How to design and develop inclusive knowledge and innovation agricultural networks: Lessons from the case of the Portuguese Cluster of small fruits

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Abstract

The idea underpinning EIP-AGRI of linking producers and users of knowledge and promoting their interaction around problem-solving is well grounded on the evidence provided by the 'innovation systems' and related literature. Evidence gaps that matter to the implementation of the EIP-AGRI activities comprise the lack of knowledge regarding the best-fitted network configuration for different farming systems and farming styles, and the nature and effectiveness of a facilitator function and role to bridge communication between researchers and farmers. This paper contributes to fill the evidence gap regarding the networks configuration best-fitted for different farming system and farming styles and provide insights on the facilitator relevance and its desirable profile, build on the evidence collected for a concrete network: the Portuguese Cluster of small fruits (CSF). The small fruit sector is a novel sector in Portugal that has attracted in the recent years a large number of new investors, in particular newly-established small-scale inexperienced producers. A social network analysis (SNA) approach has been used to depict the different actor´s positions and interactions in the network focusing on the knowledge flows involved in the creation and exchange of knowledge. The insights provided by the CSF analysis emphasises that agglomeration economies based networks, which are very important in some agricultural sectors (e.g. fruit, wine) and in countries or regions where small-scale farm is significant, can in fact be the ground for knowledge and innovation networks in the sense wanted by the EIP-AGRI, since inclusiveness and facilitation functions are accounted for properly.

Keywords: agriculture, knowledge and innovation networks, agricultural knowledge and innovation systems, clusters, EIP-AGRI

1. Introduction

Innovation has been placed at the heart of the Europe 2020 strategy for growth and jobs (CEC, 2013). The European Innovation Partnerships (EIPs) are an innovative tool launched recently by the European Union (EU) to tackle major societal challenges that look for solutions by building on the networking and interaction between actors from the research chain and the innovation players. The EIP on agricultural sustainability and productivity (EIP-AGRI) is one of the five EIP launched by the EU. The EIP-AGRI (EU SCAR, 2013) relies on the innovation systems theoretical approach (Lundval, 1992; Cooke et al., 1997; Audretsch, 1998; Asheim, 1999) that envisages innovation as a part and as well as the result of interactive learning processes involving multiple actors. Within this approach, multi-actors knowledge networks are the ground for innovation processes taking place at the territorial level. EIP-AGRI activities focus on enhancing the network of producers and users of knowledge, which includes farmers, researchers, advisors, business and other individual and collective actors whose interaction generates 'new insights and ideas, and mobilise existing tacit knowledge into focused solutions' (EU SCAR, 2013, p. 25). Hall (2009) endorse the importance of incremental innovation focused on problem solving or the constant minor adjustments and improvements that farmers make to succeed.

The link between networking behaviour of firms from all economic sectors, including the primary sector, and their innovative performance has been established by the literature (e.g., Pittaway et al., 2004; Ritter and Gemünden, 2003; Nieuwenhuis, 2002). In addition, the research on the 'innovation systems' highlights the importance of the partner diversity to the innovative capacity of the networks. Research on the agricultural innovation systems emphasizes as well the critical role of actor's heterogeneity (Wood et al., 2014; Eastwood et al., 2012; Oreszczyn et al., 2010), and defines innovation as an outcome of open-ended interactions among various actors combining knowledge from many different sources (Wood et al., 2014; Klerkx et al., 2010; Conroy, 2008; Klerkx and Leeuwis, 2008).

Therefore, the idea underpinning EIP-AGRI of linking producers and users of knowledge and promoting their interaction around problem-solving is well grounded on the evidence provided by the 'innovation systems' and related literature. Evidence gaps that matter to the implementation of the EIP-AGRI activities comprise the lack of knowledge regarding the best-fitted network configuration for different farming systems and farming styles, and the nature and effectiveness of a facilitator function and role to bridge communication between researchers and farmers.

The FP7 EU project PRO AKIS encompassed among their goals exploring and identifying the possibilities, conditions and requirements of agricultural and rural innovation networks that constitute examples for the EIP-AGRI. A set of four case studies for in-depth analysis was selected across different European countries. This paper focus on the Portuguese Cluster of small fruits (CSF), one of the networks selected by the PRO AKIS project, given that it offered useful insights on how to design and to develop knowledge and innovation networks able to cope with inclusiveness challenges.

The paper contributes to fill the evidence gap regarding the networks configuration best-fitted for different farming system and farming styles and provide insights on the facilitator relevance and its desirable profile.

The paper has two interrelated goals: (1) to present the configuration of the Portuguese CFS, by describing its structure, content and dynamics as a learning and innovation network; and, (2) to discuss how the originality of this network regarding its inclusiveness might be kept in its future development in spite of the tensions evidenced towards the segregation of different groups of farmers.

The paper is organised as follow: Section 2 presents the case study; Section 3 describes the methods and procedures applied in data collection; Section 4 presents and discusses the results. Finally the Section 5 offers some concluding remarks.

2. The case study

The introduction and expansion of the small fruit sector in Portugal is quite recent. It was launched in the nineties, while its overwhelming expansion occurred in the recent years: the sector grew from a few hectares in 2009 to 1,150 in 2015. Its recent explosion is largely due to the investment by new farmers, supported by EU funding to help young farmers settle into their production chain. Unemployment and the lack of opportunities in other areas that result from the economic crisis in the Southern European countries attracted hundreds of young (under forty years old) farmers, often searching for a new life-style as well. They are mostly highly educated individuals, but with little or no experience in the farming sector. Unsurprisingly, the small fruit sector is currently characterised by a huge demand for knowledge and information and by a strong dynamic to organise and deliver its supply.

The sector is concentrated in two sub-regions: southern and central-northern Portugal. Figure 1 shows the geographical location of the sector, as well its differentiation regarding the type of berry specialization profile.

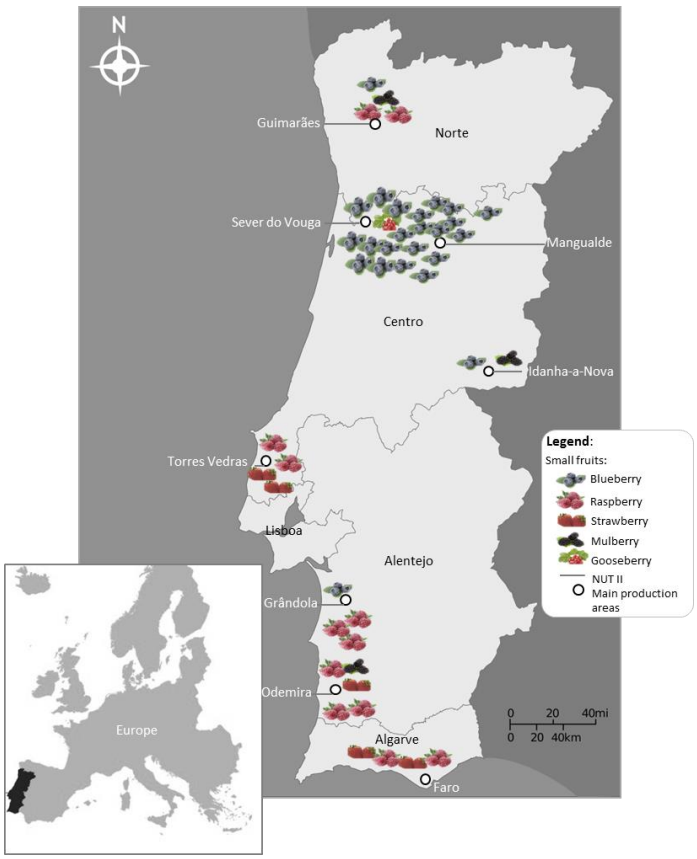

Figure 1: Main areas of production of small fruits in Portugal
Source: Madureira et al., 2014

Both sub-regions offer favourable agro-climatic conditions for berry growth and differentiation at European level due to better taste, colour and ripening time. Together, they constitute the national small fruit commodity chain which has international markets as its main destination. However, the two sub-regions present distinctive characteristics regarding the sector organisation, the profile of their producers, and the accumulated expertise and ability to mobilize knowledge and to innovate. The southern area is characterised by larger and specialized exploitations, including also farm-based organisations producing in association with a multinational company. Distinctively, the central-north is dominated by small farms, by the mono-production of blueberries and by the sector novelty experience in the area. Hence, the former's position as a supplier of knowledge and skills while the latter is viewed as highly in need of both.

The Portuguese Cluster of small fruits (CSF) was launched in 2013, resorting to public funding to agglomeration economies (creation of sectoral clusters). It was led by a sectoral association, which is the main network facilitator along with other three partners. It is a multipurpose network focused on the berry sector organization at national level. Its major concern is to ensure the sector's competitiveness and sustainability. Knowledge and innovation are key factors to achieve these goals, given the huge knowledge and information gaps in the sector caused by its novelty and lack of tradition along with the entry into the sector of hundreds of small and inexperienced producers.

Therefore, the CSF is mainly a knowledge and innovation multi-actor network with a singular configuration: it tries to benefit from the know-how and expertise of experienced pioneer producers, while transferring it to the less or no-experienced producers in the central-northern sub-region. The former producers, which are mostly located in the Southern sub-region of the country, have already well-established informal and transnational knowledge exchange networks. Hence, the study of the CSF offers an opportunity to understand the role of clusters as a tool for clustering knowledge generation and diffusion beyond a localised level (Porter, 2000; Marshall, 1920). In addition, this network presents the opportunity to understand how extra-cluster knowledge exchange and learning can determine the success of intra-cluster flows (Guilianni and Bell, 2005).

The CSF is a horizontal nationwide network; its coordination structure comprises the main facilitators of knowledge sharing and diffusion processes. It is composed of both experienced and inexperienced producers and a diversified set of other actors, such as: private agricultural advice companies, independent consultants, several FBOs (cooperatives, farmers' groups and associations), up and downstream industry firms, among others. Table 1 illustrates the diversity of actors within the Portuguese berry sector.

By being an export commodity (its domestic consumption is recent and still residual), berry production need to be concentrated to attain export scale. This situation originated a dynamics for agglomeration economy, although it also entailed in the central-northern sub-region an increasingly large number of small and fragmented organizations, such as producer groups, farm-based small firms and other business models in general that are also offering technical advice to their members and/or selling advisory services to other producers. Hence, this network offers a good example for EPI-AGRI, given that it has been created to overcome the sector challenges regarding its productivity and sustainability, which underpin its competitiveness within the global markets, and to address simultaneously the risks faced by the sector competitiveness due to the massive entrance of the small-scale and inexperienced producers.

Table 1: Major actors and their roles in the small fruit sector

Actors	Description of their role in small fruit sector
Independent producers	Production
Private companies Micro SME	Berry production, harvest and/or trade Storage, processing and transformation Advisory services (technical support, accounting, marketing, certification) supply Advisory services supply for application to PRODER incentives, direct payment, project installation
Producer groups	Berry production, harvest and trade
Cooperatives	Knowledge transfer (creation, storage, conversion and sharing) Supply of advisory services (technical support, accounting, marketing, certification) Berry harvest and trade
Farmer associations	Support and sectoral promotion
Sectoral associations	Promotion and support of knowledge creation and exchange Support and sectoral promotion Internationalization and innovation promotion
R&D public institutions	Knowledge creation, storage, conversion and sharing
R&D private institutions	Knowledge creation, conversion and sharing
Local governments	Supporting and encouraging enterprising farmers (land banks, business incubators, licensing new projects), territorial marketing
Public regional advisory agencies	Providing support to project installation management and technical advice Knowledge transfer (creation, storage, conversion and sharing)

Source: Madureira et al., 2014

3. Methods and data collection

The methodological approach adopted for data collection encompassed two phases. In the first phase, aimed at understanding and mapping the actors of the Portuguese small fruit sector, an exploratory study was carried out that included different steps from the collection and systematization of the latest news and events, taking place in the sector of small fruits, to the direct observation and participation of the researching team in some of those events, such as: meetings of producer groups, the Blueberry National Fair and sectoral workshops related to production and harvesting techniques.

During the second phase, the team of researchers participated in meetings involving the facilitators of the CSF. These meetings allowed for the collecting of information on the CSF foundation, previous informal networks and ties, understanding the facilitator's role and to identify and map all the actors involved in the network.

In the third phase, an exploratory-descriptive approach was chosen to gather information about the structure, content and dynamics of the network. For this phase, two different interview guides were constructed, and applied through questionnaires: one for the participants and the other for the facilitators. This script was also applied using a matrix to record relationships and interactions between actors and the flow of knowledge/information, whether in the process of creating, sharing or storing knowledge. These interviews took place on site, lasting on average 60 minutes and were set up by prior contact via email and telephone so that respondents were aware of the objectives of the study and the type of information to be collected. The sample selection distinguished the actors involved, according to the criterion 'role in the network' and contemplated the following groups: 'facilitators', 'suppliers of knowledge' and 'knowledge demanders'. The sample selection was random and ended as follows: three interviews with 'facilitators', nine interviews with 'suppliers of knowledge', and 24 interviews with small farmers ('knowledge demanders').

To carry on the analysis of social network, supporting the flow of information in the process of creating, sharing and storing knowledge, Social Network Analysis (SNA) methodology was adopted (for more detailed description see e.g., Hanneman and Riddle, 2005 or Wasserman and Faust, 1994). SNA is based on mapping and characterizing the relationships that are established as a result of the interactions between different actors and/or groups of actors. The analysis of the interactions between the actors allows us to look into: (1) interaction patterns within the network; (2) knowledge flows (central actors, direction and intensity). The specific software for SNA, the Ucinet (version 6), working directly with another program, the NetDraw, was used with the purpose of drawing the graphs of the networks under study. The main purpose of adopting the SNA methodology was to obtain well-founded insights regarding key actors and the intra-network and external interactions that explain some of the relevant processes of knowledge creation, sharing and storage, taking place in the network.

4. Results

4.1 Actors, roles, interactions and the network configuration

The CSF players can be grouped into four major categories. There is a core group with four organizations that coordinates the network and includes their key facilitators.

A second group of members is a larger and more diverse one, encompassing independent producers, producer groups, small and medium firms of producers and others, cooperatives, farmer associations, private advisors,

project developers and up and downstream firms, among others, which are direct or indirectly responsible for the knowledge, expertise and information supply. This group also includes regional agencies of the Ministry of Agriculture and, to a lesser extent, researchers and universities. The experienced pioneer producers (independent or members of profit and non-profit producer groups) stand out within this supply-side group. Our rough estimates suggest them to be around 15 people/organizations. The latter are vital to CSF insofar as they are the main knowledge and expertise suppliers, while being simultaneously innovation-led producers, ergo fundamental to encourage innovation processes within the network.

The third category of actors comprises the inexperienced producers. This is the largest group, with hundreds of producers, although not all of them participate in CSF activities. Among this group there are some active knowledge searchers, whereas the majority are apparently passive recipients of information.

The local governments and local development associations of central-northern region constitute the fourth group of actors in the SFC network. They act mainly as enablers and supporters, promoting the settlement of new producers, and acting as lobbyists in favour of the sector.

Figure 2 represents the interactions among the interviewed actors of CSF network, based on the SNA methodology for data gathering and mapping.

In Figure 2, the actors are identified according to their level of experience and type of activity and described as follows: experienced and inexperienced producers, producer groups (both profit and non-profit), cooperatives, the public regional agency of the Ministry of Agriculture and the three members of the core coordination group of the CSF that are relevant for the knowledge flows within this network, that is, the small fruit sectoral association, the R&D private and non-profit organization, and the R&D public institution. The grey circles are the network nodes, the interviewed actors, and the grey squares represent the actors they referred to be linked with. The grey lines represent the ties with the direction (arrows) that indicates to whom the actors direct their main interactions to.

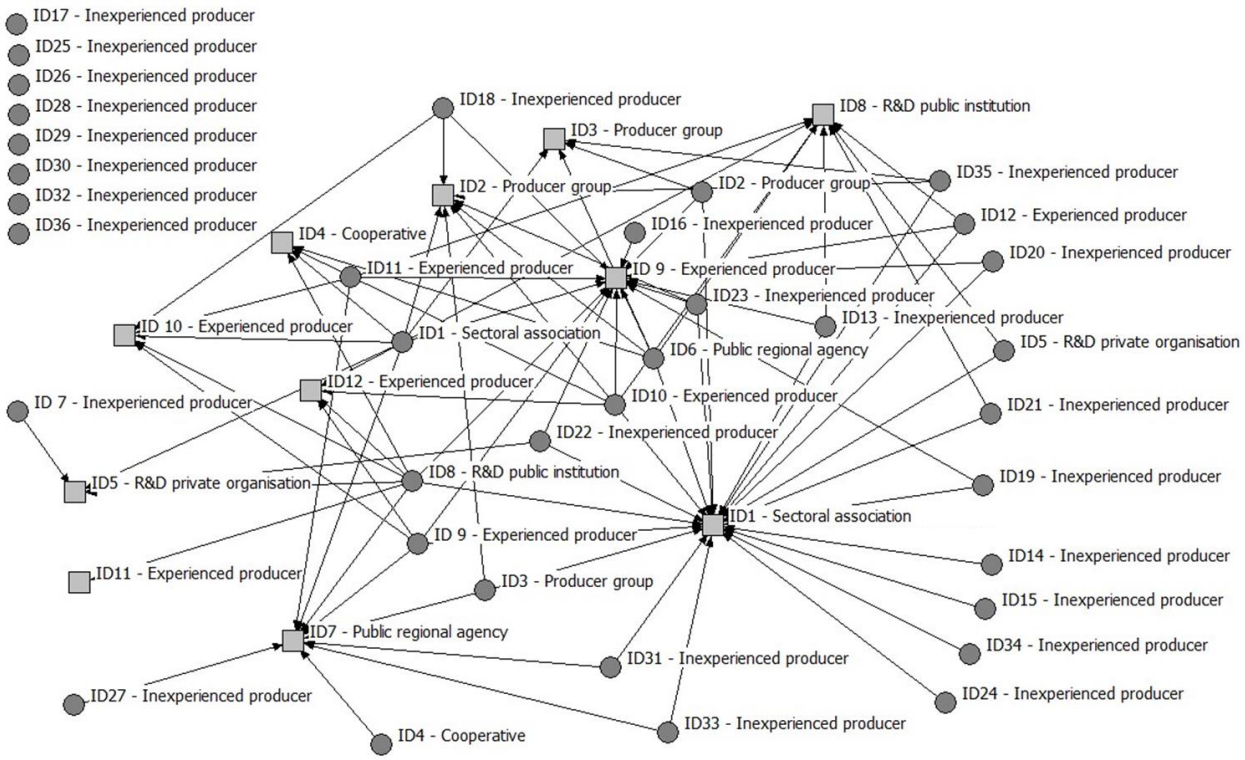

Figure 2: Interactions among the SFC network interviewed actors
Source: Madureira et al., 2014

The analysis of the sociogram depicted by Figure 2 illustrates four important features defining the configuration of the CSF network. Firstly, the dichotomous relationship between experienced and inexperienced producers, in which the later are clearly the demanders for knowledge, expertise and information, and the former play the role of active supply-side exchangers. Secondly, the polarization of the network around two central actors, the sectoral association (ID1) coordinating the CSF located in the Central-northern sub-region and the ID9 a medium independent producer located in the Southern sub-region, reflecting the geographical fragmentation of the network. Thirdly, the importance of the sectoral association (ID1), producer groups (e.g. ID2, ID3 and ID4) and the regional public advisory agency (ID7), all located in the Central-northern sub-region as facilitators, intermediating the interaction between inexperienced producers and the researchers and the experienced producers, and as well overcoming the geographical fragmentation. Fourth, although the CSF shows to be an inclusive network by bringing on board the small inexperienced and mostly new-established producers, the sociogram suggests there are probably a relevant number of isolated inexperienced producers (IDs 17, 25, 26, 28, 29, 30, 32 and 36). These producers isolation is probably due to lack of time (in view of their status as part-time farmers) and/or their passive attitude towards seeking knowledge and expertise.

The spatial fragmentation of the network is illustrated by the Figure 3. Another challenge faced by the network, in addition to the geographical distance between suppliers and demanders of knowledge, is that there is a cognitive distance between experienced and inexperienced producers: the former have knowledge needs on a superior stage in comparison with the latter. Less or inexperienced producers are mostly small-scale farmers, looking for basic knowledge and expertise related to topics such as, orchard planting, berry

farming practices and cultivation and harvesting techniques. Their main motivation is to be successful in the planting and maintenance of the orchards, ensuring the quality standards required by the buyers or FBO assemblers they are linked to.

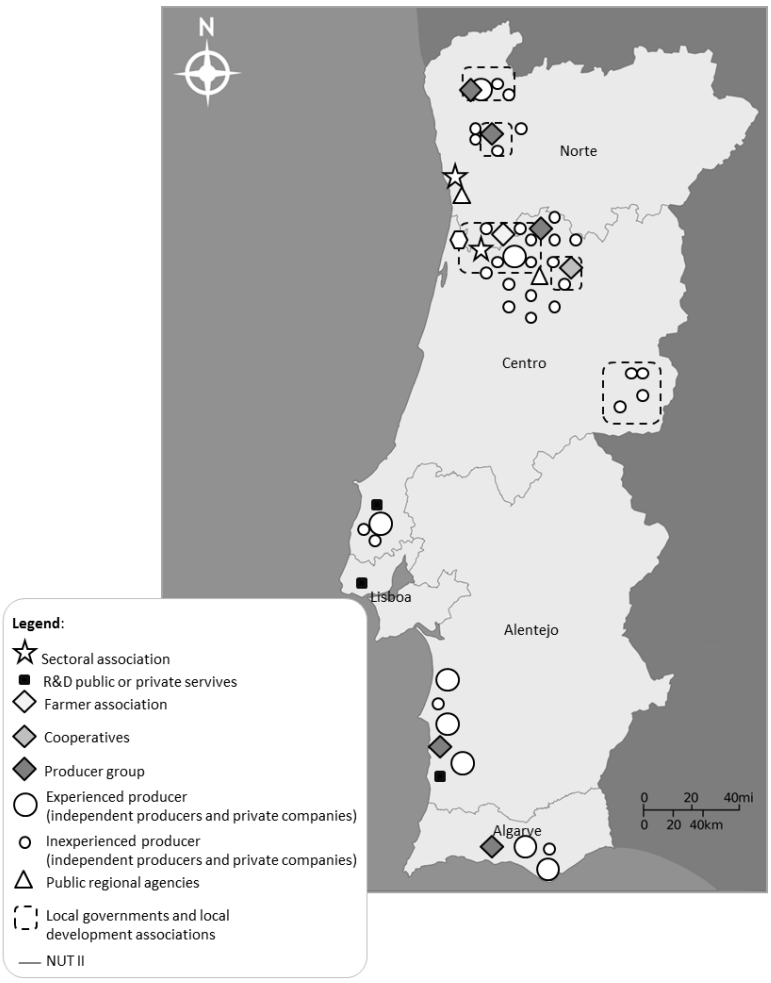

Figure 3: Spatial configuration of the SFC network's actors
Source: Madureira et al., 2014

Geographical distances and asymmetries in the knowledge needs and demands of the two groups of producers create imbalances that threaten its cohesion and sustainability. The triangular configuration of the coordinating structure of the network, including the sectoral association, two R&D institutions, and a partner association focused on the international promotion of the sector, appear to have been a wise governance model by being able to tackle the tensions caused by the imbalances just mentioned. Pre-existing relationships and ties between producers, advisors and researchers established during the pioneering period, when the berries were introduced in Portugal, in the nineties, created a number of strong informal, personal and interrelated networks, which appear to be the critical cement for the network governance cohesion. The importance of 'persons' rather than 'roles' is acknowledged as key aspect for the success of communication within the farmers networks (Wood et al., 2014).

The network facilitators have a significant role in mobilising experienced producers, regarding whom inter-personal liaisons appear to be essential to ensure their participation. In fact, producers are motivated to participate in the network by their concern with safeguarding the (good) reputation Portuguese berries enjoy

in the export market destinations. The inexperienced farmers are mobilised to participate by the intermediate facilitators, whose job is made easier by the former's acute needs for knowledge and skills to plant, cultivate and harvest the berries.

The learning activities promoted by the CSF mainly directed to the inexperienced and new-established producers include thematic workshops, open days, fairs and technical visits to 'best orchards', involving experienced pioneer producers as trainees tend to be very much valued by the former group of producers. This confirms that learning from/with the 'peers' whom communicate knowledge and information in a common ground, built on empirical experience, facilitates the overcoming of the cognitive distances (Nooteboom, 2000), and enhances innovative behaviour by mimicking the innovation-led producers from the Southern sub-region.

Interaction among small-scale producers, enhanced by the CSF activities, creates huge networking opportunities, also involving other actors (e.g. advisors or researchers) that often lead to informal collaborative innovation processes driven by the goal of solving practical problems. Collective learning processes among small-scale producers enhanced by the network are very important for the creation (accumulation and storing) of knowledge about local response regarding varieties of berries and farming practices (e.g. irrigation, plant protection). Available scientific and synthetic knowledge reports to very distant contexts, such as central-northern Europe or US and Canada. On the other hand, networking enhances inter-personal relationships and social learning processes that are often the result of informal sub-networks led by the small-scale producers. These informal sub-networks offer an effective platform for the co-creation, conversion and sharing of knowledge and information oriented towards problem-solving. In addition, they provide actual opportunities for resource sharing, and consequently cost reduction, especially as product transportation and other logistic operations are concerned. Simultaneously, they are a way of creating agglomeration economies through informal cooperation and product assembling (i.e., examples of marketing and value chain innovation). The case study illustrates also how problem-solving approach enhances the farmers networking and innovative behaviour with broad scope, comprising the marketing and organisational innovation. Hence it offers some insights on the research gap highlighted by Viaggi and Cuming (2012), that there is lack of evidence on the connection between the commercialisation networks (very relevant in sectors such as the fruit production) and innovation, by showing that marketing and value chain innovation can come on the other way round, be induced by knowledge and learning networking.

The CSF illustrates how social interaction becomes a powerful tool capable of enhancing systemic innovation (Knickel et al., 2009), that is mostly incremental in its nature and resorting to processes of imitation and informal collective learning experiences to solve practical problems, within which farmers act as knowledge co-creators and exchangers. Nonetheless, different innovation patterns can be identified, namely when comparing experienced innovative producers with others that are small-scale and inexperienced. To a large extent, the former rely on incremental innovation processes, products and marketing. In their innovation processes, they combine scientific, synthetic and tacit knowledge (cf. Asheim and Coenen, 2006), aiming at continuously improving their production practices (e.g. irrigation and fertilizer dosing and timing) and adjusting their products to market demand. In the case of mature producers, collaborative innovation processes take place in their own networks, involving other experienced producers (national and abroad), buyers and researchers who are largely outside the CSF. However, their innovation outcomes are used intra-network by some of the small-scale and inexperienced producers through imitation/adaption of innovation processes, facilitated by the CSF, for instances by the technical visits promoted by the network.

4.2 Common goals, tensions and dynamic of the network

In spite of the divergence in the participant producer expectations towards the CSF there is compatibility of objectives in the network. There is clearly a dichotomy in the participants' expectations: (1) on one side, experienced pioneer producers expect their participation will help safeguard Portuguese berries' brand reputation; (2) and, on the other side, inexperienced farmers hope to get knowledge, expertise and information that will help them meet producers' and buyers' quality challenges. Hence, despite different expectations for joining the network, the underlying goals of these two types of producers are actually convergent. In addition, individual goals and the collective objective of the network of guaranteeing the competiveness and sustainability of the berry sector are compatible. Therefore, while there are different expectations and goals among individual actors, these appear to concur to the network overall goal, thus giving it social cohesion. Though, there is a significant number of small-scale producers (as suggested by Figure 2) who chose not to participate in the network and who, on account of their lack of knowledge and experience and the fact that they work alone, may endanger the collective goal, particularly as regards the sector's sustainability, for they may adopt less adequate varieties and/or wrong farming or selling practices.

On the other hand, some experienced producers joined the network with feelings of distrust and keeping themselves on the sidelines. While the attitudes and behaviour of the latter do not compromise the network overall goal, their full participation, however, could boost its outcomes, namely as far as filling in learning needs of inexperienced farmers is concerned.

CSF presents experienced producers an insufficient offer and is still not able to attract a relevant number of small, inexperienced producers, especially those with less time and/or interest in knowledge demand processes. These tensions are a threat to the network cohesion and suggest that inclusiveness is still a challenge not completely achieved. However, the major threat relies on the transition from the cluster to the operational groups to be created in the frame of EIP-AGRI funded by the Portuguese RDP, similarly to what is happening on the other member states.

The EIP-AGRI is being implemented through a variety of public funded actions aimed at creating networks involving researchers, farmers, and other actors, focused on creating solutions to challenges related to agricultural sustainability and productivity adjusted to the diversity of farming systems and farm styles across Europe. The operational groups (OGs) are the operational framework at the member states level to join the research and innovation actors driven by the solving of concrete problems. The OGs are funded by the rural development programme (RDP) of each country which defines: 1) priorities respecting the nature of the problems (goals and contents of the OG); 2) the OG structure (e.g. number and type of actors to be involved); and, 3) the amounts and the typology of actions to be eligible for public funding.

The lessons learned with the study of the CSF appear to be quite valuable to guide the requirements related with the OG configuration, namely to avoid its geographical fragmentation. This is likely to happen due to the segmentation of the producers according to the two sub-regions: Central-northern and Southern. The network segregation by sub-regions and group of producers: experienced pioneers and inexperienced newly-established will cause the loss of its original inclusiveness feature. This feature is particularly important as shown given that it allows the linking of these two groups of heterogeneous producers by resorting on the knowledge and expertise of the experienced pioneers producers. These later shown to be able of converting analytical and synthetically knowledge (scientific and technical) into empirical tacit one, relying on their informal knowledge networks with Portuguese and international researchers and with other innovation-led producers (illustrate by the Figure 4). Their facilitation role is obvious. They bridge the communication between research and inexperienced producers looking for local-specific empirical knowledge. They are

actually the knowledge and innovation brokers. The 'formal' facilitators in the network are equally important, given they bring on board the experienced and pioneer producers. Meanwhile, some of the newly-established producers can take over that role, but time is needed for that, so the current configuration of the cluster is critical to boost the sector in the Central-northern sub-region.

Figure 4 is a sociogram representing the CSF network drawn by aggregating the actors according to their characteristics, which allows for visualising network border and the extra-cluster actors and interactions with the intra-cluster ones.

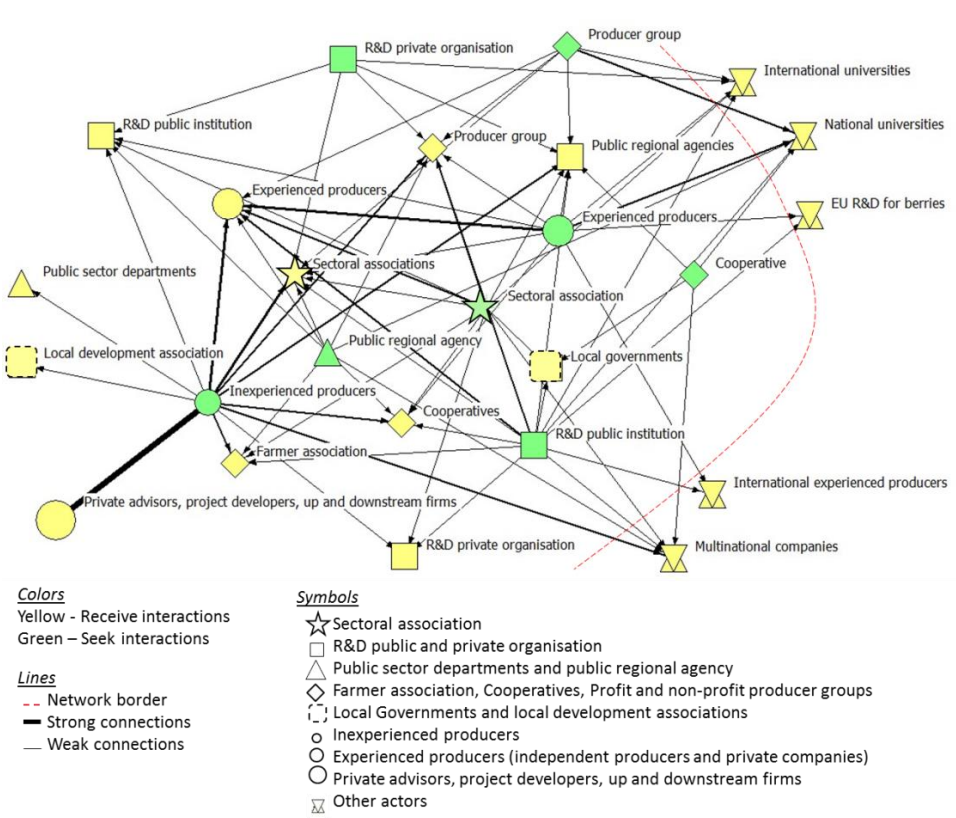

Figure 4: SFC network interactions according to the categories of actors
Source: Madureira et al., 2014

Figure 4 makes clear the importance of facilitators, both the ones that enable the communication bridge, the experienced producers and some advisors and more empirical researchers, and the ones that bring people together, build on their networking ability. Yet, to sustain this inclusive network models, which relies at large extent to the 'good will' of many actors, namely the experienced pioneer producers, investment is needed on the knowledge and innovation infrastructure enabling it to deliver the converted local-specific knowledge also needed by the latter group of producers.

5. Concluding remarks

The study of the Portuguese CSF offers interesting insights on how to design and develop inclusive knowledge and innovation agricultural networks. It contributes to research gaps respecting the configuration and the facilitation role on this type of networks to enhance the farmer's innovative behaviour. The lessons

learned are also relevant at the policy recommendations level, in particular respecting the operationalisation of the EIP-AGRI regional and local actions to be funded by the national RDP in the cases, such as the Portuguese, where the knowledge and advisory infrastructure is poor and fragmented (Knierim et al, 2015; Madureira et al., 2014) and where there might emerge the temptation to use temporary funding of networks to fill structural holes. It appears to be also useful in contexts where the farmers knowledge demand is high, for instance due to the presence of a substantial number of new-entrants in the sector and/or the investment in novel sectors, a situation that will tend to happen across Europe due to the dynamic in the consumers preferences, markets and the climate change.

The lessons learned can be summarised into the following:

- The CSF illustrates that the facilitator function is important and that it might assume different configurations: a) the bridging communication facilitators, brokering analytical and synthetically knowledge delivered by researchers; and, b) the facilitators that enable the bridge between different actors.
- Pioneers, best farmers or innovation-led farmers appear to be good bridging communication facilitators, in particular when networks are uneven respecting the knowledge needs and demands, such as the case of networks addressing the needs and demands of newly-established, novel sectors, small-scale and other farmer's populations or groups with limitations to access and to mobilise directly the scientific and technical knowledge.
- The inclusiveness can be a critical feature of knowledge and innovation networks focused on productivity and sustainability gains, such as the case of the OG designed under the EIP-AGRI framework, because when there is a segregation between farmers with more access to scientific and technical knowledge and the ones that have less ability to do that, the goals of EIP-AGRI will be attained only in a limited level.
- Inclusiveness can be achieved by knowledge and innovation networks in spite of geographical and cognitive distances, when farmers share common goals, such as the competitiveness of the sector, showing that national clusters might make sense and be helpful to enhance sectoral competitiveness built on farmer's innovation, which is boosted by networking based on multi-actors networks.
- Imbalances and tensions within knowledge and innovation networks caused by geographical and cognitive distances between key actors might be surmounted with wise governance structure, namely through the inclusion of best/pioneer farmers and ensuring the representativeness of the different types of actors: sectoral associations, advisory services and researchers.

The insights provided by the CSF analysis emphasises that agglomeration economies based networks, which are very important in some agricultural sectors (e.g. fruit, wine) and in countries or regions where small-scale farm is significant, can in fact be the grounds for knowledge and innovation networks in the sense wanted by the EIP-AGRI, since inclusiveness and facilitation functions are accounted for properly.

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References

Asheim, B. (1999). Interactive learning and localised knowledge in globalising learning economies. Geo Journal, 49, 345-352.

Asheim, B. and Coenen, L. (2006). Contextualising Regional Innovation Systems in a Globalising Learning Economy: On Knowledge Bases and Institutional Frameworks. The Journal of Technology Transfer, 31, 163-173.

Audretsch, D. (1998). Agglomeration and the Location of Innovative Activity. Oxford Review of Economic Policy, 14, 18-29.

Commission of the European Communities (CEC) (2013). State of the Innovation Union 2012 - Accelerating change. Brussels: Commission of the European Communities, COM (2013), 149 final.

Conroy, C. (2008). The nature of agricultural innovation. In Snapp, S. and Pound, B. (Eds.), Agricultural Systems: Agroecology and Rural Innovation for Development. San Diego, California, Academic Press.

Cooke, P., Uranga, M., and Etxebarria, G. (1997). Regional Innovation Systems: Institutional and Organisational Dimension. Research Policy, 26, 475-491.

Eastwood, C. R., Chapman, D. F., Paine, M. S. (2012). Networks of practice for coconstruction of agricultural decision support systems: Case studies of precision dairy farms in Australia. Agricultural Systems, 108, 10–18.

EU SCAR (2013). Agricultural knowledge and innovation systems towards 2020 – an orientation paper on linking innovation and research. Brussels.

Giuliani, E. and Bell, M. (2005). The micro-determinants of meso-level learning and innovation: evidence from a Chilean wine cluster. Research Policy, 34, 47-68.

Hall, A. (2009). Challenges to strengthening agricultural innovation systems: Where do we go from here? In I. Scoones and J. Thompson (Eds.), Farmer first revisited: Innovation for agricultural research and development. Rugby: Practical Action Publishing.

Hanneman, R. A. and Riddle, M. (2005). Introduction to social network methods. Riverside, CA: University of California, Riverside (published in digital form at http://faculty.ucr.edu/~hanneman/)

Klerkx, L., Aarts, N., Leeuwis, C. (2010). Adaptive management in agricultural innovation systems: The interactions between innovation networks and their environment. Agricultural Systems, 103, 390–400.

Klerkx, L., Leeuwis, C. (2008). Matching demand and supply in the agricultural knowledge infrastructure: Experiences with innovation intermediaries. Food Policy, 33, 260–276.

Knickel, K., Brunori, G., Rand, S., and Proost, J. (2009). Towards a better conceptual framework for innovation processes in agriculture and rural development: From linear models to systemic approaches. The Journal of Agricultural Education and Extension, 15, 131–146.

Knierim, A., Boenning, K., Caggiano, M., Cristóvão, A., Dirimanova, V., Koehnen, T., Labarthe, P., Prager, K. (2015). The AKIS concept and its relevance in selected EU member states. Outlook on Agriculture, 44, 29–36.

Lundvall, B. (1992). National Innovation Systems: A Comparative Analysis. Oxford: Oxford University Press.

Madureira, L., Ferreira, D., Pires, M. (2014). Designing, implementing and maintaining (rural) innovation networks to enhance farmers' ability to innovate in cooperation with other rural actors. The berry networks in Portugal. Report for AKIS on the ground: focusing knowledge flow systems (WP4) of the PRO AKIS project. December 2014. Online resource: www.proakis.eu/publicationsandevents/pubs

Marshall, A. (1920). Principles of Economics, 8th ed., MacMillan, London.

Nieuwenhuis, L.F.M. (2002). Innovation and learning in agriculture. Journal of European Industrial Training, 26, 283–291.

Nooteboom, B. (2000). Institutions and forms of coordination in innovation systems. Organization Studies, 21, 915–939.

Oreszczyn, S., Lane, A., Carr, S. (2010). The role of networks of practice and webs of influencers on farmers' engagement with and learning about agricultural innovations. Journal of Rural Studies, 26, 404–417.

Pittaway, P., Robertson, M., Munir, K., Denyer, D., Neely, A. (2004). Networking and innovation: a systematic review of the evidence. International Journal of Management Reviews, 5/6, 137–168.

Porter, M. E. (2000). Location, competition, and economic development: Local clusters in a global economy. Economic Development Quarterly, 14, 15–34.

Ritter, T. and Gemünden, H.G. (2003). Network competence: its impact on innovation success and its antecedents. Journal of Business Research, 56, 745–755.

Viaggi, D., Cuming, D. (2012). Innovation in Multiple Networks and Networks of Networks: The Case of the Fruit Sector in Emilia-Romagna. International Journal of Food System Dynamics, 3, 258–263.

Wasserman, S. and Faust, K. (1994). Social Network Analysis. Cambridge: Cambridge University Press.

Wood, B. A., Blair, H. T., Gray, D. I., Kemp, P. D., Kenyon P. R., Morris, S. T., Sewell, A. M. (2014). Agricultural Science in the Wild: A Social Network Analysis of Farmer Knowledge. PLoS ONE 9(8): e105203. doi:10.1371/journal.pone.0105203.