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Boosting Sustainable Innovation in Densely Populated Areas: A *Milieux Innovateurs* Approach

Yari Vecchio [1,*], Felice Adinolfi [1], Claudia Albani [2], Luca Bartoli [3] and Marcello De Rosa [3]

[1] Department of Veterinary Medical Sciences, University of Bologna; Via Tolara di Sopra, 50, 40064 Ozzano dell'Emilia (Bologna), Italy; felice.adinolfi@unibo.it
[2] Italian Association Coldiretti; Via Ventiquattro Maggio, 430018 Roma, Italy; claudia.albani@coldiretti.it
[3] Department of Economics and Law, University of Cassino and Southern Lazio; Viale dell'Università, 03043 Cassino (FR), Italy; bartoli@unicas.it (L.B.); mderosa@unicas.it (M.D.R.)
* Correspondence: yari.vecchio@unibo.it

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Abstract: This paper deals with innovation adoption, with the purpose of analyzing the uptake of sustainable innovations among young farms working in urban and periurban contexts. Our hypothesis is that innovative milieus (IM) play a fundamental role in boosting sustainable innovation. In order to analyze the uptake of sustainable innovation, we will make reference to the two logics of the IM approach: the logics of interactions and the logics of learning. The former is focused on the socio-institutional domain, more precisely on relational assets and coordination mechanisms activated by the farms. The latter makes reference to the profile of innovation adopted and on various impacts innovation have under economic, social and environmental points of view. A questionnaire has been submitted to young farms participating to the *Oscar Green Coldiretti Awards*. In total, three dimensions of innovation are taken into account: economic, social and environmental. Data are processed through statistical tools aiming at describing the diversified set of interaction-learning mechanisms. Results evidence different innovative milieus which pave the way to diversified paths of innovation with different degree of sustainability and impacts.

Keywords: sustainable innovation; sustainability; young farmers; multifunctionality; peri-urban agriculture

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1. Introduction

This paper deals with innovation, as the process through which new products, services, processes or business models are introduced [1], which boost the dynamics and transformation of territorial systems [2]. The paper aims to analyze the role of innovative milieus in triggering farm innovation in urban (including densely populated areas and intermediate density areas). More precisely, the paper focuses on sustainable innovations in farms managed by a young farmer in order to excavate their contribution in building up sustainable worlds of food [3].

A wide literature has provided a sound definition of sustainability, through diverse conceptualization and approaches, but all grounded on the concept that *the main principle underlying the idea of sustainability is that environmental conservation and economic development should become interdependent and mutually reinforcing goals* ([4], p. 40). In the new paradigm of sustainable rural development, sustainable agriculture is drawn on this view and is conceived as a place-based model of development aiming at reconfiguring agricultural activity through empowering its multifunctional role [5] against this background. In this paper, sustainable innovation is carried out through grassroots driven processes, which emphasizes and strengthens multifunctional agricultural activity. This is particularly true in urban and periurban contexts, where farming is identified as an innovative and sustainable practice [6].

Coherently with this perspective, our analysis dwells on the one side, relational and networking elements in shaping innovation [7] and, on the other side, the multiple dimensions of sustainability to be taken into account.

The study is contextualized in urban areas, which are gaining growing attention in the rural policy debate. The opportunity to focus on densely populated and intermediate density areas is evident in account of the recent competition in land use induced by the urban sprawl [8], which is to the detriment of the agricultural sector. Despite this, recent literature agrees on addressing alternative paths of development and innovation linked to the paradigm of multifunctional agriculture [9]. This transition is not completely achieved and evidences many patterns between various urban and periurban areas [10].

Complementarities between farming and the cities are widely recognized [11] as relationships between agriculture and urban areas involve many dimensions, such as food safety, urban planning and environmental issues [12]. Consequently, densely populated areas may represent a challenge and an opportunity for farming activities, then stimulating sustainable innovations [13]. Set against this background, our research questions are the following: which elements have to be taken into account when considering sustainable innovation? What kind of mechanisms of knowledge transfer do young farmers opt for in case of sustainable innovation? The hypothesis the paper aims to demonstrate is that an innovative milieu triggers innovation adoption and encourages trajectories of sustainable development in urban and periurban areas.

The paper is articulated as follows: next, Section 2 concerns the theoretical background. The aim of the section is not to provide an exhaustive literature review, but to focus on the main critical issues related to the role of knowledge transfer on sustainable innovation in densely populated areas. innovative milieus are at the center of this section as an engine for sustainable innovation adoption. The following Section 3 describes the methodology of analysis, while Section 4 evidences the results. The discussion of the results and some conclusions will end the paper.

2. Theoretical Background

In recent years, numerous researches have shed light on topics such as sustainability in innovation adoption, by stressing the importance of corporate social responsibility in addressing the paths of innovation [14,15].

Hekkert et al. [16] posit that the relationship between technology and environment is "paradoxical" in that technology, on the one side, may negatively affect the environment through intensive use of natural resources and, on the other side, technologies oriented to efficient use of resources may positively affect the environment. This paper deals with the second type of innovation, that is, with sustainable technology development [17] in farms managed by young workers in urban contexts.

In urban areas, agricultural activity may suffer from the competition in the use of land with nonagricultural utilization. Moreover, urban sprawl may endanger farming activity also in periurban areas, subsequently raising new challenges for farmers [18]. As a consequence, farms' strategies may pursue diversified paths of adaptation, which involve different business models [19]. Driving forces of these adjustment strategies are citizens, who are evidencing new interests towards farming and encouraging farms' sustainable food strategies [20,21]. As a consequence, recent rural development policies draw attention to the importance of agricultural activity in densely populated areas through strengthening the multifunctional side of it. New societal demands in urban contexts address a large variety of farming activities and call for sustainable innovation, to make urban farming more competitive in land use, concerning nonagricultural utilization [22].

For the purpose of this paper, we conceptualize innovation as the set of activities through which a firm conceives, designs, manufactures and introduces a new product, service, process or business model [23]. As far as farming activity is concerned, Knickel et al. ([24], p. 94) point out that "*Innovation involves much more than technology; more and more it relates to strategy, marketing, organization, management* *and design. Farmers looking for alternatives to industrial agriculture don't necessarily apply "new" technology. Their novelties emerge as the outcome of different ways of thinking and different ways of doing things*".

This deep perspective amounts to different worlds of innovation [25], characterized by social and economic variables raising the level of complexity of analysis [26], in account of diverse mechanisms of knowledge diffusion and innovation adoption. These processes may be affected by territorial variables. Set against this background, farming activity in urban and periurban contexts raises different challenges and opportunities to rural and remote rural areas [27,28]. More precisely, van der Schans et al. [29] highlight the huge potential for technical, social, organizational and institutional innovation to draw on the interactions between agricultural activity and urban environments.

Transition and dynamics of sustainable innovation in urban agriculture are fields of analysis which require more attention [30]. This paper tries to fill this gap in the literature, by providing insights on the relationships between knowledge transfer and innovation adoption in farms managed by young people. Actually, barriers to innovation are strictly related to knowledge transfer and, more precisely, to access to sound and pertinent knowledge. As underlined in *The future of food and farming*, access to sound, relevant and new knowledge is very patchy around the Union ([31], p. 12). Knowledge relevance and soundness depend on both the structural and functional characteristics of the agrifood chains and the territorial rural context of reference [32]. The sociotechnical transition towards multifunctional and sustainable agriculture [33] addresses the issue on which forms of knowledge are at stake [34]. Therefore, the governance of mechanisms of innovation adoption seems more complex, in account of numerous variables (economic, social institutional, etc.) to be taken into account. As pointed out by Kebir et al. ([35], p. 16) "*new actors have joined the process of innovation: policy-makers, the media, civil society actors [association, NGO], even activist consumers*". From this perspective, the innovative milieus approach plays a fundamental role to analyze innovation adoption in urbanized areas [7,36].

Innovative Milieus and Sustainable Innovation

In this paper we put forward a contextualized perspective of innovation adoption, in account of the fact that some geographical environments are endowed with a structure as well as a culture which seem to be well suited for the dynamic and economically sound development of knowledge, while other environments can function as a barrier to entrepreneurship and change ([37], p. 181). This suggests considering multiple dimensions of context, more precisely, territorial and socio-institutional contexts [38]. With this purpose, the innovative milieus approach seems a suitable tool for analysis. This approach is framed within neo-Schumpeterian theories of local development, which explore the role of knowledge creation and innovation adoption in territorial productive systems, by assuming a relational-diversified vision of the space [39].

The analysis of innovative milieus was launched in 1986 [40] by the European research group on innovative milieus, named Groupe de Recherche Européen sur les Milieux Innovateurs (GREMI), according to which the milieu retains a multidimensional character, referring both to the "context milieu" and to the "actor milieu" [41]. More precisely, an innovative milieu is a set of relations and interactions among actors in a geographical area, which foster either a reduction in uncertainty or a boost in innovation [42]. An innovative milieu brings about a virtuous territorial pattern of innovation, whose phases are marked by knowledge acquisition, innovation adoption and performance [43]. The evolution of the GREMI approach points out the wide opportunities of application of the approach, that has been recently employed also to natural and cultural resources [44].

In this wider perspective, innovation integrates various dimensions of sustainability, involving not only economic and technological domains, but also cultural aspects, civic participation, cultural, aesthetic and symbolic dimensions. As pointed out by Peyrache-Gadeau et al. [45], this brings about recognizing multiple rationales of the fields of valorization and social legitimization of innovation.

The new perspectives of innovative milieu and sustainable innovation are tailored for our purpose of analyzing sustainable innovation in densely populated areas. Anyway, recent literature [46] emphasizes that motivational pathways to innovation adoption may be multiple, in account of diversified farmer's value systems [47]. In this scenario, cumulative knowledge dynamics are replaced by composite and combinatorial knowledge dynamics [32,48], where innovation is the outcome of heterogeneous and diversified sets of both local and mobile knowledge. This has required an adaptation of traditional analysis of innovative milieus, to be replaced by a new vision built on "combinatorial knowledge", which address new and diversified trajectories of regional development [35,45]. By sorting out the traditional innovative milieu approach, Crevoisier and Jeannerat [49] underline how knowledge has become extremely mobile and combinatorial, so stressing the importance of local context: *The local environment thus undoubtedly continues to play an extremely important role regarding the way in which it interacts with mobile knowledge* ([49], p. 1236). Consequently, how to understand the way of mobilization of "elsewhere" knowledge and how to combine it with local knowledge becomes a relevant field of research [50]. A possible pathway of combination is possible through mechanisms of knowledge anchoring, which become strategic to territorially reconfigure and readapt knowledge produced and mobilized elsewhere. As pointed out by Crevoisier ([51], p. 13), *The anchoring milieu can be defined as a set of local players [firms, individuals, public authorities, research and training organisations, local entrepreneurs, medias, cultural institutions, NGO, etc.] who interact locally and with distant and/or mobile players in order to develop ever more advanced [efficient or meaningful] knowledge on the basis of competition/cooperation rules.* Recent approaches to innovative milieus as a driver of sustainable innovation pointed out how different innovative milieus may emerge as a consequence of different anchorage modes [35].

Accordingly, sustainable innovation is drawn on various dimensions of knowledge anchorage, recalling economic, social and environmental pillars that shape the multifunctional role of agricultural activity and, as confirmed in recent studies, its social responsibility [15]. Sustainable innovation in agricultural activity is then rooted in the new European agricultural model grounded on multifunctional and sustainable agriculture [52]. As a matter of fact, multifunctionality is the cornerstone of the transition to sustainable agricultural systems [53]. Accordingly, multiple patterns of innovation may be considered, regarding the economic, environmental and social dimensions of multifunctional agriculture.

This is particularly true in the case of populated areas, characterized by a paradigm shift from modernization towards multifunctionality [54]. Analyses of innovative milieus in urban areas have been carried out in the strand of GREMI tradition [55]. However, little attention has been devoted to the farming system in urban areas. Therefore, this paper tries to fill a gap in the literature by highlighting the relevance of innovative milieus in performing the transition towards multifunctional agriculture boosted by young farmers.

From a methodological point of view, the presence of innovative milieus must be analyzed through excavating the two constituent logics: *interaction* and *learning* logics [2,7]. As posited by Maillat and Grosjean [56], the interaction sphere refers to the capacity to cooperate and to develop synergies with other actors at both local and extra-local level, then engendering pertinent knowledge anchoring. Learning logics is a direct consequence of the interaction and brings about actors' capability to adapt to the changing environment and, consequently, to innovate. Set in the background of this paper, the logic underlines the young farmers' aptitude to boost sociotechnical transition towards multifunctional agriculture in urban areas. The following empirical analysis will refer to the previous logics to test the propensity to innovate by young farmers.

3. Methodology

The empirical analysis was based on secondary data, collected during the 14th edition of the Oscar Green Awards promoted by Coldiretti, the main Italian Farmers' Organization. A questionnaire was submitted to the 758 participants and 428 valid questionnaires (only farms located in urban and peri-urban areas) were collected. The questionnaire was articulated in the following parts:

a. Sociodemographic profile, which indicates the level of education, family composition, stage of the life cycle.

b. Description of the innovative idea and its economic, social and environmental impact. It is worth clarifying that all innovations considered in the analysis may be identified as sustainable innovations aiming at empowering multifunctional agriculture.

c. Interaction and cooperation activated by the farms as inputs for learning and innovation. Farmers were invited to detail sources of knowledge, by distinguishing formal/informal and individual/collective sources of information and knowledge. This allowed us to specify the logic of interaction as follows.

d. Drivers/barriers to innovation; farmers had to classify (in order of importance) the following drivers and barriers to innovation (Table 1):

Table 1. Variables considered as barriers and drivers to innovation.

Barriers	Drivers
Bureaucracy	Family context
Technical complexity	Personal knowledge
Cost of access to innovation	Policy support
Credit access	Training
Difficulties of organizational adjustment	Adequate information
Uncertainty about results	Networking
Lack of information	Extra-family context

Due to the high number of variables to be considered, a multidimensional technique aiming at synthesizing all information was used. In cases of qualitative variables, this was a multiple correspondence analysis, which can reduce the number of explicative variables [57]. In a second step, a cluster analysis was implemented, with the purpose of grouping homogeneous farms based on selected variables [58]. The choice of variable gives a response to the necessity of intercepting both interaction and learning logics. First factorial axes were employed to clustering farms, under the condition of explaining a high rate of variability.

Through a multiple correspondence analysis, the set of active variables was reduced to main factors able to explain the total variability of data. In order to properly choose factors explaining maximum variance, we followed Benzècri's re-evaluation method [59]. Therefore, we extracted the first 4 factors (absorbing more than 70% of the total variance) to process the following cluster analysis. The clustering procedure allowed us to group similar data points such that the points in the same group were more similar to each other than the points in the other groups. In other words, the procedure lets to aggregate groups where internal inertia was minimum (within inertia), while between groups inertia was maximum. With a view to clarify the characteristics of each group of farms, the V-test criterion was taken into account, more precisely, all variables with a value test higher than 2 contributed to specifying clusters [60]. Data were processed through the SPAD program, version 3.21, with the agglomerative hierarchical procedure [61]. According to Ward's criterion of aggregation, 10 iterations with mobile centers were completed.

Table 2 evidences both active and illustrative variables utilized in the cluster analysis. As a whole, 7 actives, with 34 associated categories, and 7 illustrative variables with 33 categories were used.

Table 2. Variables used in the cluster analysis.

Active Variables	
Interaction sphere (cooperation)	4 categories
Learning sphere (type of innovation)	3 categories
Type of quality certification	4 categories
First barriers to innovation	7 categories
First drivers of innovation	7 categories

Table 2. *Cont.*

Active Variables	
Sum of impacts of innovation	7 categories
Agricultural specialization	2 categories
Illustrative variables	
Impact (economic, social, environmental)	3 categories
Level of education	5 categories
Age	5 categories
Sex	2 categories
Second barriers to innovation	7 categories
Second drivers of innovation	7 categories
Farm's localization	4 categories

More precisely:

✓ Interaction logics and anchoring mechanisms are synthesized by an index of local synergies and interactions [62]. By referring to previous studies on innovative milieus [7,63], inputs for learning are classified according to various typologies of interaction. First of all, relationships with other farms, from either a formal and informal point of view. Moreover, interaction with individuals, such as advisory services and innovation support system, which may be provided by both private and public actors. These interactions are gaining importance in recent approaches to innovation provided in rural development policies of the EU [64]. All actors are essential parts of innovation that support services that the farms turn to acquire knowledge and, consequently, adopt innovation [65]. Thus, 4 categories of interaction spheres were detected, as illustrated in the following Table 3:

- ◦ No interaction;
- ◦ Low interaction, that is farms have just one relation with one of these actors: public institutions, advisory services, other farms (horizontal integration);
- ◦ Average interaction, where farms receive two ways of interaction (for instance, horizontal and farm advisory services);
- ◦ Full interaction, where farms are involved in all potential types of interaction. Innovative milieus are grounded on these types of interaction spheres.

Table 3. Types of interaction among farms.

No Interaction	No Cooperation
Low interaction logics	institutional relationships
	farm advisory services—FAS (provided by both public and private actors)
	horizontal integration (cooperation with other farms, through either formal or informal agreements)
Average interaction logics	Institutional integration + FAS
	Institutional integration + horizontal integration
	FAS + horizontal integration
Full interaction logics	Institutional integration + FAS + horizontal integration

- ✓ Learning logics is synthesized as the capability of changing and adapting to external environments, synthesized by an index of local innovativeness [62], which evidences farmers' propensity to innovation. Set against the idea of sustainable innovation, farmers were requested to clarify:
    - ◦ First of all, which kind of innovation they have introduced and to evidence 2 main categories of innovation:
        - ■ Innovation aiming to integrate existing practices as incremental innovation;
        - ■ Innovation that changes actual practices or completely replaces the farm's productive activity, which represents a radical innovation.
    - ◦ Secondly, farmers were also asked to specify which of the 3 key elements of multifunctionality are emphasized through innovation. Therefore, the impact of innovation is classified according to 3 dimensions, economic, social and environmental by attributing a numeric variable to each type of impact, economics, social, environmental (low = 1; medium = 2; high = 3). Thus, the maximum impact is equal to 9.
- ✓ Quality certifications analyzed refer to conventional farming, organic production and products with geographical indications.
- ✓ As far as barriers and drivers to innovation are concerned, farmers were asked to specify the variables by listing the most important ones, while the second one has been inserted as an illustrative variable.
- ✓ Farm's localization was taken into account, drawn on the Eurostat degree of urbanization (DEGURB). A total of 3 types of areas were considered:
    - ◦ Cities, that is, densely populated areas: at least 50% of the population lives in urban centers.
    - ◦ Towns and suburbs, that is, intermediate density areas: less than 50% of the population lives in rural grid cells and less than 50% of the population lives in urban centers.
    - ◦ Rural areas, that is, thinly populated areas: more than 50% of the population lives in rural grid cells.

4. Results

The sample analyzed was collected during Oscar Green, the annual award promoted by Coldiretti that enhances and spreads sustainable innovation in agriculture. The competition is dedicated to young farmers (under 40) and their innovative ideas. Since its first edition in 2006, the number of participants has grown steadily, reaching more than 12,000 applications. By taking into account these figures, and provided that Coldiretti is the Chief Union Trade in the Italian Agriculture, the results offer a good insight on young farmers' behaviors concerning knowledge and innovation adoption in urban/periurban areas.

The goal of the competition is to reward experiences of successful young entrepreneurs who have been able to develop competitive and sustainable business projects while strengthening the bond with their territories. The core idea is to look to the future through innovation, focusing on the "agricultural enterprise", innovative business models and concept of production combining innovation and tradition, respecting and promoting certain conditions: welfare, quality, food safety, authenticity, attention to the environment and consumers' expectations. The award is made up of six categories: *Impresa4.Terra*, *Campagna Amica*, *Noi per il Sociale*, *Creatività*, *Sostenibilità* and *Fare Rete*.

The sample was composed of 428 farmers, 93 of whom are located in urban areas and 337 in periurban areas. The socio-demographic characteristics of the sample are shown in Table 4 and show the peculiarities of young farmers. The average age is in line with the target of the award, being 31.5 years. The sample is composed mostly of men (68.9%). The largest number of women is observed in North-East (35.6%) and South and Island area (33.5%), compared to the other areas of the country. The ratio between men and women of the sample is consistent with the Italian average (31.5%) [66].

As far as education is concerned, most of the sample has a medium-high level of education. Actually, 62.3% of the sample has a diploma and more than 33.5% declares to have a degree. These data explain that the new generation of young farmers has a higher level of skills compared to the past. Moreover, their education is not strictly connected to the agricultural sector (only 20.5% of participants hold a specific agricultural education).

Table 4. Socio-Demographic characteristics.

	SEX		Education		
	Female	**Male**	**Middle School**	**Diploma**	**Graduate**
North-East	35.6%	64.4%	5.8%	60.6%	33.7%
North-West	23.4%	76.6%	7.8%	68.8%	23.4%
Central	27.0%	73.0%	2.7%	62.2%	35.1%
South and Islands	33.5%	66.5%	2.3%	60.6%	37.1%
ITALY	31.1%	68.9%	4.2%	62.3%	33.5%

By looking into farmers' business models, Figure 1 shows that more than half of the sample (57%) apply strategies oriented towards multifunctional agriculture, while 43% is oriented towards conventional farming. By borrowing the Banks et al.'s [67] classification, processes of boundary shift are at stake, grounded on broadening and/or deepening strategies. Of these, 16% have decided to expand their business through the opening of agritourism or social farms, while 26% have taken on more eco-sustainable paths, by certifying organic products or have adhered to a geographical indication. On the other hand, a group of 63 farms (15%) fully embodies the figure of the multifunctional entrepreneur, having followed both the path of deepening and broadening.

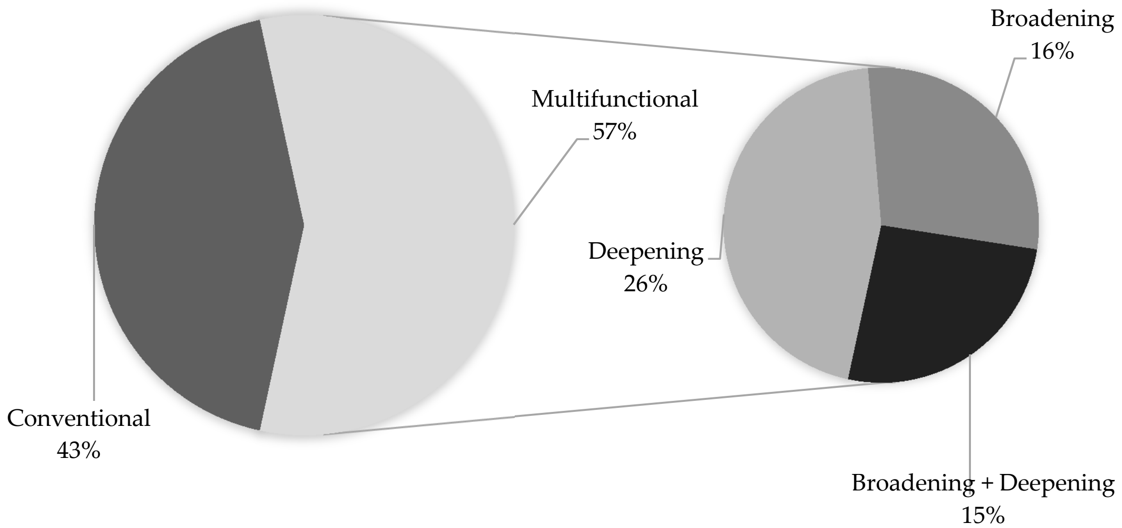

Figure 1. What kind of farmer are you?

4.1. Multivariate Analysis

The hierarchical clustering technique has been envisioned through a Dendrogram, from which 4 homogenous groups of farms have been extracted, with the highest internal homogeneity and the highest external difference to other clusters (Figure 2).

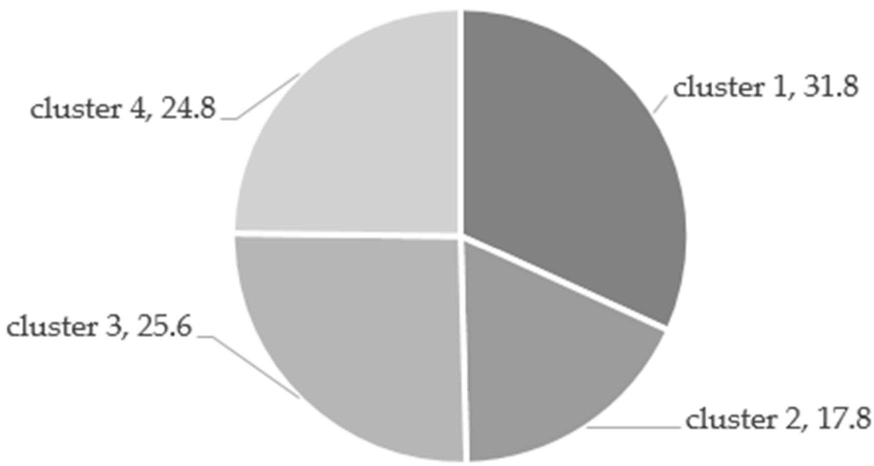

Figure 2. Distribution [%] of the farms in the four clusters.

4.2. Cluster I: Informal Interaction Sphere and Incremental Innovation with Medium-Low Impact

The first cluster includes 136 farms (31.8%), primarily localized in intermediate density areas. with high levels of specialization (T-value = 8.83) and a good education. The highest percentage of farmers have a diploma in agricultural subjects (T-value = 6.43), while a relevant share also graduated in agriculture. Human capital, the family context and informal networks seem to be the main drivers of innovation adoption. The specialized education is cited as the main driver to innovation (T-value = 5.31), jointly with the family context (T-value = 5.13). To find evidence of this, inputs of knowledge, which shape the interaction sphere, are grounded on informal relational capital cooperation with the family networks and with other farmers (T-value = 6.46).

As far as learning logics is concerned, synthesized by the farm's innovativeness, incremental innovation was recorded, aiming to integrate current agricultural practices. Some innovations are realized in intermediate density areas, through the promotion of a reconnection perspective with final consumers or through supporting public canteen with local products. Despite this, the impacts of the innovation are relatively low either from an economic, social and environmental perspective.

4.3. Cluster II: Farm Supported by (Moderately) Innovative Milieus

In the second cluster, 76 farms were extracted (17.8%). The main characteristic of this group of farms is product differentiation, based on the organic method of production. This brings about distinctive pathways of innovation, amounting to a high impact (declared by 88.8% of farms, T-value = 8.05) from either environmental and social point of view, but, above all, with high level of economic performance. What typifies this group of farms is the presence of innovative milieu supporting sustainable innovation. This result is attributable to effective interaction logics, regarding (a) autonomously managed information, such as magazines, online resources, etc. (T-value = 9.42); (b) active networking activity (T-value = 3.10) aiming at building up innovative milieus in the local agrofood system of reference; (c) horizontal (formal and informal) cooperation (with other farms), supported by the assistance of farm advisory services (T-value = 3.0). Innovation may be classified as incremental, oriented to integrating current agricultural practices (T-value = 3.07). What hinders a radical change in farming activity is technological complexity and low familiarity with innovative practices and the cost of access to innovation.

4.4. Cluster III: Innovation Boosted by "Exogenous" Mechanisms

The third cluster absorbed 110 not-specialized farms (25.6%) with the minimum degree of impact (3) from innovation adoption (T-value = 9.96). Innovation adopted will engender a radical change in agricultural specialization (T-value = 4.70). Innovation adoption seems not linked to effective interaction logics: actually, no cooperation was observed in the farms of the cluster (T-value = 3.55).

Therefore, innovation seems the outcome of exogenously boosted mechanisms. To have proof of that, high barriers to innovation adoption emerge: the most important is bureaucracy (T-value = 4.16), which configures "hidden costs" for these farms. Secondly, economic uncertainty, in that farms are not sure about the performance of the innovation. As far as drivers of innovation are concerned, extra-family networks (T-value = 9.05) are the main engine for adopting innovation, supported by autonomously produced information through magazines, video, etc.

4.5. Cluster IV: Farms in Innovative Milieus

The fourth cluster consisted of 106 farms, absorbing 24.8% of the total. These farms are mainly located in urban centers and a relevant share of them is oriented towards high quality products, such as organic and geographical indications. These farms are operating in innovative milieus where both interaction and learning logics are at stake. As a consequence, innovation takes on the characteristic of radical innovation, which reveals relatively high impacts (T-value = 10.31), with a special performance from a social point of view. Innovation seems to be the result of an effective interaction logics, where both institutional and horizontal cooperation is at work (T-value = 8.03); however, in a significant number of farms, a full interaction sphere has been found, through either institutional support or cooperation with other farms (formal and informal) and the support of farm advisory services contribute to innovation adoption. This innovation is of a radical type, which will change either current agricultural practices or will affect organization aspects of farm management (T-value = 2.31).

A synthesis of the previous results is mapped in Figure 3, where clusters are positioned according to average values of the first two factorial axes of the multiple correspondence analysis. By taking into account that the first two factors absorb the highest variance and, at the same time, they are explicative of the two logics of interaction (factor 2) and innovativeness (factor 1), the figure provides relevant information about each extracted cluster. The local milieu plays a relevant role in addressing sustainable innovation and high impacts. Effectively, when learning logic is in action, sustainable innovation emerges, both radical (4 cluster) and incremental (cluster 2). On the other side when interaction lowers, reduced levels of impact are found, both in cases of incremental innovation (cluster 1) and radical (cluster 3). Relied to previous considerations, we can affirm the cluster 4 typifies farms working within innovative milieus. These farms are mainly located in cities, that are in densely populated areas.

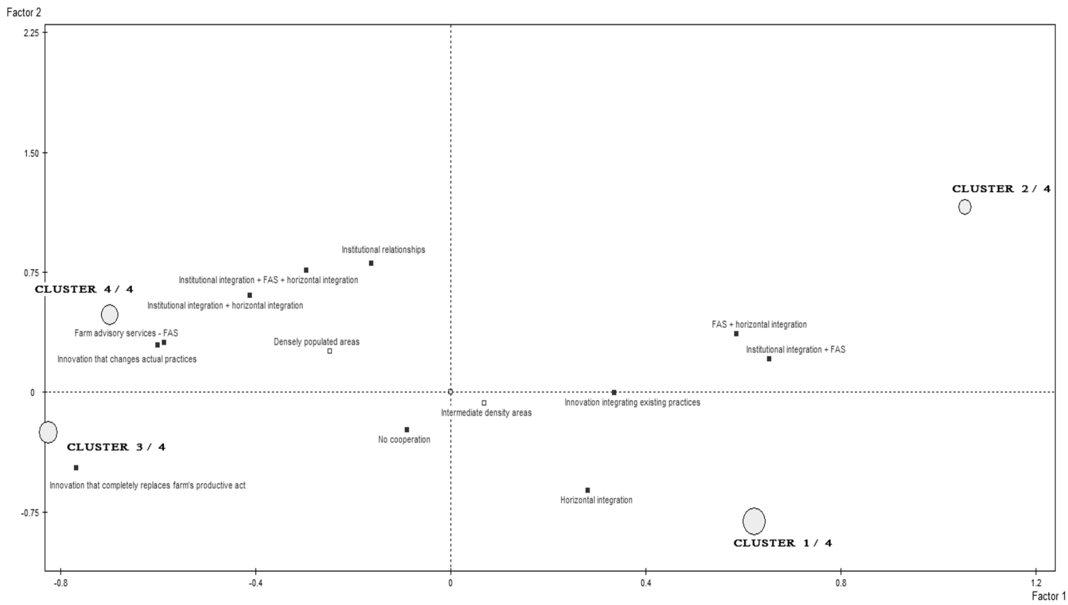

Figure 3. Distribution of clusters according to the first two factorial axes.

5. Discussion and Conclusions

This paper aimed to analyze innovation processes in urban and periurban contexts, under the lens of sustainable innovation in farms managed by young farmers. A limit of the paper concerns the sample of farmers: as a result, the sample is biased and not representative of the Italian context. Nonetheless, the purpose of the analysis was to carry out exploratory research without the ambition to generalize. Therefore, despite this limitation, some important insights emerged: the sample represented a large group of young (under 40) entrepreneurs who are innovators. So, we have a niche of agricultural entrepreneurs who are well aware of the importance of sustainable innovation. This allowed us to obtain more aware opinions dictated by their greater knowledge and awareness of the importance of moving towards sustainable innovation. We believe these indications can be useful for further analysis.

As far as empirical results are concerned, a variety of alterity was revealed in our research, so confirming recent studies of farm's adaptation in urban contexts [68]. This variety developed in different "technological environments", where socialization spaces affect differentiated trajectories of sustainable innovation, so contributing to the design of innovation induced supply chains [69]. An innovative milieu approach revealed its utility in explaining the dynamics of innovation adoption. More precisely, the paper provided a sound answer to the research questions, in that an innovative milieus approach can clearly explicit the mechanisms of knowledge/innovation adoption that young farmers privilege when introducing sustainable innovation in urban contexts. The approach confirmed the "traditional" idea of sustainable innovation as triggered by relational assets, here synthesized through the interaction logics. The presence of the interaction sphere addressed sustainable innovation, by empowering it with high impacts from either an economic, social and environmental point of view. As a matter of fact, an innovative milieu points out the functional repositioning of agriculture, through the specification and valorization of resources in alternative economic circuits [7]. Nonetheless, as previous empirical analyses have demonstrated, not all milieus are to be considered as an engine of innovative entrepreneurship [70,71]. This was evident from our analysis, where farms under investigation showed a relatively high propensity to innovate, which relies on different anchoring milieus. Actually, different logics of interaction bring about diversified paths of sustainable innovation, where various trajectories of resource specification are activated. However, the relevance of the interaction sphere was clear in addressing paths of sustainable innovation, particularly in densely populated areas. Here, innovative milieus are at work in engendering high impact of innovation from either economic, social and environmental point of view.

Our empirical analysis was enlightening in this regard. In both cases of radical (clusters 3 and 4) and incremental (clusters 1 and 2) innovation, the presence of high relational assets and interaction sphere boosted high levels of impact (cluster 2 and 4), then upgraded the sustainability of innovation adopted.

This is particularly true in urban centers, where new processes of relocalization of production-consumption circuits are at stake [72,73]. More precisely, farms localized in urban centers show the dynamics of innovation characterized by the transition towards multifunctional agriculture [71]. In this case, interaction logics is the engone of innovation adoption, bringing about and configuring an innovative milieu. For instance, this happens in some urban contexts marked by the presence of high-quality standards (organic products and geographical indications). This is in line with recent literature on the evolution of farming activity in the urban fringe of Italy, where alternative food networks and community supported agriculture may provide a sound basis for relaunching multifunctional agriculture [68,74].

Despite the relevance of local milieu in affecting the decision of innovation, it cannot be neglected that local milieu may act as a barrier to innovation. Furthermore, barriers to sustainable innovation are intensified by the presence of a not well-developed anchoring milieu and by the presence of a low interactional sphere, which adds up to limited innovativeness and sustainability effects, such as in the farms of cluster 3, which were marked by the absence of forms of cooperation. In this case, innovation is exogenous, not dependent from the local milieu, which feeds a not optimistic view about innovation.

By de facto, economic uncertainty revealed by these farmers raises the perceived complexity [75] and, consequently, barriers to innovation in these farms, as underlined in other studies.

The aforementioned classification presents some policy implications, involving both territorial (urban) and individual (farm) perspectives. From a general point of view, embedding farming activity in densely populated areas implies the recognition of cities as sociotechnical systems [76], which addresses a wide range of territorial, relational and multiactor policies. As far as farming is concerned, anchoring milieu is the basis for sustainable innovation. The absence of a dense anchoring milieu is a key gap to be filled, in order to secure diffusion of "sound and pertinent knowledge", subsequently feeding interaction and learning logics. Against this background, the role of future policies for rural development seems strategic in providing a contribution to solve the problem of the patchy distribution of knowledge in various territorial contexts [77]. As a matter of fact, the next programming period is providing strong support to foster the exchange of sound and pertinent knowledge [31] and, in general, strengthening the agricultural knowledge and innovation system. On a territorial plan, this could be a good occasion to enhance and stimulate cross-fertilization in denser and more effective milieus.

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