innovation process at the beginning	Space to innovate within the organisation or with other organisations Legal authorization to experiment out of the legal institutional framework		Design of new certifications (for products, process or advisors). Identification of certification bodies Communication and marketing	Taxes and subsidies for orienting individual and collective actions. New norms for production and processing New indicators for monitoring and assessing advisory services	

Table 4 illustrates that ISS depend on the innovation phases and shows that, for each function, ISS cover a wide range of actual activities. During the first phases (initial idea, inspiration, and to a lesser extent, planning), the services are mainly aimed at provoking exchanges, generating new knowledge and facilitating access to seed funds for key actors to innovate. ISS providers essentially create pathways for actors to connect with those other actors they need in order to develop the initiative further. During the final phases of the innovation process (dissemination and embedding), the service provision is more standardised and many services are oriented to farmers to dissiminate the innovation based on knowledge tranfer or advisory services. We can also observe that services aiming at strenghtening farmers' business skills and entrepreneurial attitudes are not common.

4 DISCUSSION

In this section we discuss (i) the alignment and coordination of ISS including the networking, facilitation, and brokerage function, which is key for the innovation process, and (ii) the factors influencing the alignment and coordination of ISS by taking into account the diversity of innovation and the characteristics of AKIS.

4.1 Alignment and coordination

Based on our results, Figure 2 shows the diversity of ISS along the innovation process. These ISS are part of our generic seven ISS classes.

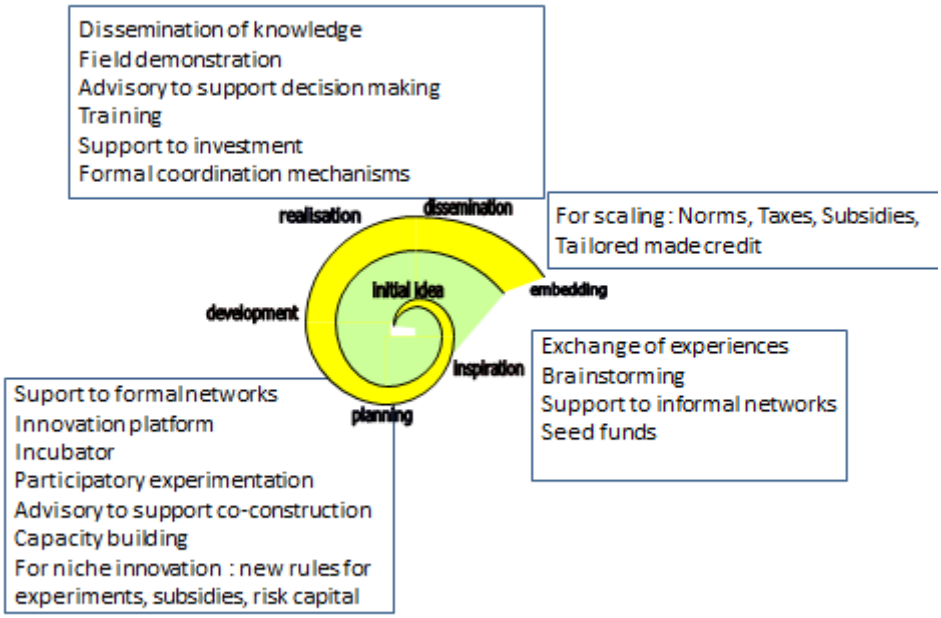


Fig. 2: Main type of ISS depending of innovation phases

The articulation of services and the alignment of ISS remain challenging. First, the demands for ISS emerge gradually in the innovation process and need to be adequately matched with a combination of ISS. Such an evolving demand, depending on the innovation phases, implies a permanent co-construction of the services to achieve a "best-fit" (Le Coq et al., 2010). Second, all the service providers act in various ways (cooperation, competition or 'co-opetition') which may make more complex the coordination among service providers. Kilelu et al. (2013) point out that matching demand and supply of ISS in pluralistic and privatised

system is a complex process given that there are competing interests and power relationships, which in turn, underscores the need to strengthen farmers' capacities to be able to negotiate with service providers.

In this context the ISS associated to 'networking, facilitation, and brokerage' and 'demand articulation' appear to be crucial across all phases of the innovation process. This highlights the gradual shift from the previous expert and top-down model of innovation into a model accounting for more complex processes that require intensified and timely interactions between actors based on pluralistic ISS provider settings. Nevertheless, the corresponding ISS are complex and include several types of activities for the service providers. Three issues require attention in order to provide practical guidance to ISS providers:

First the 'networking, facilitation and brokerage' ISS, while crucial all along, takes different forms depending on the phases, the actors involved and their needs. This is in line with Klerkx and Leeuwis' (2009) remark that ISS depend on the different requirements of the innovation network in different phases of its development as well as on the composition of the network in terms of number of actors, type of actors and actors' capacities. During the first phases, ISS aimed at supporting and facilitating informal and flexible networks or temporary associations of actors. As Beer et al. (2014) observed, in the early phases, support to flexible networks, either formal or informal, are more effective and cost-efficient than other type of ISS to facilitate innovation. During the last phases, ISS provide more frequent and efficient support to more formalized networks (e.g. formal association, innovation platform). Intense intermediation and institutional dialogue are required for addressing scaling issues to ensure adequate embedding of innovation in value-chain and in local territories and for designing and enforcing new arrangements towards institutionalisation.

Second, our empirical findings show there is no specific type of service provider solely responsible for this kind of ISS. It can, of course, be provided by a specialised service provider as showed by Klerkx and Leeuwis (2008). However specialized service providers dedicated to such an activity are quiet rare. In fact, this kind of ISS can also be provided by another type of organisation (e.g. farmers' organisations, private firms) interested in pushing forward the innovation process, or by different organisations sharing this function, each of them with a specific coordination task, or different organization acting at different phases of the innovation process or finally, by an multi-stakeholder innovation platform with a dedicated facilitator. However, some organisations playing a brokering function may have a normative, political or commercial orientation which deeply influences the innovation process (Kilelu et al. 2013).

Third providing this ISS implies new roles and, to a large degree, unexplored skills for change agents (Koutsouris, 2014). Besides the now well recognised skills such as good communication, ability to listen and to value farmer's insights, combined with technical capacities and interactional expertise (Ingram 2008), such individuals have to be able to collaborate with different kinds of actors and develop adequate practices (Nettle et al., 2017). Conventional advisors encounter difficulties in taking over new roles and becoming professional facilitators. Klerkx and Jansen (2010) argue that this is due, among others reasons, to the lack of the right attitude and competencies (especially social competencies) of advisors and their unwillingness to abandon their 'comfort zone'. Brokering functions have yet to be thoroughly described, operationally defined, or well-evaluated. Attention should be given to the brokerage praxeology (i.e., theory informing practice, and practices feeding new theory) especially the position of innovation brokers in the different phases of innovation processes (including their specific competencies needed to successfully carry out their tasks). Such an agenda will help in further highlighting gaps in our knowledge as well as strategies to

address such gaps and, thus, in building a solid knowledge base which will be valuable for policymakers, academics and practitioners. (Koutsouris, 2017).

4.2 Factors influencing the alignment and coordination mechanisms

We address here the factors influencing the alignment and coordination of ISS even if we have not been able to fully validate these results based on our research.

First, our findings seem to indicate that ISS vary according to the types of innovations. However, there are many ways to describe the diversity of innovations. For example, Beers et al. (2014) distinguish between systemic innovation and innovation for optimisation. Every innovation includes several dimensions: the "hardware" related to the technical change, the "software" related to the changes regarding the values and rules, and the "orgware" related to the new institutional arrangements (Leeuwis and Aarts, 2011). We suggest the use of a generic classification of innovation that might better address the diversity of ISS needed to support innovation with regards to the complexity of innovations. We propose to take into account two dimensions of the innovation:

- the level of technological change required to achieve desired changes (at farm level, value chain level, territory level). This dimension mainly refers to the "hardware" dimension.
- the level of changes for new coordination among actors (including service providers) required to achieved to the desired changes. This dimension mainly refers to the "orgware" dimension.

This analysis leads to four groups of innovations with distinctive characteristics and corresponding ISS, as illustrated in Table 5.

Table 5: ISS and type of innovation

	Low level of coordination	High level of coordination
Low level of technical change	The innovation is usually incremental because both technological and organisational changes are light. Here, ISS may largely relate to traditional, individual advisory services and consultancy at farm level or firm level.	ISS may emphasise demand articulation, networking, capacity building. For example, such innovations may occur for promoting new management practices for farmers based on new advisory services or new value chain based on new marketing practices of existing products.
High level of technological change	Such innovations are more likely to be radical changes at farm level or among small processors ~~but~~ with secured access to market. There is no need for strong coordination among actors to stimulate the innovation. Here, ISS may be focused on knowledge awareness, technology transfer, advisory, consultancy and capacity building.	Such innovations are really challenging and are more likely to be radical. For this group, a wide range of ISS is needed. Knowledge awareness and exchange, and capacity building services are expected to be attracted for serving the high technological demands, while services for networking and facilitation, advisory and consultancy are, amongst others, expected to serve the coordination needs of actors

Such hypotheses are in line with the work of Toillier et al. (2018). However, our test of such hypotheses using our AgriSpin data did not yield clear cut conclusions (Ndah et al., 2018).

Secondly, the overall Agricultural Advisory Service System (Garforth et al. 2003) is also key to explaining the diversity, alignment and coordination of ISS. One characteristic is crucial: the degree of integration vs. fragmentation of the AKIS (Knierim et al. 2015a). We may identify several situations.

In a few countries we observe an integrated ASS and a "integrated" agricultural service system with a limited number of service providers. In some cases, one dominant service provider is responsbile for a wide range of ISS, based on an in-depth knowledge of the farmers' needs. It coordinates ISS with other service providers who may complement on a "spot basis" the range of services (e.g. Teagasc in Ireland). . In other cases, a dominant provider (e.g the farmer-based organisation Seges in Denmark and ZLTO in the Netherlands) largely support innovation processes and simultaneously interacts and coordinates ISS closely with other service providers. Beside demand articulation, networking facilitation, and capacity building, this dominant service provider may offer specific additional services owing to its capacity to co-construct the service to better meet farmers' needs. We observed that integrated agricultural service systems usually warrant a comprehensive ISS offer and facilitate a strong

coordination between actors. However, there is a certain risk to have less opportunity to generate innovative ideas from outsiders.

As a consequence of privatisation and decentralisation reforms, we observe in many countries a "fragmented" agricultural service system with a large number of service providers, each of them offering a limited number of services, often competing with each other. Whether and to what degree such fragemented ASS may hinder innovation processes depends on the socio-technological complexity of the innovation and the equilibrium between the different components of the ASS: the governance, the funding mechanisms, the competencies, the methods to provide advice (Birner et al., 2009 ; Faure et al., 2012) . Fragmented ASS with an important number of competing service providers may leave a lot of space for emerging innovations if not strong coordination is needed. In this situation the innovation process could be more easely leaded by either the private sector or the public sector. However, as soon as changes in social systems such as farmers' organisations, rural communities etc. are required, there is a strong need for coordination between service providers and other actors to fully support innovation. In some cases, this coordination may effectively exist. For example, in Italy the experience of the Biodistrict show the key role played by one association to coordinnate a wide number of actors from different sectors (agriculture, tourism, natural park, example, both in Italy). In other cases this coordination is weak. For example, For exaple, in Greece, the shortage of advisors along with the lack of links between public extension services, cooperatives, and the private sector point the fragmented and inefficient character of the Greek AIS (Koutsouris 2014)

5 CONCLUSION

Our results highlight that ISS play critical roles in innovation processes in various ways. We showed that during the first phases of a given innovation process (initial idea, inspiration and planning), the actors willing to support innovation mainly need to provide space and resources for key actors to innovate. During the final phases of the innovation process (development, realisation, dissemination and embedding), the service provision is more standardised and many services are oriented to farmers to ensure the scaling and institionalisation of the innovation. However, ISS needs in terms of diversity and intensity seem to depend on two dimensions: the level of technological change required to enhance the innovation process and the level of changes for new coordination mechanisms among actors (including service providers). The ISS are provided by large range of service providers and depend on the characteritics (governance, funding, etc.) of the service providers. The mechanisms to align the ISS, and thus to fully support the innovation, largely depends on the degree of concentration vs. fragmentation of the AASS. Finally, we confirm that "networking, facilitation, and brokerage" functions are crucial across all the phases of the innovation process. Furthermore, there is a diversity of mechanisms to operationalise an ISS and a diversity of organisations which may fulfil this role.

Even if we attempt to draw generic lessons based on our analysis, the case studies show that the ISS remain case specific and no 'silver bullet' can be provided to support innovation in agriculture. Birner et al. (2009) describe such a situation with the expression "from best practice to best-fit" when analysing extension and advisory services to provide recommendations to improve them. The cross-cutting recommendation for innovation support practitioners and policy makers is, therefore, that targeted diagnoses with regard to innovation phases, types and the characteristics and functions to be fulfilled by the support systems may precede proposals for improving innovation support services. With our results, we hope to lay the bases for such diagnoses.

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