

Article

The Role of Education in the Transition towards Sustainable Agriculture: A Family Farm Learning Perspective

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Abstract: This paper deals with the analysis of decision-making processes at the family-farm level with reference to the transition towards sustainable agriculture. Despite literature that has underlined the relevance of education in strategic decision making, less attention has been devoted to the (family) collective decision-making process by taking into account the maximum level of education of the family members regardless of the position and whether they are the manager of the family farm or not. Therefore, this paper tries to fill a gap in literature by emphasizing the family farm's collective decision-making process. In order to empirically measure this relevance, an econometric model was carried out that allowed us to evidence clear differences in the transition paths among various typologies of family farms on the basis of the level of education. Our results confirm the impact of education at the collective family level on transition towards more sustainable agricultural practices. This is particularly true in remote rural areas, where the transition is realized with higher intensity with respect to other territorial contexts. This brings about policy implications on enskilling farmers and upgrading their level of human capital.

Keywords: family farms; education; sustainable agriculture



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1. Introduction

In many parts of the world, the activity of farming is grounded on family farms, whose characteristics are recognized as unique due to high interaction between the productive and the reproductive spheres [1,2]. As pointed out by Dawson and Mussolino [3], uniqueness of family businesses is attributable to: (a) socioemotional wealth (affective endowment), (b) the essence of family business (family involvement), and (c) familiness (unique bundle of resources). This is particularly true in the farming activity, where a family business perspective may explain entrepreneurial processes [1,4] under the hypothesis that the family bears the business risk [5], and decision-making process occur within the collective entrepreneurial processes [6]. This approach offers an interesting perspective on entrepreneurship, providing a “setting where normative systems (affect, altruism, tradition) and utilitarian systems (economic rationality) are combined” [7] (p. 99). Therefore, the farmer's personal attitude to feedback from the family is indicated as strategic skill [8,9].

The analysis of family farm businesses implies high levels of variability in order to take into account the huge diversity among these businesses, like the family composition and stage of life cycle [10,11]. On the other side, a common trait of the family business is linked to the high levels of persistency due to the collective entrepreneurial traits and to the F-connection (family, friend, firm) boosting higher resilience [12–14]. With this respect, Ben-Porath [14] (pp. 3–4) is enlightening: “The most important characteristic of the family contract is that it is embedded in the identity of the partners without which it loses its meaning.”

Due to the importance of the family context in European agriculture, Common Agricultural Policy (CAP) has devoted much attention to family farm businesses by providing

family farms with a large set of measures to support farm strategies [5,15] and downsize the constraints affecting rural areas. As underlined in official documents developed by international institutions, like the OECD [16] and the European Union [17], rural areas are typified by the presence of four dimensions feeding a vicious circle: demography (mainly ageing population), remoteness (lack of services and infrastructures), education, and, as a consequence, lower job opportunities.

In order to revert this path, sustainable rural development is boosted as an alternative paradigm grounded on place-bound strategies of agriculture. Banks et al. [18] identified the boundary shift as a fundamental strategy for implementing new entrepreneurial activities based on deepening (valorisation of agricultural products at farm level, direct selling, organic farming, etc.) and broadening (diversification of farming activity, for instance, through promotion of agritourism). Both deepening and broadening strategies shape the new paradigm of agriculture and provide farmers with value-creation strategies, allowing them to escape the price-costs squeeze characterizing conventional farming [10]. These development paths are designed along alternative and sustainable modes of food provisioning based on high quality products and diversification strategies that address rural innovation [19]. Consequently, rural innovation is identified as a must for rural regions. Moreover, human capital is addressed as a key driver of innovation [20] due to its empowering and transformative role in shaping farmers' behaviours [21]. Accordingly, education, one of the key dimensions of human capital, is of paramount importance to positively impact on economic growth [17] and boost transition to sustainable agriculture [22–24]. Moreover, one of the dimensions taken into account in the CAP is related to the upgrading of the level of family education under the hypothesis that, among various motivations for farmers to adopt sustainable innovations [25], high levels of education may accelerate the transition towards the new European agricultural model based on multifunctional agriculture [26]. The underlying hypothesis makes reference to Venkataraman's [27] call for an education for sustainable development grounded on the idea that family individuals can take part in boosting development paths through enabled levels of knowledge and skills. Framed within the context of the family farm, the entrepreneurial household literature emphasises the links between the family and the market [7] and then bridges the theories of expansive learning where "learning proceeds through complex cycles of learning actions in which new objects and motives are created and implemented, opening up wider possibilities for participants involved in that activity" [28] (p. 458). Set against this background, education is of paramount importance.

The role of education, a key element of human capital, in farming activity has been deeply recognized in literature concerning both developing and developed countries. Starting from the seminal work of Becker [29], an abundant literature points out the importance of human capital with main reference to the increase of agricultural productivity and innovation [30–34]. As far as transition towards sustainable farming is concerned, education is underlined as specific competence in numerous studies, as in the case of agroecological transition [35]. Moreover, a large body of literature emphasises the various forms of education as fundamental for boosting transition towards sustainable farming [36–38], which addresses normative implications in terms of educational programmes to support farmers in transition [18,39].

Despite a growing body of literature focusing on the relevance of education, it is possible to identify a gap that this paper aims to fill: the level of education taken into account when analysing the family farm business is usually in reference to the farm manager. Our work provides an original contribution in that it assumes the collective level of education within the family. This aim is framed within the "kinship and business" literature [7] and is linked to the idea of cultural mediation within a collective process developed at the family level.

This paper tries to fill the aforementioned gap in literature by considering the family farm framed in a collective process of decision making affected by the level of formal education of all family members. Therefore, the aim of the paper is to analyze the role

of (collective/family) education in transition towards sustainable agriculture. We will analyze this influence through the lens of activity theory and expansive learning [40], where mediation mechanisms are carried out at family farm level and where level of education may act as mediating factors.

Activity theory is rooted in the Russian historical cultural approaches [41,42] with special reference to Vygotsky's [42] cultural perspective grounded on the mediation triangle, which attributes relevance of cultural factors and artifacts (developed within institutions like the family, the school, etc.) in shaping an individual's psychology. This definition links activity theory to original institutional economics [43], focused on the role of institutions as "durable systems of established and embedded social rules that structures social interactions" [44] (p. 655). Consequently, according to institutional theory, the institutions' potential for moulding and changing individual dispositions and aspirations is emphasised [45]. Similarly, Leontyev's version of the activity theory stresses how individual and group actions are entrenched in a collective activity system [46]. Set against the background of collective decision making at family farm level, the following principles identify the current activity theory approach [47]:

1. Activity regards the decision-making process bringing about adopting or not sustainable agriculture;
2. Object concerns the motives boosting transition toward sustainable agriculture;
3. Subjects responsible for adopting the decision are not only the farm manager. In our research, we attribute a key role to the entire family unit;
4. Tools, whose role is mediating the object of activity;
5. Rules, here considered as rules of thumb regulating the family farm decision making;
6. Division of labor, indicating the ways the responsibilities of value creation are distributed within the community (that is, within the family);
7. Community, that is, the wide array of actors involved in the supply chain of farm products and data (including consumers);
8. Outcomes refer to possible transition towards sustainable agriculture, bringing about more agronomically sound agricultural practices.

Set against the activity theory approach, transition towards more sustainable agricultural systems is assimilated to a transforming experiment, which "radically restructures the environment, producing a new configuration that activates previously unrealized behavioral potentials of the subject" [48] (p. 528). This experiment involves a decision-making process which is analyzed here as the outcome of collective action, carried out at level of a community (the family) sharing same interests. In this paper, the community concept is drawn on Lioutas et al.'s [47] sense, as the group of persons who hold the farm.

Therefore, the family farm is unit of analysis and is considered as the subject of a learning process, which, in line with the cultural history activity theory, is shaped and addressed by a set of institutions rooted in cultural history of each family member. As a consequence, decision making at family farm level is characterized by progressive conflicts between different attitudes or institutions shaping perception and behavior of each individuals and bringing about heterogeneous possible consequences. For instance, intergenerational conflicts are the basis of maintenance of the status quo at family farm business [49]. Cultural mediation is also central in the activity theory in that activities are always mediated with human-made artifacts [50]. In this paper, we posit that cultural mediation happens within the family context with the purpose of planning future strategies of the family farm. This cultural mediation is not free of conflicts, above all, between young and elderly generations, each one linked to a set of institutions in the sense of habits, conventions, and ways of doing things [51]. How education enters into the decision making is a relatively unexplored field of analysis. As a matter of fact, level of education may hold a specific relevance in decision making regardless of the degree of involvement in farming activity. This means that a family member with a relatively good level of education who is not the farm manager may affect the family farm's strategic decision. This is particularly important if we contextualise the analysis according to the various and differentiated rural

contexts classified according to the EU directive as: urban poles (A), areas with intensive and specialized agriculture (B), intermediate rural areas (C), and rural marginal areas (D). Agricultural models and practices may be largely diversified: for instance, in areas with intensive agriculture the agroindustrial model of agriculture, working in globalized agrifood chains may be dominant. On the other side, in peripheral areas, remoteness and infrastructural constraints impede cost-leadership strategies, boosting farm diversification in order to escape the price-costs squeeze [36]. Consequently, the territorial dimension must be considered jointly with the educational profile in the analysis of strategic decision making of the family farm business.

2. Material and Method

Human capital can be measured through various indicators, such as education, information, and knowledge. Our paper focuses on the level of education: the hypothesis to be tested is that the level of education affects the probability to engage in virtuous paths of transition towards sustainable agriculture. Coherently with the activity theory and differently from other analyses, we consider the maximum level of education of the family members of the family farm business under the hypothesis of a collective decision-making process.

The sample was extracted from the Farm Accountancy Data Network (FADN), which contains relevant information on educational qualification in the family farm members distributed at regional and local level. The FADN is a Europe-wide survey launched by the European Commission in 1965. It is the official reference and source for microeconomic analysis of the agricultural sector based on harmonised accounting principles. The Italian survey consists of an average of 11,000 annually sampled farms that are representative at the regional level. The representativeness of the farms is such that it provides a realistic picture of the different types and sizes of production present on the national territory, allowing a national average coverage of 95% of the Utilised Agricultural Area (UAA) and 97% of the value of standard output. The FADN, as a sample survey, suffers from some limitations among which is the lack of inclusiveness of small farms that are not commercial despite being recipients of the Common Agricultural Policy premiums [52,53].

Our sample is represented by 9032 farms. In order to discriminate propensity to sustainable agriculture, we focus on sustainable agricultural practices as recognized by the CAP. Therefore, collected data involve organic farming, geographical indications (protected designation of origin—PDO—or protected geographical indication—PGI), integrated farm management practices, and other sustainable agricultural practices. In order to estimate the probability of transition towards sustainable farming practices, a multilevel logit model with random effects was carried out.

Explicative variables refer to education and farms' territorial location. More precisely, coherently with the idea of cultural mediation developed within the activity theory, we assume that each member of the family is able to interfere in the collective-family strategic decision making. Therefore, as far as level of education is concerned, we consider the maximum level of education held by the family members living in the family farm. To this end, seven levels of education are considered:

1. No qualification/primary school certificate.
2. Secondary school certificate.
3. Professional qualification diploma.
4. High school diploma.
5. University diploma or short degree.
6. University degree.
7. Postgraduate specialisation.

As far as the territorial dimension is concerned, following the rural development policy (RDP) of the EU, we take into account the four homogeneous areas identified by the Italian National Strategic Plan (NSP) for rural development:

1. Urban poles (A);

2. Areas with intensive agriculture (B);
3. Intermediate rural areas (C);
4. Rural marginal areas (D).

Farmers' education and farms' territorial localization generated random effects on the logistic regression model. Following Hox et al.'s [54] multilevel logistic regression assumes the presence of at least two levels, as in the following formula:

$$\text{Logit} (\pi_{nj}) = \alpha + u_j + \beta X_{nj}$$

In our work, the random effect that we include in the equation modifies the formula in this way:

$$\text{Logit} (\pi_{nji}) = \alpha + u_j + \beta X_{nji}$$

where:

- X_{nji} represents the highest level of education on the farm;
- u_j represents the random effect due to the territory in which the farm is located, specifically PSN areas were analyzed.

In line with the hypotheses for the implementation of the model, pure logistic regression with fixed effects was first carried out. The relationship $Y = \alpha + \beta X$ is conditioned by the independent variable, which is identified by the different levels of the maximum educational qualification. A total of seven levels of education are identified; furthermore, we assumed that the variable X is continuous because the objective is to observe the trend of the probability curve and not how the probability reacts to each individual level of education. The dependent variable Y of dichotomous type is represented by the probability of either adopting or not adopting trajectories linked to sustainable agriculture. Subsequently, how the random effect of the NSP area changes the trend of the curve derived from the fixed-effects regression is analysed. The curve generated by the regression (fixed-effects) will be used as a comparison term after the subsequent development of the mixed-effects logistic regression, $Y = (\alpha + \text{va}) + \beta X$, which includes both fixed and random effects. The random effect (va-territory) is represented by the NSP areas (A, B, C, D). For this mixed-effects model, the probability distributions resulting from the same query as for the fixed-effects model are analyzed. In particular, we examine how fixed effects and random effects affect the probability of moving towards sustainable farming models. In this regard, the calculation of the dependent variable Y will serve to better understand how the transition is linked to the variables used for the study. The applied model presents limitations concerning the interpretation of the effects of a treatment, which may vary from one group to another. Therefore, it is only possible to estimate an average effect without providing indications on the intensity of the effect on a specific group or on the degree of variability of the effect between clusters, which raises problems of result generalisation [55].

3. Results

All the elaboration was run with the SAS software. From the initial sample of 9032 farms, the information regarding the highest qualification of the family members is found in 8049 farms.

Contingency tables were created by the model in order to understand in percentage and frequency terms what kind of relationships exists between the variables taken into consideration for observation.

Table 1 links the education level variable with the RDP area variable.

Table 1 shows the frequencies and percentages of educational attainment in relation to the area in which the farms are located. The highest percentages of educational level were found in zones C and D.

Table 1. Maximum title of study for different NSP.

NSP Areas	Statistics	1. No Qualification/Primary School Certificate	2. Secondary School Certificate	3. Professional Qualification Diploma	4. High School Diploma	5. University Diploma or Short Degree	6. University Degree	7. Postgraduate Specialisation	Total
A	Frequency	39	64	29	76	4	40	1	253
	%	0.48	0.80	0.36	0.94	0.05	0.50	0.01	3.14
	% row	15.42	25.30	11.46	30.04	1.58	15.81	0.40	100.00
	% column	5.27	2.56	2.29	2.74	3.60	6.23	7.14	
B	Frequency	204	623	341	710	37	139	1	2055
	%	2.53	7.74	4.24	8.82	0.46	1.73	0.01	25.53
	% row	9.93	30.32	16.59	34.55	1.80	6.76	0.05	100.00
	% column	27.57	24.94	26.94	25.56	33.33	21.65	7.14	
C	Frequency	305	878	408	1164	42	257	3	3057
	%	3.79	10.91	5.07	14.46	0.52	3.19	0.04	37.98
	% row	9.98	28.72	13.35	38.08	1.37	8.41	0.10	100.00
	% column	41.22	35.15	32.23	41.90	37.84	40.03	21.43	
D	Frequency	192	933	488	828	28	206	9	2684
	%	2.39	11.59	6.06	10.29	0.35	2.56	0.11	33.35
	% row	7.15	34.76	18.18	30.85	1.04	7.68	0.34	100.00
	% column	25.95	37.35	38.55	29.81	25.23	32.09	64.29	
Total	Frequency	740	2498	1266	2778	111	642	14	8049
	%	9.19	31.03	15.73	34.51	1.38	7.98	0.17	100.00

In the following Table 2, the frequency of farmers taking on sustainable trajectories is illustrated.

Table 2. Response profile.

Value	y	Frequency
Conventional	0	5055
Multifunctional	1	2994

Table 2 shows that out of the total of 8049 observations, 5055 farms opted for conventional farming models, while 2994 farmers adopted sustainable farming. The quality and consistency of these observations is confirmed by the state of convergence of the model, which is satisfied for the criterion ($GCONV = 1 \times 10^{-8}$). The estimation statistics covered the following criteria shown in Table 3.

Table 3. Model estimation statistics.

Criterion	Only Intercept	Intercept and Coovariate
AIC	10,626.627	10,492.662
SC	10,633.620	10,506.649
-2 Log L	10,624.627	10,488.662

Once the fitness of the model was estimated, it was possible to identify the mixed-effects model to define the value of the intercept and the fixed effect, the maximum level of education. Both are significant, as shown in Table 4. At this point, the solution for random effect, the NSP area, is determined, as shown in Table 4 below. In this case, although the estimates show different impacts, none of the modes is statistically significant.

Table 4. Solution for fixed and random effects.

Effect	Estimation	Standard Error	DF	T-Value	Pr > t
Intercept (α)	−0.8704	0.1813	3	−4.80	0.0172
Fixed: Max level of education (β)	0.1981	0.01749	8040	11.32	<0.0001
Random: NSP AreaA	0.06137	0.2120	8040	0.29	0.7722
Random: NSP Area B	−0.3152	0.2016	8040	−1.56	0.1180
Random: NSP AreaC	−0.00799	0.2016	8040	−0.04	0.9684
Random: NSP Area D	0.2618	0.2023	8040	1.29	0.1957

The estimates in the column impact the coefficient α , which is determined through the solution for fixed effects. Therefore, it is possible to obtain the four lines in Table 5 to describe the random effects plus one from the fixed effects. These values are added to the intercept, resulting in a shift of the curve above or below the fixed-effects curve depending on the sign and magnitude of the estimate. For the random effect, a value has been estimated for the four NSP areas, which affects the trend of the fixed-effects curve. Actually, if we add the estimates referred to the four areas to the value of the intercept of the fixed-effects curve and keep stable the estimated parameter for the independent variable, we obtain another four curves. Two of these curves are below the reference curve for areas C and B, while the other two curves, referred to as areas A and D, are above it. The value referred to as area B and the one referred to as area D represent the extremes of the displacement as they present more sustained values. The curve referred to as area B moves far below. On the contrary, the curve referred to as area D moves far above the curve that does not consider random effects. In order to better understand the logical transition, we have constructed the hypothetical lines that would be created if the parameters estimated by the model were available.

Table 5. Hypothetical lines with random effect.

Function	Effects
$y = -0.8704 + x (0.1981)$	Fixed effect (only max title of study)
$y = -0.80903 + x (0.1981)$	Random effect (area A)
$y = -1.1856 + x (0.1981)$	Random effect (area B)
$y = -0.87839 + x (0.1981)$	Random effect (area C)
$y = -0.6086 + x (0.1981)$	Random effect (area D)

Figure 1 below shows what the hypothetical course of the lines might look like if one simply changed the coefficient of the intercept of the fixed-effects line.

The explanation of the lines is to be found in the assumptions of the model. The level of education determines the increasing trend of the fixed-effects line and thus the increasing probability of farms moving towards sustainable farming models. Therefore, the contribution of higher level of education to transition toward sustainability seems undisputable. The intervention of random effects has a major influence on the study of the probability of farms moving towards sustainable farming models. Most interestingly is that for increasing levels of education, the probability of environmentally sound farming is higher in D areas and lower in B areas. The practical explanation for the graph is that D areas are rural areas with development problems, e.g., mountainous areas where it is necessary to diversify activities in order to have a profit margin. Nonetheless, diversification of farming activity is the result of a strategic process requiring high skills and competencies jointly with high levels of human capital. Therefore, the model shows that for high levels of education, the likelihood of diversifying is higher in more disadvantaged areas. More educated entrepreneurs whose farming activity is carried out in disadvantaged areas need

to diversify away from traditional uses and, for example, towards organic farming, quality production (PDO/PGI), and other sustainable practices.

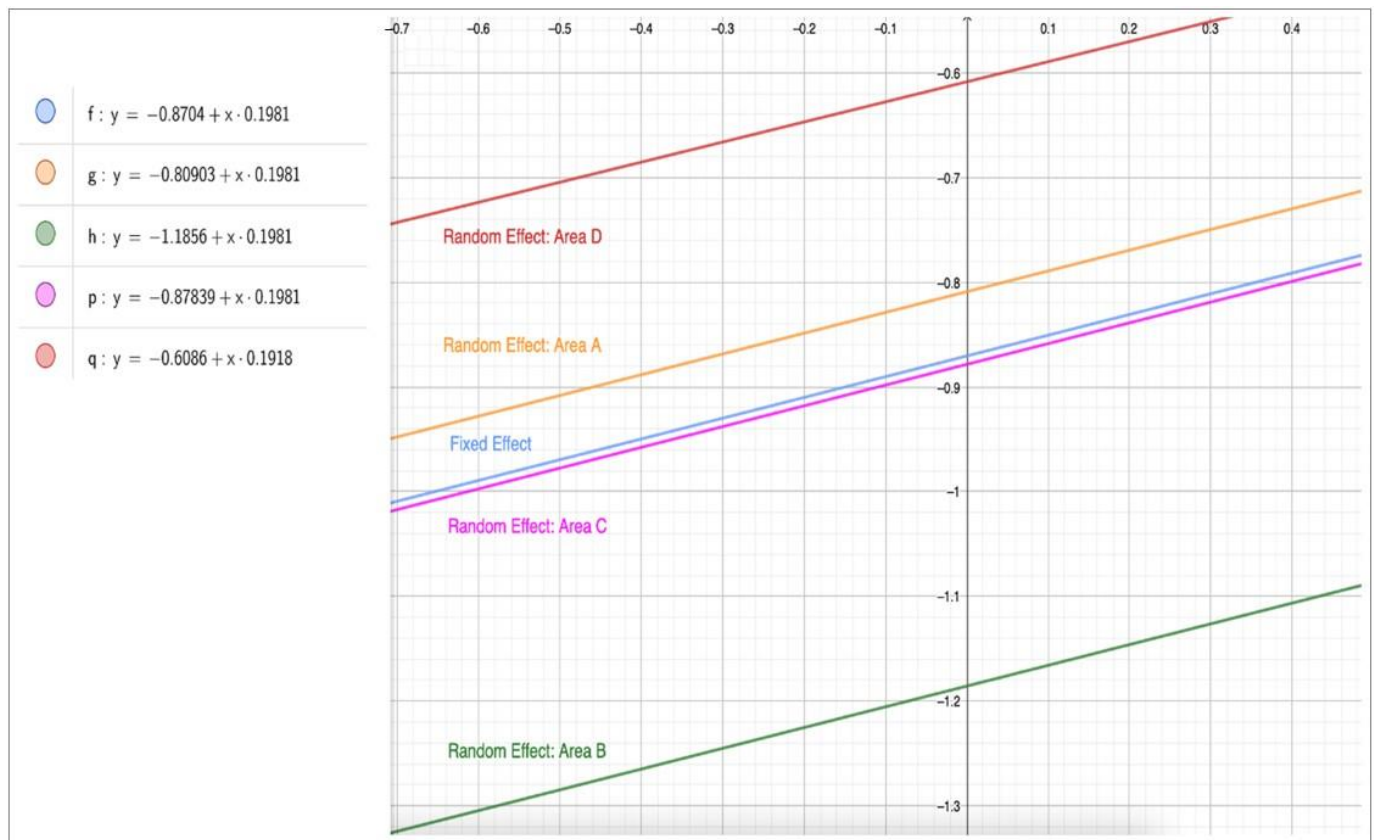


Figure 1. Graphical representation of hypothetical random-effect lines.

4. Discussion and Conclusions

Under the perspective of activity theory, the mediating role of the family in addressing farm strategic decision was investigated. The empirical analysis confirms the hypothesis that the highest level of education has the largest impact.

Nonetheless, the paper presents a limit in that the analysed links between levels of education and transition towards sustainable agriculture needs to be investigated also through field researches with the purpose of clarifying the effective mechanisms of decision-making mediated by the level of education. Therefore, future field analyses will be implemented.

Despite this limit, this work may represent a starting point to develop further researches on the role of the collective family farm's process of decision making in the transition towards sustainable agriculture. As a matter of fact, the paper provides sound relevance of the links between level of (family) education and adoption of sustainable agricultural practices. Set against this background, it provides original contribution with respect to other analyses, which have mainly investigated the impact of education on productivity and on the adoption of technologies [28,56]. Moreover, the role of education for boosting sustainable farming was explored through the lens of the sole farm manager's perspective. Additionally, the territorial dimension we introduced in our analysis has already been considered in literature but set in the context of raising productivity [24]. With respect to previous researches, the empirical analysis carried out has shown the goodness of this original approach from the two perspectives adopted here:

- a. Family perspective, in that the cultural mediation underlined in the activity theory seems effective in explaining the decision of transiting towards sustainable agriculture. As a matter of fact, the highest level of education does not always coincide with

the farm manager's level of education, then implying an influence of other family members in decision making.

- b. Territorial perspective; what is said in the previous point is particularly evident in rural marginal areas (D areas of the national strategic plan). Actually, the intensity of transition towards sustainability is higher when the farm is located in remote rural areas.

Empirical analysis addresses some policy implications at both the farm and territorial level. If, on the one side, literature has underlined the role of educational programs in governing transition towards sustainable farming [31], on the other side, by focusing on the family farm business, our findings recall the need for more inclusive educational programmes which empower family farms with effective, life-long training systems due to the high impact education has in affecting strategic decision making. Moreover, it is necessary to raise the educational standard in rural remote areas, which benefit the most from high levels of education.

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