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The Peripheral Systems of Eco-Innovation: Evidence from eco-innovative agro-food projects in a French Rural area

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Abstract:

A growing literature highlights the development of specific innovative patterns in peripheral areas and the need to better understand how and why firms can innovate despite the absence of agglomeration effects. These peripheral areas can, among other things, offer local resources (material and immaterial) for developing environmental innovations. Thus, the aim of this article is to gain a more in-depth understanding of innovation processes in peripheral areas by analyzing the dynamics of utilization of local (i.e. place-based) and extra-local resources for the building and development of eco-innovative projects. We adopt an evolutionary framework inspired by the literature on eco-innovation and geography of innovation, which articulates internal organizational factors and those external to eco-innovative organizations, including place-based factors. We use and enhance a mixed method borrowed from economic sociology that enables us to quantify the external resources utilized throughout the innovation process (nature, means of acquisition and location), through narrative analysis. We analyze five agro-food projects located in rural areas. Based on in-depth interviews, we identify 196 external resources that were utilized for developing these projects. We find that these projects are strongly embedded in their local environment and rely, to a large extent, on local resources and networks, which shows that, even in peripheral areas, the local context can be conducive to innovation. However, these eco-innovation processes are not confined to the local sphere; indeed, their stakeholders are able to tap into specific, more-distantly located resources and market opportunities, and do so increasingly as the projects develop. The results also point to the different roles of institutional and market actors in the acquisition of resources, according to their nature and location, and highlight the importance of institutional actors at the regional level.

Keywords: eco-innovation; rural areas; agro-food chains; personal networks; institutional actors; mixed method.

JEL: O31, R11, O13, Q01

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1. Introduction

Following the seminal works of Marshall (1919) and Jacobs (1969), the economic literature has largely demonstrated the effects of geographical proximity and agglomeration economies on innovation. By placing emphasis on the concepts of agglomeration and urban externalities, this literature has implicitly considered that low-density peripheral areas are characterized by low innovation levels. However, an increasing number of studies highlight the development of specific innovative patterns in peripheral areas (Eder, 2018; Shearmur and Doloreux, 2016; Galliano et al., 2015) and emphasize the importance of identifying these patterns for building smart rural development policies (Camagni and Capello, 2013; Naldi et al., 2015). As noted by Eder (2018), further analysis at individual or micro level is needed to better understand how and why firms located in peripheral areas can be innovative. These low-density areas can, among other things, offer local resources and facilities that can be used to develop environmental innovations, in other words eco-innovations. Innovative projects that benefit the environment are therefore particularly relevant research topics, as they reveal various forms of rural dynamics, and show how resources are acquired and utilized, and how those dynamics draw on place-based factors (Esparcia 2014).

In this context, we aim to gain a more in-depth understanding of eco-innovation processes in peripheral areas. More specifically, our main question is: how do the actors located in peripheral areas procure and utilize place-based resources and networks to develop eco-innovations?

Our study's contribution is threefold. First, we propose an analytical evolutionary framework inspired by the eco-innovation model developed by Rennings (2000), and which articulates the respective roles of internal organizational factors and of those external — including place-based factors — to eco-innovative organizations (Galliano and Nadel, 2015). The analysis of innovation processes will provide insight into the respective roles of internal and external factors and the dynamic through which innovation processes become embedded in peripheral territories. Secondly, we use this framework to study agro-ecological projects, i.e. the development of climate-smart and sustainable agro-food chains. This type of projects has seldom been studied in geography of innovation, even though they are important in the transition process towards sustainable food systems, and although peripheral areas have natural and environmental resources that can be used for the development of such projects. Thirdly, from a methodological perspective, the empirical study is based on narratives describing the trajectories of eco-innovative projects implemented in a rural area of the South West region of France. For the purpose of this study, we apply an original mixed methodology borrowed from sociology: « Quantified Narrations – QN » (Grossetti et al., 2011). This type of quantified analysis of narratives is particularly useful for performing an in-depth analysis of the innovation trajectories, and more specifically of the dynamics through which they become locally embedded.

Empirically, we selected five eco-innovative agro-food projects developed in rural areas of the South-West of France. For each project, the methodology has enabled us to identify and code the external resources (nature, means of acquisition, provider and location) used at each stage of the innovation process. According to our coding, 196 external resources were used. They are the basis of our statistical analyses. The results show that these projects are strongly embedded in their local environment, both geographically and relationally. However, they are not confined to their local area, as their stakeholders have also found specific resources and market opportunities outside their local environment. The analysis also highlights the changing role of institutional and market actors throughout the life cycle of eco-innovative projects.

The article is organized into four sections. The first introduces our theoretical framework, which is based on a spatial approach to the literature on eco-innovation. The second describes the case studies and the QN methodology. We then present and discuss the results we have obtained

concerning the structure and dynamic of the eco-innovative projects developed in a peripheral area through qualitative and statistical analyses of the resources and means of acquisition used at each stage of the projects. The last section provides conclusions and presents the policy implications of the findings.

2. Eco-innovation in peripheral areas: the determining factors

Identifying the specific patterns of innovation in peripheral areas involves challenging the innovation models based on agglomeration economies and core - periphery models. In recent developments, the geography of innovation systems places increasing emphasis on the diversity of innovation patterns among regions (Camagni and Capello, 2013; McCann and Ortega-Argilès, 2015) and on the necessity of identifying innovation patterns specific to rural or peripheral areas (Naldi et al., 2015; Shearmur, 2015; Eder, 2018). Because of their low density, rural areas do not have the same potential for agglomeration economies, especially diversification and urbanization. In other words, the economic actors do not have the same possibility as urban actors to access knowledge and markets and to benefit from communication infrastructures. However, they do have place-based resources such as natural resources and facilities that help to foster entrepreneurial dynamics (Naldi et al. 2015). Furthermore, the absence of agglomeration is far from being synonymous with a lack of networks and social capital (Greenberg et al., 2018; McKitterick et al., 2016; Tregear and Cooper, 2016).

In this context, the analysis of the factors and mechanisms of emergence and development of eco-innovative projects in rural areas requires using different analytical frameworks. First of all, it necessitates reconciling environmental economics, which tends to focus on analyzing the effects of regulation on innovation (Porter and Van der Linde, 1995), and the economics of innovation and technological change (Malerba, 2005), in order to better emphasize the interaction between the internal and external environments of innovative organizations (Rennings, 2000; Horbach et al., 2012; Galliano and Nadel, 2015). Secondly, it requires that more attention be paid to the territorial dynamics of eco-innovation, which have received little attention in the literature. Yet, they have a structuring function, particularly because of their specificity in terms of production of environmental externalities and because these processes are often dependent on local resources (Porter and Van Der Linde, 1995; Del Rio Gonzalez, 2009).

The literature on smart specialization and development provides significant insights into the relationship between regional contexts and innovation (McCann and Ortega-Argilès, 2015; Camagni and Capello, 2013, Cooke, 2011). It highlights the key role of networks in the innovative dynamics of peripheral areas (Esparcia, 2014; Grillitsch and Nilsson, 2015; McKitterick et al., 2016; Bonnet-Gravois and Shearmur, 2014; Virkkala, 2007). In this context, this section aims to present the framework for analyzing the respective influence of internal organizational factors and of place-based factors (1.1) and the role of local and non-local networks in the dynamic of eco-innovative projects in rural territories (1.2).

2.1. Internal and external factors

2.1.1. Organizational factors: internal resources and absorptive capacity

As the literature shows, the internal characteristics of an organization, such as its size, the organization of its production or its various resources, whether financial, technological, or managerial, are fundamental for its ability to innovate. This organizational design plays a critical role in organizations' absorptive capacity (Cohen and Levinthal, 1990) and has a significant impact on how

the endogenous economic potential of rural territories is utilized (Baumgartner et al., 2013). As highlighted by Grillitsch and Nilsson (2015, P305), firms “with a strong absorptive capacity are more able to form collaborations and thereby compensate for a lack of knowledge spillovers”. The concept of absorptive capacity refers to the ability of an organization to recognize the potential value of new externally-generated knowledge, to assimilate it and use it for its own activity (Cohen and Levinthal 1990; Escribano et al., 2009). This absorptive capacity is often seen as a function of the organization’s knowledge base and as being strongly correlated to its R&D investment. However, this approach is particularly unsuited to the analysis of the forms and determinants of innovation in rural areas where many firms innovate and develop their absorptive capacity with little or no R&D (Virkkala, 2007; Naldi et al., 2015). Studies on the subject place special emphasis on the role of entrepreneurship and on the fact that innovative firms compensate for their location disadvantages through a more efficient internal organization (McAdam et al., 2004; Glückler, 2007).

As various scholars in this field (Rennings, 2000; Ghisetti et al., 2015; Nadel et al., 2016) have highlighted, the importance of organizational design applies to all types of innovations, including eco-innovations. A firm’s attitude towards eco-innovation is strongly dependent on the other types of innovations it has developed (products, processes, organizational, etc.). These other types of innovation serve as foundations for eco-innovation, and this complementarity (as understood by Milgrom and Roberts, 1990) between eco-innovations and other types of innovations is emphasized by various studies in different economic sectors. In other words, eco-innovation may be technological and rely on product or process innovations, but, it is also often organizational and linked to innovations and changes in the coordination between actors within the organization and between the organization and its partners (Nadel et al., 2016; Laperche and Lefebvre, 2012; Horbach, 2008). This non-technological dimension - which is typical of a “Doing-Using-Interacting” model (Jensen et al., 2007) - is particularly important in peripheral areas, in which this type of innovation is more common (Naldi et al, 2015). As various authors have noted, the nature of traditional innovation indicators (R&D expenditure or patent application) introduce an urban bias (Shearmur 2017, Westlund et al, 2014) and need to be complemented with a broader approach to innovation, that is to say an approach that encompasses more incremental, non-technological or slow innovations (Shearmur, 2015).

The literature also highlights the importance of small and medium-sized enterprises in peripheral areas and of the processes of creation of new activities. These creative processes raise the question of organizational management around the Schumpeterian entrepreneur (Schumpeter, 1934). The type of coordination used in the organization has a strong influence on the adoption and success of innovations and eco-innovations. Different authors emphasize the importance of specific forms of management and governance in the eco-innovation process (Wagner and Llerena, 2011). They show that the manager’s behavior plays a key role in the development of environmental innovations and that the creation of new ideas, strategies and projects requires a trade-off between a hierarchical structure and a team-based structure (Avadikyan et al., 2001). Authors also highlight the importance of governance in multi-stakeholder projects. The literature on eco-innovation shows that the type of governance adopted is often a key factor in the success of partnerships, for example in the framework of industrial ecology projects in which heterogeneous stakeholders collectively build eco-innovations (Baas and Boons, 2004).

2.1.2. Place-based and extra-local factors of eco-innovation in peripheral contexts

Camagni and Capello (2013) point to the existence of different regional patterns of innovation, which must be revealed to design smart innovation policies. They define a territorial pattern of innovation as “a combination of context conditions and specific modes of performing the different phases of the

innovation process” (*op. cit.*, p 131). Territorial innovation models highlight a complex interaction between local context and the various phases of the innovation process, each phase requiring specific local (or non-local) elements for its development. This suggests that, beyond organizational factors, external factors play a central role in innovation processes. This external environment encompasses different spatial, sectoral, and regulatory dimensions.

Regarding knowledge creation, urban agglomerations and cities are now recognized as the natural location for R&D and skilled labor. But while there is a consensus in the literature about the role of agglomeration economies in the diffusion of innovation and knowledge (Audrescht and Feldman, 2004), there is now a debate over what types of externalities foster innovation (Galliano et al., 2015). Marshall’s specialization theory is based on the idea that knowledge externalities only occur between firms of the same industry and therefore can only emerge from the geographical concentration of firms that belong to similar industries. Unlike Marshall, Jacobs emphasizes that it is the local variety of industries that generates knowledge spillovers and ultimately innovation activity. However, an organization’s location in a low-density area has an impact on its access to competences and resources and on the intensity of the industrial and tertiary base of the area. Thus, low density has consequences on the industrial diversity and on the intensity of knowledge spillovers. A low-density configuration can increase the positive effects of “related variety” (Frenken et al., 2007) in these territories. Related variety is defined as the presence in the same region of a variety of activities that are technologically and cognitively related (Frenken et al., 2007). The hypothesis is that, in peripheral areas such as rural areas, related variety tends to compensate for the lower agglomeration of activities (Camagni and Capello, 2013; McCann and Ortega-Argilès, 2015; Naldi et al., 2015). Its main positive effect is to facilitate the exchange of knowledge on the territory in that the use of similar technologies creates a stronger cognitive proximity between firms (Boschma and Frenken, 2011). The positive effects of related variety are also linked to the complementarity of the knowledge exchanged, particularly between pre-existing and new activities in the territory (Munro and Bathelt, 2014; Iammarino, 2011). Thus, it is not only the agglomeration of activities that explains innovation but also the nature of the activities.

Thus, the local sectoral context plays a key role in the sectoral system of innovation (Malerba, 2005) and eco-innovation (Galliano and Nadel, 2015) and an even more central role in low-density areas. In line with this, the literature on regional development – including that on smart specialization and development (Foray et al., 2012) — emphasizes the importance of place-specific resources as key factors of innovation, particularly in rural areas (Naldi et al., 2015). They may be facilities, materials, or inputs that constitute a comparative advantage for a territory (Besser and Miller, 2013). However, this notion also refers to more immaterial characteristics of the region, such as those related to its history (Cainelli and Iacobucci, 2016). Among them are the local knowledge and skills that are not easily transferable (Asheim and Isaksen, 2002), proximity or even “milieu” relationships (Capello, 2014). In sum, the hypothesis holds that related variety and place-based resources are two key factors of eco-innovation in rural areas.

Following the works of Porter and Van der Linde (1995), studies about eco-innovation have shown that regulation and therefore public policies play a central role in the emergence and diffusion of this type of innovation (Rennings, 2000; Horbach et al., 2012). Their importance is related to the non-tradable nature of the environmental externalities generated by eco-innovations, which prevents the firms at the origin of these innovations from taking advantage of all their positive effects. This double externality is what makes public incentives and regulation crucial for eco-innovation. These incentives help firms to overcome the technical constraints related to the implementation of eco-innovation, and financial obstacles (investments, difficulties in forecasting the possible impacts for the firm, etc.). However, the types of regulation implemented and their impact vary. Some authors

show, for example, that direct public subsidies have little effect on SMEs (Triguero et al., 2013; Gallaud et al., 2012). Galliano and Nadel (2015) show that, in the case of manufacturing firms, indirect public incentives (legislation, environmental taxation) and respect of the industry's good practices are central factors in eco-innovation, whereas a strict compliance with regulation has a weaker effect. Agri-food projects, especially those directly involving farmers, are also influenced by public incentives, in particular the measures implemented as part of the common agricultural policy and the direct and indirect financial aids provided by its two pillars, some of which are intended to encourage farmers to adopt greener agricultural practices. These different studies tend to show that the support provided by public actors plays an essential role during the different stages of development of innovative projects, especially in rural areas (Esparcia, 2014). However, this support can consist of different forms of regulation of territorial eco-innovative projects, with situations in which private actors carry the projects (self-regulation) and others in which private actors and public actors jointly develop measures for the promotion of eco-innovation (Vermeulen and kok, 2012).

Ultimately, the implementation and development of eco-innovative projects in rural areas are strongly dependent on material and immaterial place-based factors. Given the importance of organizational factors, analyzing the interactions between the organization and the spatial, sectoral and regulation dimensions of its environment, throughout the innovation development process, is essential to understanding the development of eco-innovative projects in rural areas.

2.2 The Interactions between the organization and its external environment: the eco-innovation's trajectories

Through the concept of regional patterns of innovation, Camagni and Capello (2013) emphasize the role of external factors in innovation, and how internal and external factors interact and evolve. This concept highlights the role of networks — particularly personal networks — whose importance is stressed by the literature on smart development (McCann and Ortega-Argilès, 2015). The analysis of innovation processes in low-density areas raises the question of how resources are accessed and of the role of networks in the creation and development of a project. The concept refers to the capacity of organizations in peripheral regions to access the external knowledge necessary for their own innovation strategies, and, more specifically, to engage in various networks (McCann and Ortega-Argilès, 2015; Dubois, 2016).

The network approach helps to analyze how the stakeholders in an innovation project cooperate to innovate and how they coordinate at the different stages of the eco-innovative project (Cainelli et al., 2015). Combined with a resource-based perspective (Cainelli et al., 2015), this approach helps to understand how and when organizations utilize local or non-local networks to access a set of external resources. The circulation of knowledge also raises the question of the combined role of local and non-local networks (Bathelt et al., 2004; van Egeraat and Kogler, 2013). Thus, the hypothesis is that local networks facilitate the circulation of tacit knowledge, which is difficult to codify and thus necessitates face-to-face interactions and, therefore, geographical proximity (Ernst and Kim, 2002; Torre and Rallet, 2005). Beyond the relation between social and geographical proximity, it is also important to consider the other forms of proximity (cognitive, institutional, organizational), which facilitate mutual understanding between actors throughout the project (Balland et al., 2015). Finally, the question is raised of firms' ability to source useful knowledge for innovation by using different sources at territorial level. Legendijk and Lorentzen (2007), among others, argue that global sources are the most important sources of innovation, while the local or regional level basically provides a labor market and entrepreneurship.

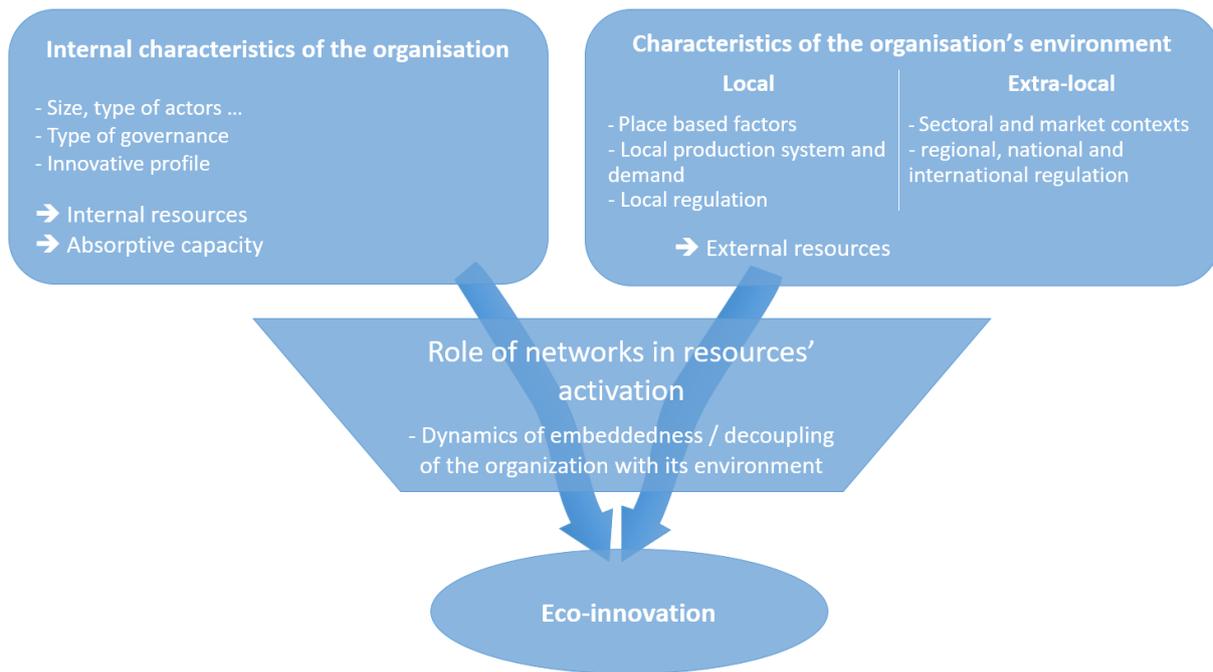
In peripheral areas, characterized by a low density of firms, activities and knowledge, the use of specialized networks can compensate for the lack of proximity and poor accessibility to services, information and knowledge (Naldi et al., 2015; Grillitsch and Nilsson, 2015). External knowledge is often obtained through networking and interacting with external partners (suppliers, customers, public actors, *etc.*) and is essential to providing the firm with the resources it needs to pursue its innovation process, which the firm itself cannot provide (Von Hippel, 1988; Davenport, 2005). R&D cooperation between firms and public and private researchers is critical to innovation (Leten et al. 2014; Maietta, 2015), as are sectoral and cross-sectoral relations with clients, suppliers and competitors (Klevoric et al., 1995). Regarding rural areas, literature also emphasizes the importance of personal networks and key actors in the governance of innovative projects (Esparcia, 2014). To access specific resources and knowledge, the ties that exist between a community and its former residents – especially highly skilled individuals – can serve as levers for development in peripheral areas (Virkkala, 2007; Mayer and Baumgartner, 2014).

A number of studies show that in addition to interpersonal networks, the contributions of institutional mechanisms are important (Guillaume and Doloreux, 2011). These studies stress the key role played by public actors during the different stages of innovative and eco-innovative projects, especially in rural areas (Esparcia, 2014, McKitterick et al., 2016). Eder (2018) highlights the importance of public policy subsidies, support institutions, and innovative policies in supporting rural organizations' innovative behavior. Among the various geographic scales of implementation of public policies, the regional scale is often considered the most suitable for promoting innovation in peripheral areas (Camagni and Capello, 2013).

Concerning the trajectory of innovation, the main hypothesis is that resources can be acquired differently depending on the stage in the innovation process (Ferru et al., 2015; Grossetti et al., 2011). This implies considering the successive choices made by the actors, the learning process and the progressive construction of the specific material or immaterial assets used in the eco-innovation process (Laperche and Lefebvre, 2012). The genesis phase of a project, particularly, is an important phase in which the project's governance mechanisms are established and during which trust relations begin to develop (Wallin and von Krogh, 2010). Once the project has been created, the ability of the leaders to procure and utilize external resources and to structure the project internally is key in building trust between the actors (Lee et al., 2010). Thus, the analysis of the networks and interactions between public and private actors throughout the eco-innovative process is often essential to understanding their development in peripheral areas.

In conclusion, eco-innovation in rural areas can be considered as the product of the interactions between the organization and its environment. The organization and environment interact through networks (local and extra-local) that are essential to the acquisition of resources all along the project. Figure 1 below sums up this framework, which will serve as the blueprint for the empirical study. The internal factors refer to the characteristics of the innovative organizations that enable them to develop both their internal resources and their capacity to absorb external resources. The environment of the organization provides external resources. We distinguish local from extra-local environment, the local environment providing place-based resources. The external resources can be acquired through mediation mechanisms or personal networks; the distribution ratio of the two varies according to which phase of the innovation process the project is in. This variation in the distribution reflects the process' embeddedness in / decoupling from the local environment. Empirically, this implies analyzing "peripheral innovation patterns", or in other words, how eco-innovations emerge and develop in peripheral environments, that is to say, in a specific territorial, sectoral, and institutional system.

Figure 1: Framework of analysis of eco-innovative projects



3. Methodology and data: a quantified approach based on monographs of eco-innovative projects

The analysis is based on case studies of eco-innovative projects (Yin, 2009). For each project, we analyze the factors that explain their emergence and dynamic, the resources utilized at each stage of the project and the networks' evolution during the process. For this purpose, we use, and improve, a "mixed" method, the so-called « Quantified Narrations » (QN), which is particularly well suited to the study of innovative processes and their dynamic (3.1). We then present the criteria of selection and main characteristics of the case studies (3.2).

3.1. The quantified narrations

In order to collect and analyze the information from the case studies, we have used the QN method, which was developed in the field of economic sociology, from studies on social networks and the embeddedness of economic phenomena (White, 1992; Granovetter, 1985), and designed by Grossetti et al. (2011). This method has enabled us to examine the discourses of key actors of an innovation process on the resources they have utilized, and then to perform a quantitative analysis based on the resource coding derived from the narrative data (Small, 2011). The reconstruction, by the interviewees, of the history of the process is intended to enable the investigator to identify the external resources used and how they were acquired. Each acquisition of new resources is considered an "access sequence" whose characteristics are coded. The main value of this coding and of the quantification lies in facilitating the objectivization of the resource acquisition processes. This mixed method was applied, among other things, to the analysis of the creation of start-ups (Grossetti et al., 2011) and of the dynamics of collaborative projects, by integrating the viewpoint of the different stakeholders in the project (Ferru et al., 2015).

This method is particularly well suited to studying the dynamics of embeddedness/decoupling of processes (Granovetter, 1985). Its main purpose is to characterize the means of access to the resource by distinguishing two main modalities: access gained through personal connections or through a mediation mechanism. Distinguishing these two modalities helps to avoid criticism

concerning, on the one hand, the tendency to "over-socialize" economic phenomena by focusing solely on what comes from networks, and on the other hand, of the opposite tendency to under-socialize these phenomena (Gulati, 1999). It is also possible to code the characteristics of individuals and organizations involved in procuring the resource. The literature on innovation in peripheral areas highlights the role of institutions; for this reason, we have distinguished two categories of resource providers: "institutional actor" and "market actor". This distinction helps to better understand the respective roles of institutions (public or private) and companies in the dynamics of eco-innovative projects.

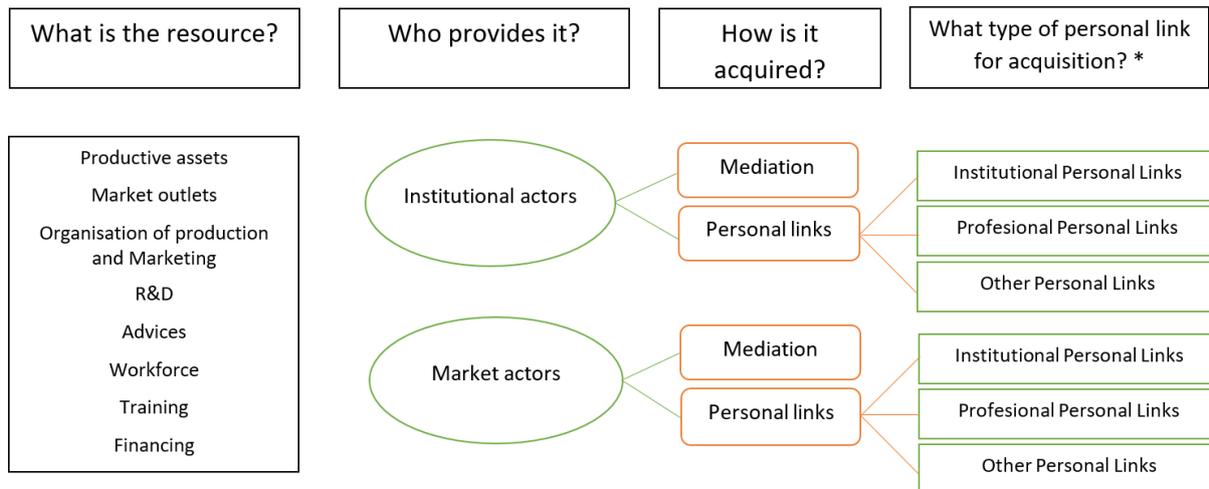
Figure 2 describes the framework used to characterize a sequence of access to a resource:

- The resources can be tangible and intangible, and eight types have been identified. "Productive assets" refer to the raw materials and the technologies. "Market outlets" refer to the potential markets (clients) whether they be industries / wholesalers (B2B) or retailers/consumers (B2C).
- The resource provider can be an institution or a market actor. Institutions refer here to public structures (administrations, educational and research institutions, development agencies, *etc.*) but also private organizations such as consular chambers, training institutions, associations, or professional federations. "Market actors" refer exclusively to enterprises or individual entrepreneurs (customers, suppliers, competitors, subsidiaries, *etc.*).
- The resource is accessed via personal networks or mediation. "Personal relation" indicates that the resource was acquired through someone the interviewee already knew. This person may be part of the organization that provided the resource but may also have acted as an intermediary between the interviewee and the resource provider. In the absence of a personal relation, the resource is obtained through "mediation": technical apparatus (internet, digital tool), other channels of information dissemination (press, catalogue, book, *etc.*) or of networking (trade fair, seminar, invitation to tender, *etc.*).
- A final type of information collected concerns the location of the resource. Four geographical scales are distinguished: *département* (Nuts 3), region (Nuts 2), France and abroad. The term "local" is reserved for resources acquired at Nuts 3 level.

Our definition of "local" is based on two interconnected dimensions. First, the projects we have studied are located in rural *départements* characterized by relative territorial homogeneity. These *départements* are classified as "predominantly rural, remote" in the Dijkstra-Poelman typology and "agrarian" in the EDORA structural typology; in other words, they have no significant urban centers. Secondly, the concept of "local" denotes the idea of geographical proximity; and the *département* scale seems to us compatible with geographical proximity to local resources. These two criteria therefore lead us to select the *département* level as an expression of the "local", as it seems to be the most suitable level for studying the construction of an eco-innovative project closely connected to a peripheral territory and based on interactions facilitated by geographical proximity.

In addition to the data on resources, we collected data about the governance of the eco-innovative projects - more specifically from project steering meetings (participants, frequency, issues discussed, and modes of decision-making). Data on the general characteristics of the project (size, type of products, actors involved, legal status of the organization that supports the project ...) were also collected to ensure that our collection of information was as comprehensive as possible.

Figure 2: Complete diagram of the collection of information concerning the resources



*The "what type of personal link for acquisition" item contributes to the enhancement of the method we have proposed for our case studies. This item enables us to distinguish three types of relations, among which "others" for friendship, family, or neighborhood connections. The results related to this item are not developed in the article but summarized in Appendix 1.

Each sequence of access to the resources is then positioned in one of the three phases in the trajectory of the studied project. The genesis phase consists of generating ideas regarding the project. The second phase of creation is the actual launch of the project. The third phase of stabilization starts when a significant event— reflecting the degree of maturity of the project— occurs (the beginning of a new “cycle”).

The methodology is therefore based on the collection of the data contained in the statements made during in-depth interviews by the main actors in the project, on a transcript of the interviews conducted by the researchers which is sent back to the interviewees for validation, and finally, on the coding carried out by the researchers based on the materials collected and validated. The results are then summarized in tables, which facilitates the comparison between projects, and, above all, allows for a transversal and aggregated analysis of the projects.

3.2. Characteristics of the five rural eco-innovative projects

We have used three main criteria to select our case studies. The first was location. The projects had to be located in the most rural and agrarian *départements* (Nuts 3 level) of the former Midi-Pyrénées region (Nuts 2 level). Secondly, the projects had to be related to agriculture and include an environmental dimension, *i.e.* they had to be eco-innovative (Horbach, 2008). The third criterion was the maturity of the initiatives. They had to have tangible outcomes (production, outlets...) to allow us to characterize their trajectory from genesis to development.

The projects were identified thanks to different sources of information: local and agricultural press, exploratory interviews with representatives of local authorities, *etc.* Combining this information helped us to identify the projects considered by local actors as interesting and representative of eco-innovative projects in agriculture and agro-food industry.

Two projects are located in the *département* of Aveyron (*Bread* and *Cheese*) and the three others are situated in the *département* of Gers. Some of these agri-food projects involve several actors but all of them are managed by a clearly identified organization (an association for *Bread* project, cooperatives for the four others). They all involve farmers and cooperatives but are different in size. The largest project, which involves the production and commercialization of organic cereals, comprises 300 farmers, whereas the smallest project (*Cheese*) involves 23 farmers producing conventional and

organic sheep milk for a cheese-making cooperative. Table 1 summarizes the main characteristics of the projects.

Table 1: Main characteristics of the projects

Project	Organizations that carries out the project	Production	Beginning	Environmental dimension
<i>Bread</i>	Association (20 farmers, 36 bakers, 2 millers, 1 cooperative)	Bread made with local wheat	1992	Sustainable and agro-ecological wheat production
<i>Cheese</i>	Cooperative (23 farmers)	Sheep cheese	1993	Conventional and organic cheese
<i>Cereals</i>	Cooperative (300 organic farmers)	Cereals	1999	Organic production
<i>Pulses</i>	Cooperative (180 organic farmers) and agri-food firm (subsidiary)	Pulses	2008	Organic production
<i>Sunflower</i>	Cooperative and agri-food firm (subsidiary)	Sunflower oil and sunflower cake	2011	Organic production

The environmental dimension of each project is different. Three projects concern the development of organic products (cereals, legumes, and sunflower oil). The sheep milk cheese cooperative uses organic as well as conventional production methods. Finally, the wheat used in the production of bread in the Aveyron bread production project is cultivated with sustainable farming techniques and the farmers are required to use at least part of their manure as fertilizer.

We conducted the first interviews with a project leader, involved in the genesis phase. Other interviewees were identified during the first or next interview, using the relational chains method. The number of interviews varies from two for *Cheese* to five for *Cereals*. Sixteen interviews — of an average length of one hour and twenty minutes — were conducted in 2015 and 2016. A transcription of each interview was sent to each interviewee for validation and additional questions were asked when necessary.

The information about the resources and their origin were then coded, using the QN method. The coding was performed separately by the three authors; the coding results were compared, and then harmonized. A chart for each project summarizes the information on each resource cited by the interviewees and coded by the researchers. The coded resources are then categorized according to the phase of the project during which they were acquired and utilized.

Table 2 shows the distribution of external resources used in the five projects.

Table 2: Distribution of resources for the five projects (in %)

Project \ Phase	Genesis	Creation	Development	Total (number)
<i>Bread</i>	42,6	31,9	25,5	100,0 (47)
<i>Cheese</i>	28,2	38,5	33,3	100,0 (39)
<i>Cereals</i>	25,0	34,4	40,6	100,0 (32)
<i>Pulses</i>	17,8	53,3	28,9	100,0 (45)
<i>Sunflower</i>	21,2	39,4	39,4	100,0 (33)
Total	27,6	39,8	32,6	100,0 (196)

In total, 196 different types of resources were used in the five projects. The low number for *Cereals* can be explained by the extensive use of internal resources by the cooperative running the project.

For *Bread*, the number can be explained by the fact that the project is relatively old and has experienced highs and lows. We note that the *Pulses* project has utilized an important number of resources, even though it is the most recently developed. The pace at which the activity (relatively enough for *Pulses* and rather slow for *Bread*) develops also seems to be an explanatory factor. Finally, we also observe a strong regularity in the number of resources utilized during the stabilization phase.

Table 3 presents the resource provider according to the type of resource

Table 3: Provider of the resources according to their nature

Resources \ Provider	Institutional actors	Market actors	Total (<i>number</i>)
Product. assets	6.0	94.0	100.0 (50)
Market outlets	3.6	96.4	100.0 (28)
Orga. /marketing	26.1	73.9	100.0 (23)
R&D	76.9	23.1	100.0 (26)
Advices	66.7	33.3	100.0 (9)
Workforce	13.0	87.0	100.0 (23)
Training	92.9	7.1	100.0 (14)
Financing	69.6	30.4	100.0 (23)
Total	34.7	65.3	100.0 (196)

Of the 196 resources, the two main external resources are productive assets and market outlets, which are mainly provided by market actors. Of the 50 productive assets, 24 are raw materials provided by farmers and 26 are technological resources, mainly equipment. Of the 28 market outlets, 19 are retailers or consumers (B2C) and 9 are industries or wholesalers (B2B).

4. Results

This section presents the determinants and dynamics of eco-innovation observed for all five projects studied. First, we take a closer look at internal factors (i.e. those related to the characteristics of eco-innovative organizations) and then at external factors. We then focus on the dynamics of interaction between organizations and their environment by examining the means of access to resources throughout the project.

4.1. The role of internal and external factors

4.1.1. Internal factors: entrepreneurship, governance, and internal resources

Each project involves individuals with a strong ability to procure resources. With both technical and organizational capabilities, they are, in most cases, the authors of the initial ideas; they were and remain the main driving force behind the projects. They are entrepreneurial figures, who have the capacity to procure and organize tangible and intangible resources, and therefore strongly contribute to structuring and developing the project. These leaders also participate in the definition of the strategy to be adopted and the associated governance arrangements.

In terms of governance, we note that some projects were initially managed on a collective (team) basis and then gradually shifted towards a more hierarchical form of governance, whereas others started with a hierarchical structure and then gradually moved towards a more team-based form of management (Avadikyan et al., 2001). The first is a type of collective governance in which a large

number of individuals participate in defining the project and its trajectory. Its purpose is to build, from the onset, strong commitment to the project and a high level of cooperation and knowledge-sharing among the various stakeholders. Such is the case of the *Bread* and *Cheese* projects whose objective was to create a new product with heterogeneous actors who did not already belong to collective initiatives. It was necessary to achieve a high degree of knowledge-sharing to reinforce the foundation of the project. However, as the projects developed and entered a period of stabilization, the increase in the number of participants, on the one hand, and the existence of more codified knowledge on the other, led to the adoption of a more representative form of governance. Conversely, the second type of governance is, from the outset, more representative, and relies on a few key players who belong to existing organizations. Its purpose is, first of all, to build and establish trust between stakeholders, and then to progressively reinforce their level of cooperation. This dynamic results in the progressive formation of working groups (particularly farmers) involved in defining and disseminating new practices, particularly cultivation practices.

The absorptive capacity of an innovative organization refers to its ability to acquire external resources and then exploit them internally in order to innovate (Cohen and Levinthal, 1990). In our cases, the projects' innovative profiles are characterized by a low level of internal R&D— at least according to traditional indicators such as R&D spending. However, the actors acquire and utilize external resources and knowledge (new cultivation practices for *Pulses* or new pollination practices for *Sunflower*...). This open-innovation strategy is also characterized by a growing involvement in the co-construction of R&D systems. The other characteristic of the projects studied is that they are not primarily based on technological innovation but on a number of incremental product, process and/or organizational innovations. Finally, our results confirm that measuring innovation and knowledge in peripheral spaces implies moving away from a technologically-based approach (Virkkala, 2007; Naldi et al., 2015). They emphasize the importance of organizational innovation and of “Doing-Using-Interacting” processes (Jensen et al., 2007).

4.1.2. *Place-based and extra-local factors*

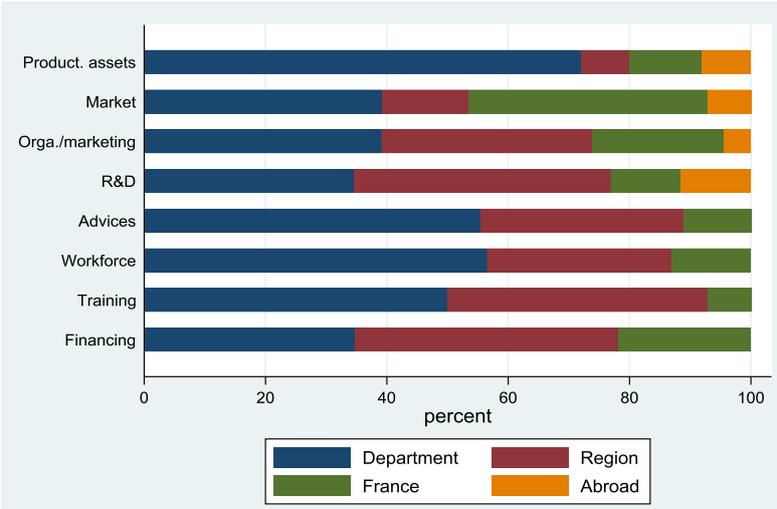
Several external factors played central roles. They are local (specific local issues and factors, related variety) but also non-local (sector, demand and public policies).

Related variety refers to the variety of industries within a region that are cognitively related (Frenken et al, 2007) and can be used to define the degree to which different industries of an area share common knowledge bases which allow interaction and knowledge spill-overs to occur (Boschma, 2014). In the five cases studied, the knowledge bases used are embedded in the agricultural systems that has developed locally over time, particularly Aveyron' breeding activity and the Gers' specialization in cereals. Building on these knowledge bases, each project has relied on a diversity of related local activities, which has made it possible to structure a localized supply chain. This related variety is reflected, for example, in the development, among some Aveyron breeders, of a cereal cultivation sector for a new purpose, that of bread-making (*Bread*), or in the utilization of existing knowledge and infrastructure in organic cereal production in the Gers for the development of a new organic pulses sector (*Pulses*).

The importance of related variety is revealed by the analysis of the location of the external resources utilized for the projects (see Figure 3). Thus, more than 50% of these resources are local (Nuts 3 level) and 27% are regional (Nuts2 level). The resources found at local level (Nuts3) are the means of production (raw materials, machines/equipment, premises) and labor. The actors thus rely on technologies and expertise that already exist on the territory to develop their new activity (Munro and Bathelt, 2014; Iammarino, 2011) and the circulation of knowledge and skills (Asheim and Isaksen, 2002) occurs through the recruitment of local labor. The localized nature of the knowledge

exchanges is also apparent in advisory activities and, to a lesser extent, training activities. This tends to confirm Ernst and Kim's (2002) hypothesis according to which the local level is better suited to the circulation of knowledge that is not easily codified. Conversely, a significant part of the resources utilized come from distant — national or even international — sources, in particular the resources linked to market integration (outlets, production, and sales organization) and to a lesser extent R&D and financing. This confirms the results obtained by Legendijk and Lorentzen (2007) which show that, in peripheral regions, organizational proximity is not necessarily built at the local level. Our results show that while local resources are essential to eco-innovation, they are not sufficient (Cainelli et al., 2015, Ferru et al. 2015).

Figure 3: Location of resources according to their nature



Regarding sectoral determinants, these projects were all developed in response to macroeconomic difficulties experienced by the livestock and field crop sectors; this confirms the role of the sectoral context (Malerba, 2005). Demand also had a positive influence. No prior market study was conducted for any of the projects. Nevertheless, each project has benefited from increased consumer demand for quality local products, especially organic goods. Four of the five projects have chosen to market their products on both local and (inter)national markets. They therefore use a wider range of market resources and experience stronger growth. The only project that has chosen to prioritize local distribution has had more difficulty in increasing its market share. This tends to confirm the results commonly found in the literature in innovation economics on the role of market size in innovation dynamics (Galliano et al., 2015).

Finally, public regulations have played a decisive role, particularly in the projects' genesis and creation phases, which confirms their positive role in eco-innovation (Rennings, 2000; Horbach et al., 2012). These measures include indirect incentives, such as those related to the common agricultural policy (fallow systems, milk quotas, agri-environmental measures, economic aid for conversion to and maintenance of organic farming) or French policies encouraging the development of territorial projects (aid for the development of projects in rural areas, for the organization of the organic food supply chains). Although, the literature shows that direct aid does not seem to play a decisive role in the case of SMEs, (Triguero et al., 2013), the projects studied have benefited from various forms of support, particularly from the regional and local authorities (subsidies for equipment, aid for the acquisition of land, etc.).

4.2. Dynamics of embeddedness of the projects

The previous section focused on internal and external (local and extra-local) factors in the development of eco-innovative projects, shedding light on the combined role of local and non-local factors. We now examine how the organizations running these projects succeeded in procuring the resources necessary for their development and who has provided them with these new resources. The analysis of the relational dimensions of the processes shows that the stakeholders remain embedded into the networks throughout the projects but in different ways depending on the types of actors concerned (market or institutional).

4.2.1. *The dynamics of access to resources*

We have shown that eco-innovative organizations located in peripheral areas strongly rely on local or regional resources. Regarding the provider and the means of access to the resource, the literature offers little information on the respective roles of institutions and market actors. Thus, the originality of our results lies in enabling us to follow the evolution of the role of the market and institutional actors, but also of the means of access to these resource providers (see Table 4). Thus, the share of resources that are acquired via market actors increases from 53.8% to 71.9% as the eco-innovation process progresses. This reflects how these projects are increasingly integrated into the commercial domain (customers, suppliers, competitors, etc.) as highlighted by Klevorick et al. (1995). Thus, eco-innovative organizations gradually gain autonomy from their institutional environment, becoming less dependent on resources provided by public actors and professional organizations. On the other hand, it is important to note the important role played by "institutional" actors during the genesis phase of the projects — confirming the positive impact of public regulations on eco-innovation processes, as highlighted by Porter and Van Der Linde (1995) and Rennings (2000) — but also that of sectoral practices – via professional organizations (Galliano and Nadel, 2015). As Tregear and Cooper (2016) have pointed out, the sectoral norms and habits play a key role in shaping actor relations and learning processes in rural areas. These results are also in line with the findings of Vermeulen and Kok (2012), which highlight the important role of interactions between private and public actors in eco-innovation, and with those of Guillaume and Doloreux (2011) and Esparcia (2014) which point to the importance for eco-innovation projects in peripheral areas of utilizing not only professional networks but also institutional actors.

Table 4: Means of access to resources depending on the stage in the process (in %)

Stage \ Mean of access	Personal link to		Mediation device		Total (number)
	Market actor	Institutional actor	Market actor	Institutional actor	
Genesis	31.5	29.6	22.2	16.7	100.0 (54)
Creation	38.4	16.7	28.2	16.7	100.0 (78)
Development	40.6	17.2	31.3	10.9	100.0 (64)
Total	37.2	20.4	27.6	14.8	100.0 (196)

By analyzing how personal networks are used for gaining access to resources (Table 4) we were able to examine the dynamics of embeddedness/decoupling of eco-innovation processes. Our results show that 60% of the resources were obtained through personal relations, during the projects' genesis phase. This indicates that the projects are highly embedded in the relational environment of the individuals involved, which is in keeping with the results of the studies conducted by Naldi et al (2015) or Bonnet-Gravois and Shearmur (2014) on the role of personal networks in access to

resources. In the projects studied, this embeddedness in personal networks is maintained, including in the project development phase, during which almost 58% of the resources are obtained via personal connections. In this regard, our results differ from those of Esparcia (2014) or Grossetti et al. (2011) who observe a gradual decoupling from personal networks as the organizations they have studied develop. Our results could be explained by the fact that the projects we have studied are located in peripheral areas, which implies a necessity for organizations to be able to develop relations with other actors, in order to compensate for the lack of local knowledge spillovers (Grillish and Nilsson, 2015).

While we observe no relational decoupling, it is interesting to note that a geographical decoupling occurs (see Table 5). Thus, in the genesis phase, the actors procure over 70% of the resources locally, which reflects the endogenous economic potential of territories (Baumgartner et al., 2013). However, this share drops, over time, to 35.9%, which is consistent with the conclusions of other studies based on QN (Grossetti et al, 2011). Once stabilized, the projects remain embedded in the local level while benefiting from non-local resources.

Table 5: Location of the resources for each phase in the project (in %)

Location \ Phase	Local	Regional	France	Abroad	Total (number)
Genesis	72.2	18.5	9.3	0.0	100.0 (54)
Creation	46.2	29.5	19.2	5.1	100.0 (78)
Development	35.9	31.3	23.4	9.4	100.0 (64)
Total	50.0	27.0	17.9	5.1	100.0 (196)

4.2.2. Access to the resources according to their nature

The importance of personal networks varies depending on the type of resource to be acquired and on the nature of the resource provider (see Figure 4). Personal relations play a decisive role in accessing new knowledge and expertise (R&D, advice, training) and represent 70 to 90% of the means of access to these resources. This is in keeping with the literature in innovation economics which emphasizes that knowledge is acquired largely through networks and collaborations (Bathelt et al., 2004; van Egeraat and Kogler, 2013). This predominant role of personal relations can also be explained by the fact that peripheral areas are poorly equipped with institutional infrastructure that would enable them to have direct access to resources. Similarly, personal relations play an important role in accessing a workforce, which, as mentioned above, is mostly local or regional. Because of the characteristics of labor markets in peripheral areas, the literature has highlighted the important role of direct relations in facilitating the matching of supply and demand (Lindsay et al., 2003). In contrast, the resources that are obtained primarily through mediation mechanisms are market resources and financing.

The results regarding the relation between the supplier and the nature of the resource highlight the predominant role of commercial actors in supplying tangible resources (productive assets, market, organization/marketing, workforce), whereas the access to knowledge resources is more contrasted. Training is mainly provided by market actors, whereas the R&D and advisory resources are provided by a variety of actors. Regarding knowledge providers, the literature has, for the most part, highlighted the decisive role played by both market and institutional actors (Von Hippel, 1988;

Klevoric et al., 1995; Davenport, 2005; Leten et al., 2014 or Maietta, 2015). Our results show that in peripheral areas, knowledge and expertise are predominantly acquired through institutional actors.

Figure 4: Access to the resources according to their nature

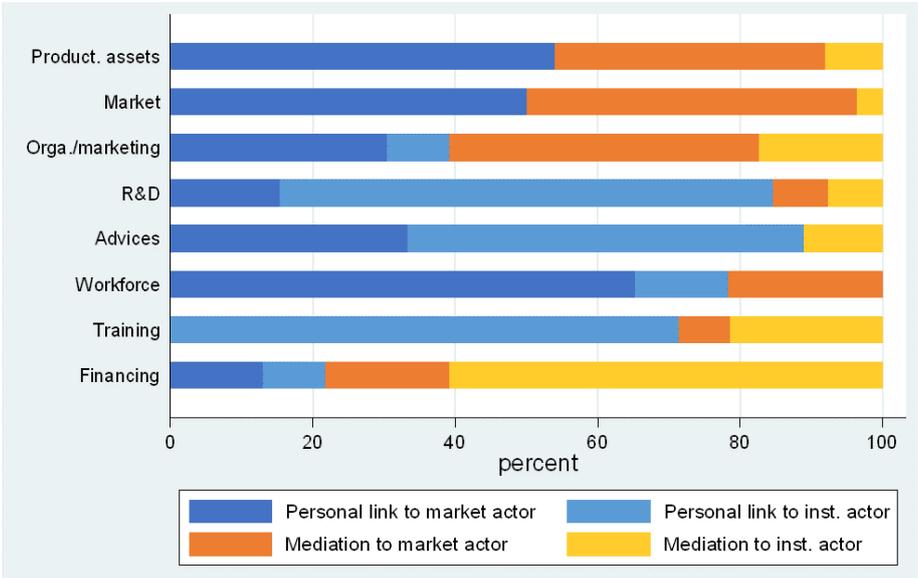


Table 6 confirms the importance of personal relations in accessing proximity resources. Indeed, more than 70% of local resources are obtained through personal relations. Personal networks also provide access to more distant resources; indeed, a significant 50% of the resources sourced regionally and 30% of those sourced internationally are procured through networks. The importance of combining local and non-local networks in resource acquisition is highlighted by geography of innovation and innovation economics (Bathelt et al., 2004; van Egeraat and Kogler, 2013). Our results provide additional information by specifying the nature of the resource provider according to the location. Thus, personal relations play a decisive role in the actors' access to the regional resources provided by institutional actors, whereas the resources sourced nationally or internationally are, for the most part, acquired through professional networks. These mixed results highlight the importance of the regional resources provided by institutional actors. Thus, the region appears as the spatial entity from which the actors involved in the projects can access the institutional resources they need. This combines with the key role of interpersonal relationships in procuring local resources for these eco-innovation processes, thus confirming the findings of Naldi et al. (2015) and Grillitsch and Nilsson (2015).

Table 6: Means of access to resources according to their location (in %)

Location \ Mean of access	Personal link to		Mediation device		Total (number)
	Market actor	Institutional actor	Market actor	Institutional actor	
Department	52.0	18.4	18.4	11.2	100.0 (98)
Region	13.2	35.8	32.1	18.9	100.0 (53)
France	34.3	8.6	37.1	20.0	100.0 (35)
Abroad	30.0	0.0	60.0	10.0	100.0 (10)
Total	37.2	20.4	27.6	14.8	100.0 (196)

5. Conclusion

The objective of this paper was to provide a more in depth micro-economic analysis of eco-innovation processes in peripheral areas. Our main question was how do the actors located in peripheral areas procure and utilize place-based resources and networks to develop eco-innovations. We have analyzed, on the basis of in-depth case studies, the impact of low density on coordination between actors and on how resources are procured and utilized to develop eco-innovations in peripheral areas. To gain more insight into the respective role of the different types of factors, we have proposed an original theoretical framework combining the literature on eco-innovation and the literature on the geography of innovation, to articulate the internal organizational factors that affect eco-innovative organizations and the external factors, whether place-based or extra-local.

This work was conducted as a continuation of studies dedicated to the analysis of innovation dynamics in peripheral areas. It shows both the importance of the embeddedness of economics activities as a key question (highlighted by the work of McKitterick et al. 2016, Tregear et al. 2016, Richter 2017 or Greenberg et al. 2018), the importance of embedding innovation processes in local but also extra-local and even globalized networks (Dubois 2016) and, ultimately, the need to adopt a broader approach to the nature of innovation in rural areas (Esparcia, 2014, Naldi et al. 2015). The originality of study lies in its object (eco-innovations) but also in the choice to approach the question of resource access and utilization in a dynamic way, which has enabled us to show the evolution of the embedding / decoupling processes, both relationally and geographically, during the project's trajectory. The results also highlight the role of related variety, which allows for a new approach to the relations to local resources.

In terms of results, our in-depth analysis of five eco-innovative agro-food projects implemented in peripheral agricultural territories of South-West France has enabled us to identify the key characteristics of their innovation pattern. Firstly, the organizations that develop these eco-innovations have a strong absorptive capacity based, in particular, on a few key people who have carried the projects since their inception and have been actively involved in their governance. Secondly, these projects strongly rely on productive activities that already exist locally and utilize the local technologies and know-how. Our results are in line with and complement previous studies that highlight the importance of the sectoral context, which contributes to shaping interactions and innovations in peripheral areas (McKitterick et al., 2016; Tregear et al., 2016). This points to the importance of related variety in the peripheral areas. Thirdly, on a broader scale, sector-related economic difficulties and the growing national – and even international - demand, for quality local

food products have played a key role in the emergence and development of these initiatives. Our results show that national and European regulations, particularly in the farming sector, also seem to be an important factor, which is in keeping with the literature on environmental innovations (Porter and Van der Linde, 1995).

In terms of dynamics, it is noteworthy that the share of local resources (Nuts3) used decreases as the projects progress. This attests to the capacity of these territories to generate innovation but also to certain limitations in terms of resources. The stakeholders' ability to procure resources from outside the local environment is therefore a key factor in maintaining momentum. A large number of resources are procured at the regional level (Nuts2)—particularly intangible resources provided by institutional actors (public actors and professional organizations). Finally, the various resources needed throughout the innovation processes are acquired through both traditional market mechanisms and the personal networks of the individuals involved in the eco-innovation projects. These networks have indeed played a key role in accessing most of the resources needed throughout the process, which points to a long-term embeddedness of eco-innovative organizations in networks. These results confirm the specificity of rural areas related to the important role that personal networks play within them.

Thus, our study tends to confirm the existence of a peripheral pattern of innovation characterized by a strong reliance on local resources and on the personal networks of a few individual leaders. The trajectories of innovative projects combining technical and organizational innovations are based on the activation of a technological and cognitive proximity with some activities already present on the territory (related variety). This activation is often facilitated by the action of entrepreneurs who make extensive use of their personal networks at different geographical levels. The persistence over time of this "relational" embeddedness, combined with a – relative – geographical decoupling, reflects the strong potential of peripheral territories in terms of innovation. It also highlights the necessity to structure — with the support of public actors — these eco-innovative organizations, which strongly rely on their personal networks to access both local and distant resources. For peripheral territories, the regional level (first level of aggregation of activities and policy development) appears as a geographic scale from which a large amount of resources is found.

Regarding public policy, these results reaffirm the importance of regional institutions, in terms not only of financial support but also of knowledge circulation. Indeed, regional institutions play a key role in facilitating access to extra-local resources, on which innovation processes in peripheral areas strongly rely. Our results also call for further research to better understand the levers for best exploiting local resources and the specificity of mechanisms of innovation in European peripheral territories. Beyond the theme of entrepreneurship, the forms of exploitation of related variety, i.e. the interactions between productive activities already present in the territory (particularly through circular economic processes) must be further analyzed to better understand the link between environmental innovation and the territory.

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Appendix 1

This appendix provides results on the type of personal connections that are exploited to acquire external resources. To make reading the results easier, the figures presented below also include the resources acquired through mediation.

Figure A.1: Personal links according to the location of the resource

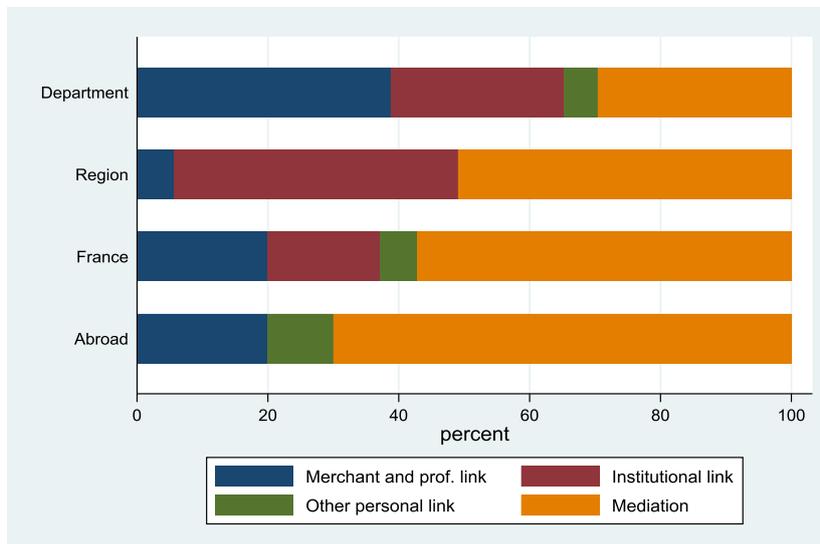


Figure A.1 shows that the share of personal connections involved in accessing resources decreases as the geographical scale increases, reflecting the important role of personal connections in accessing resources at the local level. There is also a specificity of the regional level with many institutional connections, which shows the importance of having connections with regional institutions for accessing the resources necessary for the development of the projects.

Figure A.2: Personal links according to project phase

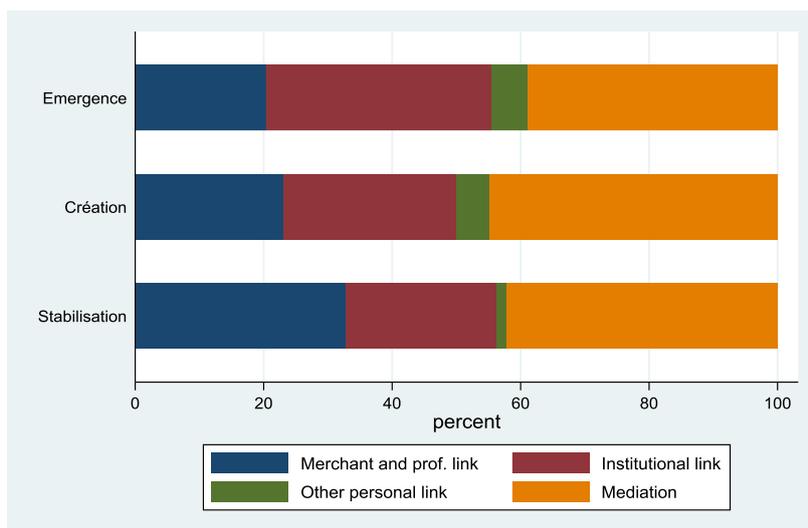


Figure A.2 shows that, while the share of personal connections in accessing resources remains relatively stable, that of institutional connections decreases as projects progress, while the opposite is true for professional links. It is interesting to note the very weak role of other types of connections.