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Is Sustainability Compatible with Profitability? An Empirical Analysis on Family Farming Activity

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Abstract: Sustainability is a social concern and a new strategic factor for productive and economic viability. Nevertheless, research on this subject in a holistic approach is limited, and even to a lesser extent when dealing with family farms. This paper analyzes the impact of different aspects of sustainability (socio-economic characteristics, environmentally respectful practices, and innovation) on profitability. The data collection instruments include a survey questionnaire on farming in Almería, a province in Southeast Spain, and the methodology followed involves a two-step regression model. The main results show how several socio-economic and environmental-innovation features of family farms have positive effects on their economic performance. Among others, profitability increases when there are better educated and younger family farm decision-makers; the farm is specialized and supported by more efficient cooperatives: and, particularly, when the family farm displays greater concern for environmental practices and better disposition towards agroecological innovation.

Keywords: profitability; sustainability; socio-economic dimension; environmentally respectful practices; innovation; family farm

1. Introduction

Precisely as in other productive sectors, achieving sustainability in agriculture is a growing concern in modern-day societies. Nevertheless, this activity tends to be more scrutinized by the public [1] due to the fact that it traditionally carries various social implications, e.g., the development of rural areas and the supply of foodstuffs, in addition to environmental aspects, e.g., the use of basic natural resources, such as land and water. These facets are closely linked to the concept of multifunctionality, commonly attributed to farming as inherent features to achieve the ultimate goal, i.e., sustainability [2].

Due to these specific characteristics, farming is, in some cases, looked upon from a perspective that differs from that of the traditional economic and productivism view ("homo economicus") of modern societies [3,4]. Therefore, although sustainability from a holistic point of view (triple bottom line: environmental, economic, and social) should also be the objective in agrarian activity, support policy tends to be regarded as the necessary complement for economic viability, e.g., profit of farming [5]. As a result, in many cases, profitability is not a characteristic normally related to, or enhanced by, the influence of social or environmental dimensions in this sector [6].

Albeit that in other productive activities there has been intense analysis of the relationship between environmental performance and profit, e.g., the Porter hypothesis [7], and the relationship of profit with social sustainability objectives, e.g., social responsibility [8], this is not the case for studies focused on agriculture [6,9].

There are a number of analyses that demonstrate how the implementation of more sustainable practices can improve farmers' competitiveness and profitability. In this way, Brouwer et al. [10] explain how environmentally respectful practices of agrifood exporters in New Zealand have increased the demand for this country's produce. Danso et al. [11] analyse the relationships between sustainability and profitability for vegetable-growers in the urban agriculture of Ghana. O´Reagain and Bushell [12] present the effects of environmental management on profit in semiarid grasslands in northern Australia. Galdeano-Gómez [13] describes the relationship between environmental performance and profitability in the agrifood sector in the Mediterranean area of Spain. Martens et al. [6] analyse how ecologically-based farming systems in Canada provide greater economic stability.

To a large extent, it is believed that the relationship existing between the economy and the components of sustainability owes it to the capacity of family farm-based systems to adapt and implement sustainable practices [14,15]. Family farms play a key role in long-term maintenance of the economy in rural areas specializing in agricultural activities due to their knowledge of local production, their ability to adapt and the fact that their know-how is handed down over the generations [16]. Consequently, various socio-economic characteristics (e.g., family decision-makers, labor specialization, experience, cooperative organization, etc.), as well as greater concern for the use of natural resources and specialization in environmentally respectful practices, are strongly associated with family farming systems [17].

These features allow encompassing social and ecological aspects better than other productive organizations, e.g., agribusiness, and provide a profit in harmony with the other components of sustainability [15]. That is, the motivation of family farms often goes far beyond maximizing their profit, promoting other sustainability benefits to the community and the environment [17]. For instance, [18] show how these family-run productive organizations have been the key for the sustainability (economic, social, and environmental) of the agricultural sector in Southeast Spain, bearing in mind that little aid has been received from public institutions [19]. In this way, the capacity to generate economic profit also serves to maintain a self-sustaining activity (socio-economic dimension) and, in general, allows farmers themselves [14] to adapt to changes in support policies, e.g., Common Agricultural Policy reforms, maintaining their multifunctional purpose and sustainability goals [20]. In this sense, multifunctionality is considered a series of capabilities and characteristics that make the objectives of sustainability possible [2].

Within this context, one of the factors that tends to attract the greatest deal of interest is environmental innovations, which in specific farming systems are making possible a more sustainable and, at the same time, profitable method of agriculture [21]. Although innovations in agriculture have been traditionally associated with productivity, other specific measures are linked to reduction in the usage of water, land and other natural resources [22]. Additionally, production and intensive farming processes must be accompanied by a balanced use of inputs, an appropriate management system and an awareness of the limits of productivity [22]. It is precisely for this reason that when it comes to managing new innovations, the system of family-farming tends to play a fundamental role towards achieving adequate sustainability [17]. Furthermore, said innovations imply aspects, such as better specialization and organization among farmers, which, in turn, favors greater economic viability [23].

Recently, there have been some studies demonstrating how environmental innovations impact farming from previously-described point of view. Kemp et al. [21] reveal how farmers can achieve 'win-win' outcomes in grassland in China and Asia. Additionally, Pretty et al. [24] demonstrate the economic effects derived from sustainability intensification (such as the implementation of integrated pest management) in farming areas in Africa. Aznar-Sánchez et al. [25] describe the economic success of the agricultural system in southeast Spain, which is linked to innovation processes related to the use of natural resources and practices that are more respectful of the environment. Alarcón and Bodouroglou [26] study the role of family and gender in the management of innovations to make them more sustainable in the international context. Nevertheless, there is a lack of analysis relating the described factors more specifically to each other [22].

The objective of this paper is to provide evidence of relationships between profit and sustainability. Although said relationships can be understood in both senses, this initial approach is focused on the socio-economic factors, and also those associated with family farms' environmental innovation, which may have an impact on profitability (see Figure 1). To this end, our empirical analysis is based on the agrarian system in Almería, a province in Southeast Spain, characterized by a structure consisting of small-scale family farms, and which has experienced an unprecedented transformation in the last 50 years. The main aim is not only to consider whether the profit of a family farm is compatible with sustainability from a holistic approach, but also to investigate how they are related.

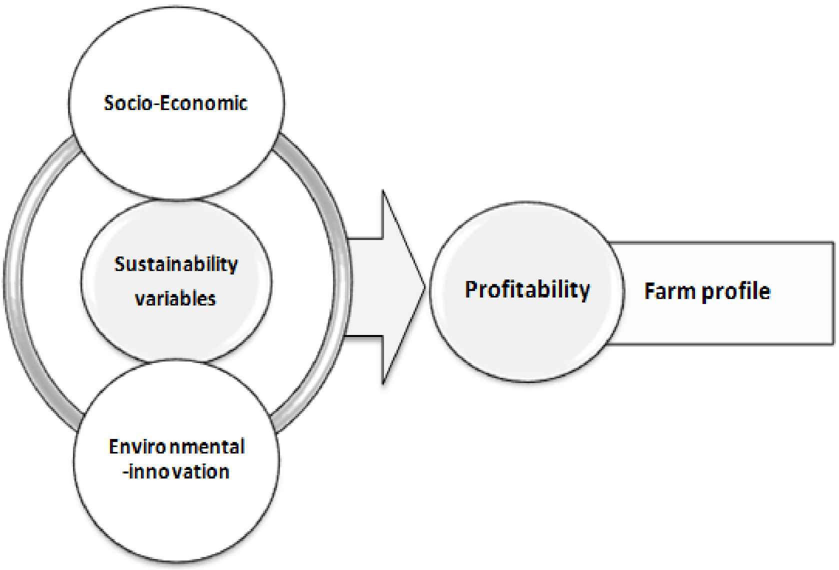

Figure 1. Overall diagram for relationships studied.

The present work, therefore, contributes to the literature on agricultural sustainability by: (a) analyzing farming sustainability from a multidimensional point of view; and (b) obtaining evidence of sustainability as a driver of profitability for family farms.

The rest of the paper is organized as follows: the section below briefly describes the characteristics of the sector of study, the data used, and the applied methodology; the various estimations and results are then presented; and, finally, the paper is concluded with a discussion of the main findings and certain concluding remarks.

2. Empirical Analysis

2.1. Case Study

We take family farms in Southeast Spain, particularly in the coastal areas of the provinces of Almería, and partly Granada (see Figure 2), as our reference case. This unique model is the most important driver of the enormous socioeconomic development the area has undergone in the last five decades, due to the hugely successful agricultural activity and tremendous effort on the part of family farms. Farming represents 27% of employment and 24% of GDP (gross domestic product) in this region [25].

Figure 2. Agrarian area in Southeast Spain.

Regarding socio-economic context, the production structure consists of around 15,000 family farms, with a mean size of 2.5 hectares. The surface covers 29,597 hectares and produce reaches 3,227,923 tons (approximately 30% of all vegetables grown in Spain), destined for both the domestic and foreign markets. Major crops include eggplant, zucchini, green beans, melon, cucumber, pepper, watermelon, tomato, and lettuce [27]. This familiar structure is also interesting from the point of view of gender equality, as about 45% are jointly owned by men and women. More than 90 farmer-owned cooperatives are currently operating in the area providing either specialist or general services. Most of the farmers are members of one or more cooperatives (marketing, supply, or financing cooperatives). However, other types of organizations in this system are also worth noting, namely the 16 irrigation communities, which include all of the growers, the farmers' associations (e.g., Association of Producers of Fruit and Vegetables in Andalusia, APROA), and the cooperatives' associations (e.g., the Association of Growers and Exporters of Fruit and Vegetables of Almería, COEXPHAL), which have played an important role in coordinating collective objectives.

In reference to the environmental innovation context, specific mention must be made of growers' strong disposition towards applying new farming techniques and technologies related to efficient resource usage. Said technologies have been applied in biological agriculture, which uses organic production and integrated pest management (IPM), representing over 90% of total production [28].

This strongly social agricultural model combines socioeconomic and agroecological goals, both of which are considered essential for sustainable development (Figure 3). At present, the major concern of these small family farms is not only to make their produce as healthy and profitable as possible, but also for the whole process to become sustainable by optimizing use of basic natural resources, such as soil and water. The use of these resources is highly efficient compared to other Spanish agro-food systems [18]. The combination of this ecological concern, sound economic performance, lack of profitable investment alternatives in other sectors and the availability of credit for agriculture, is contributing to the renewal and upgrading of an environmentally-friendly productive infrastructure.

Figure 3. Some pictures of agrarian system studied.

2.2. Data and Methods

Family farms were chosen by random cluster sampling in this area and they were surveyed during the 2014–2015 horticulture growing season (September to June), obtaining 102 observations. The design of the surveys aimed at family farms was made up of different dimensions which enabled us to evaluate their approach to sustainability and profitability: current status of the family farm, crops grown by the family farm, environmentally-friendly practices, proactivity towards innovation, etc.

As mentioned above, profitability is generally considered the most important measure of competitive success as enhancing a farm's profitability would also enhance its competitiveness [29]. In the estimated model this measure is the dependent variable, which has been calculated as the current profit per farm.

As drivers of profitability, i.e., independent or explanatory variables, we have considered different dimensions of sustainability, grouped into two blocks: (a) socio-economic characteristics of the farms; and (b) environmental and innovation variables. Table 1 details these variables used in the estimation and Table 2 shows their descriptive statistics.

Table 1. Explanatory variables.

Sustainability Dimensions	Variables	Description
Socio-economic variables	DM (Decision-Markers)	Number of family farm decision-makers.
	FA (Farm decision-markers´ Age)	Family farm decision-makers' age.
	FED (Farm decision-markers´ Education)	Family farm decision-makers' level of education. Measured on a scale of 1 (no education), 2 (primary education), 3 (middle school), 4 (high school or vocational training), or 5 (university or higher education).
	GEN (Generation)	Number of generations that have run the family farm. This is indicative of the farm's age.
	SC (Scale)	Number of hectares cultivated by the family farm, as an indication of the farm's size.
	SP (Specialization)	Level of specialization, i.e., number of crops cultivated by the family farm. Thus the lower this variable is, the higher the family farm's specialization.
	COP (Cooperatives)	Cooperatives efficiency, i.e., the family farm's valuation of the efficiency of the marketing cooperatives in the sector.
Environmental-innovation variables	OPM (Organic Production Management)	Organic production and/or integrated pest management (in kilograms) per hectare of total cultivated area. A weighted mean of all the crops was calculated.
	EC (Environmental Certification)	Other environmental certifications not related to production. Dummy variable scored 0 (No) and 1 (Yes).
	DL (Daily Life)	How much the family farm tries to develop environmental-respectful practices in their daily life. Measured on a scale of 1 (not at all) to 5 (very much).
	SEC (Sector)	How family farm feels the influence from the sector to more aware about environmental sustainability. Measured on a scale of 1 (less) to 5 (more).
	EII (Environmental Innovation Investment)	It indicates whether the family farm invests in any agroecological improvement, innovation or new technology for reducing environmental impact.
	RD (Research and Development)	Family farm's proactive work with research centers and universities on new environmental-respectful cultivation techniques and structural innovations in the farm to improve their competitiveness, scored from 1–5.
	LI (Labor intensity)	Average number of workers per cultivated area (hired and family workers). Thus the lower this variable is, the higher the family farm's use of technology.

Source: The authors.

Table 2. Descriptive statistics of variables [1].

Variable	Mean	Std. Dev.	Min	Max
PROFIT [2]	34,180.42	43,553.18	−5000.99	243,909.20
DM	1.96	0.94	1	4
FA	45.67	10.14	22	66
FED	3.11	0.99	1	5
GEN	1.94	0.75	1	4
SC	3.01	3.21	0.4	20
SP	1.76	0.84	1	4
COP	3.94	0.75	1	5
OPM [3]	89,458	27,300.4	17,308.4	156,586.5
EC	0.22	0.42	0	1
DL	4.18	0.96	1	5
SEC	3.45	1.45	1	5
EII [2]	3651.28	4217.06	1240	9150
RD	3.54	0.89	1	5
LI	1.77	1.1	0.57	6.5

[1] Number of observations = 102; [2] In euros; [3] In kilograms.

For the estimation method, a general multi-variant model is followed:

$$Y_i = \beta_0 + \beta_1 \cdot X_{1i} + \beta_2 \cdot X_{2i} + \beta_3 \cdot X_{3i} + \ldots + \varepsilon_i; \varepsilon_i : N(0, \sigma^2) \quad (1)$$

where Y is the profitability, X is the value of each of the explanatory variables, and β_j is the parameter to be estimated; the subscripts refer to the family farm i. Assuming that the residuals ε_i are normally distributed and have a constant variance, ordinary least squares (OLS) is the best linear unbiased estimator of unknown parameters [30].

Multicollinearity and correlation with the error term have been studied first (Appendix A, Table A1). Moreover, the variance inflation factor (VIF) was also calculated (these results are available upon request). All VIF values were below the recommended value of 5 [31], so multicollinearity is not a problem (these results are available upon request).

A first regression analysis was carried out. Preliminary tests (Breusch-Pagan tests) show signs of heteroskedasticity. This problem was corrected by performing a robust regression, i.e., finding a heteroskedasticity robust variance-covariance estimator (Appendix B includes diagnostic plots).

In order to test the impact of the two different groups of exploratory variables on profitability, the variables were entered in two steps: (1) only socio-economic variables; (2) environmental-innovation variables included.

3. Estimations and Results

The econometric program used is Stata (vs. 13). Table 3 shows estimations.

Table 3. Estimations [1].

Explanatory Variables	Step 1	Step 2
Constant	30,005.65 (0.8)	−28,587.27 (−0.69)
DM	−17,372.82 ** (−2.69)	−18,026.06 *** (−3.51)
FA	−108.09 (−0.17)	−1155.32 * (−1.74)
FED	2409.39 * (1.74)	5060.31 * (1.79)
GEN	2407.08 (0.5)	−10,913.85 * (−1.77)
SC	7114.65 * (1.72)	5697.09 * (1.75)
SP	−12,416.13 * (−1.73)	−6158.12 (−1.27)
COP	6982.89 (1.16)	11,485.37 * (1.89)
OPM		0.53 *** (3.95)
EC		21,748.94 (1.62)
DL		14,327.50 ** (2.26)
SEC		−7819.90 ** (−2.23)

Table 3. *Cont.*

Explanatory Variables	Step 1	Step 2
EII		6766.55 * (1.82)
RD		7090.29 (1.61)
LI		−7982.28 * (−1.99)
R^2	0.40	0.65
ΔR^2		0.25
F-test	2.40 *	3.60 **

[1] *t*-tests are reported in parentheses. *** Significant at 1%; ** significant at 5%; * significant at 10%.

As we mentioned above, we grouped the explanatory variables in two blocks: (1) socio-economic variables; and (2) environmental-innovation variables. We do this mainly in order to evaluate the variance explained (R^2) and significance level (p value) when only socio-economic variables are considered, and the increase in R^2 and F values when environmental-innovation variables are aggregated. In this sense, we can assess the impact of both groups on profitability separately.

In the first step of regression, the results indicate that socio-economic variables explain 40% of the variance. When we add environmental-innovation variables, there is a very important increase in the variance explained (25%) and a fit of up to 65%. There is also an increase in the significance of the model as a whole. Therefore, we can be sure that the environmental and innovative performance of a family farm has significant influence in its profitability.

Regarding socio-economic variables, profitability is higher when there are fewer, younger, and better-educated family farm decision-makers; additionally, economic profit increases when the farm is more highly specialized, and marketing cooperatives are considered efficient.

In terms of the second block of variables, family farms' profitability increases as they have better environmental performance. Specifically, results show that organic production and integrated pest management and other environmental certifications have a significant and positive impact on profitability. Family farm environmental awareness also has a strong influence, especially if it is considered relevant by other family farms and cooperatives in the sector. Finally, innovation aspects also improve profitability. If a family farm works proactively with research centers and universities on innovations and then implants agroecological improvements and technology, a family farm can lower labor intensity and increase profitability.

Based on the estimated values (Table 3, step 2), the calculated coefficients can be standardized [32]. With this information, the goal is to ascertain the contribution of each variable towards family farm profit in comparable values. Some authors recognize the inconsistency of this method when the variables utilized are correlated [33], something which does not occur in this work (see Appendix A). Below, the coefficients are indexed out of 100, and, consequently, the relative importance or weight of each value was obtained (Figure 4). "Others" includes the values of non-significant variables and those that, although statistically relevant, are less important.

It can be seen that the variables which contribute most towards family farm profit are related to the participation of marketing cooperatives in the sector (COP variable), the presence of more specialized and productive manual labor (LI), the securing of economies of scale (SC), and innovation and research activities (RD). These four variables represent nearly 70% of profits. This analysis scheme provides us with an approximate profile of the most profitable farms.

This analysis coincides when the average values of the variables utilized are analyzed by distinguishing the farms with the highest and lowest profit (Figure 5).

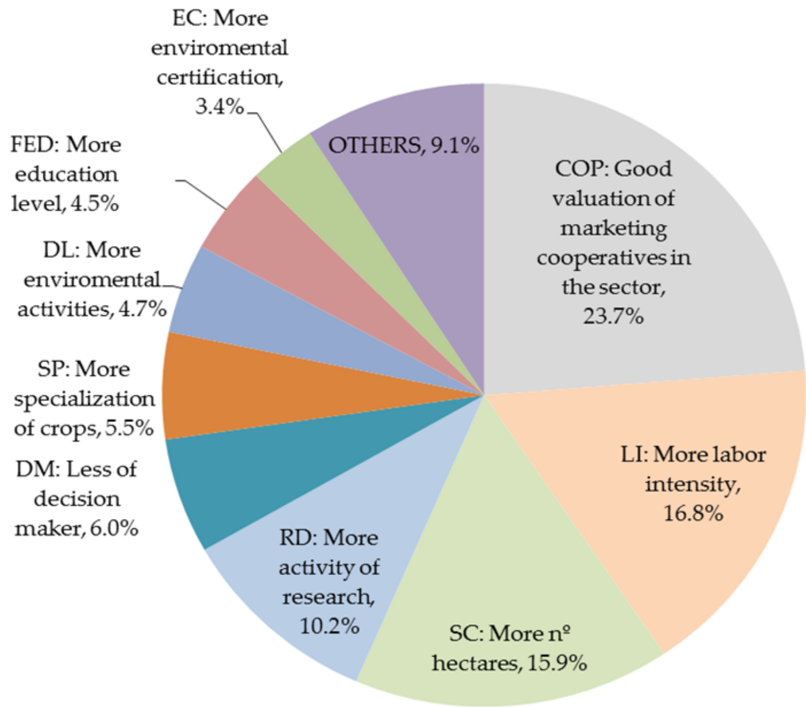

Figure 4. Relative importance of each variable on farm profitability.

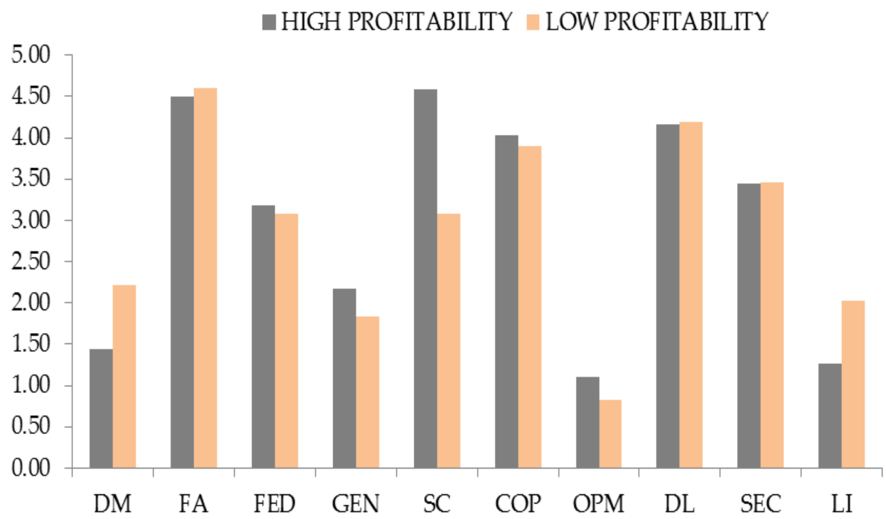

Figure 5. Differences in variable averages. High and low profit farms [1] ([1] with the objective of comparing the various variables, FA is expressed in decades and OPM in 10,000 kg).

As can be observed, the key differences between the most and least profitable farms are related to the number of hectares (SC variable) and intensive manual labor (LI). These two variables have great impact on family farm profit according to the standardized econometric estimation (Figure 4).

4. Discussion and Conclusions

Sustainability in agriculture tends to be traditionally viewed more from social and nature conservation points of view, while also being dissociated from economic aspects, particularly profitability. However, in the context of family farming systems, it is possible to identify factors associated with farms that can make sustainability objectives compatible with economic profit [6,16].

Apart from public policy programs that can promote sustainability, there are characteristics of family farming that allow an integration of economic, social, and environmental components [15,18].

Our empirical analysis focuses on family farms in the agrifood sector in Southeast Spain, which play a key role in the economic and social development of the area, while also respecting the environment. The present paper aims to analyze these family farms focusing on the link between sustainability and profitability and considering several sustainability dimensions: socio-economic characteristics, environmentally respectful practices, and innovation. The results show that there is no inherent contradiction between improving profit and improving sustainability, but rather the exact opposite. This case study of the agrifood sector reveals that the local socio-economic and environmental-innovative components of sustainability are drivers of profitability. By blocks, the socio-economic variables explain 60% of profitability and the environmental-innovation variables 40%. Therefore, these factors related to new environmental practices are a pivotal dimension of sustainability for improving farm profitability.

Innovations in this sector are not only improving the efficiency of how natural resources are used, but they are also fostering greater specialization, greater added value to produce, as well as greater adaptation of products and training of farmers in order to meet the demands of current markets [22,24]. Therefore, one of the key contributions of this study is the identification of the strong specialization in the sector and how it positively correlates to profitability. Another relevant factor is education [34]. In a world in which the economy of knowledge is more and more important as a source of competitive advantages, education and training are essential for success, fundamentally if they are aimed at technology and innovation. Policy-makers must promote training to achieve productivity and competitiveness, in turn, improving quality of life for citizens. Meanwhile, specialization in production has a significant impact on technological development, above all on everything related to increased efficiency in the use of natural resources.

Sustainable use of these natural resources proves particularly important not only in Southeastern Spain, but also around the Mediterranean basin in general, where agriculture requires that environmental quality be maintained. The concept of organic production and integrated pest management (IPM) is founded on a more sustainable approach based on the criteria of good agricultural practices, implying the efficient use of means and factors [24]. The more organic production and/or integrated pest management and other environmental certifications, the more profit is obtained by farms. The use of technologies aimed at efficient use of natural resources has allowed growers to maintain, and even improve, their profitability. At the same time, the sector has oriented production towards more organic methods, which has managed to keep it competitive in a market with greater requirements of healthy and quality food [35].

Additionally, evidence is obtained concerning other specific socio-economic aspects. For instance, the more number of decision-makers there are, the more complicated it will be to make decisions on investing in improvements to increase profitability [36,37]. The negative sign of the coefficient of family farm decision-makers' age shows that when this feature increases, profitability decreases [29]. Younger decision-makers are more likely to be aware of the profitability-sustainability link because they have a longer life expectancy and a longer time ahead of them to be earning income [38]. It is, therefore, important for governments to promote the creation of new farms that renew instruments and technologies.

In addition, family farms are collaborating more and more with the university and provincial research centers, which are, in turn, working diligently to both provide solutions for the sector's needs and foster innovation development. In any event, sustainable innovation must be established through structural reforms and decisive investments in order to ensure that it leads to a prosperous setting and creates employment.

In this context, it is necessary to reevaluate the direction of agriculture. Public policies and research must support innovations aimed at increasing production and improving diet and health, but in a way that favors rural development and environmental protection. In order to achieve these objectives, it is necessary to establish new priorities, evaluate their impacts and promote a more generalized implementation of those innovations with the best results, which are also adapted to the characteristics of farming systems [22].

It is worth mentioning that there are some limitations of this study which may encourage further work in the future. Firstly, it is focused on a single industry in a given geographical area, which affects the generalizability of the findings. It would, therefore, be of interest to explore similar matters in other more international contexts or even in other farming sectors. Secondly, the surveys collected data on variables at a specific moment in time. A longitudinal analysis would determine whether the relationships identified in this study persist over time. Finally, many other variables can influence profitability, e.g., productivity, type of produce or commercial organizations of family farm system. For this reason, it would be of interest to include several in the empirical analysis when data is available and study the causality relationships in depth. This would make it possible to analyze how profitability impacts specific components of sustainability. Future works could focus on these aspects.

In summary, as a general conclusion, it has sometimes been stated that sustainable agriculture cannot grow to become profitable and that it will likely lose its relevance due to open competition, which would generate unacceptable effects from a social, territoria, and environmental point of view. The present article seeks to rebut this belief and analyze how the most important aspects of sustainability can affect greater profitability. This sustainability-profitability link should be recognized as a matter of policy priority and farming opportunity.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Pairwise correlation coefficients of variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. PROFIT	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. DM	−0.32	1	-	-	-	-	-	-	-	-	-	-	-	-	-
3. FA	−0.11	0.29	1	-	-	-	-	-	-	-	-	-	-	-	-
4. FED	0.19	−0.03	−0.11	1	-	-	-	-	-		-	-		-	-
5. GEN	0.07	−0.08	−0.31	0.04	1	-	-		-	-	-		-	–	-
6. SC	0.40	0.21	−0.02	0.21	0.06	1	-	-	-	-		-			-
7. SP	−0.22	0.15	−0.05	−0.14	0.21	0.14	1	-	-	-	-	-	-	-	-
8. COP	0.02	−0.02	0.29	−0.17	0.02	−0.18	0.01	1	-	-	-	-	-	-	-
9. OPM	0.36	0.09	0.15	0.08	0.19	0.12	−0.27	0.03	1	-	-	-	-	-	-
10. EC	0.16	0.02	−0.11	−0.01	0.10	0.00	−0.06	0.04	0.15	1	-	-	-	-	-
11. DL	0.09	0.05	0.27	−0.19	−0.04	−0.11	0.01	0.09	−0.05	−0.10	1	-	-	-	-
12. SEC	0.01	0.04	0.05	0.00	0.04	0.05	−0.05	0.28	0.21	0.14	0.34	1	-	-	-
13. EII	0.19	0.08	0.12	0.05	0.15	0.21	−0.03	0.15	0.25	0.15	0.10	0.38	1	-	-
14. RD	0.28	0.06	0.04	−0.06	0.14	0.11	0.07	0.18	0.29	−0.07	0.14	0.17	0.25	1	-
15. LI	−0.27	−0.10	−0.25	−0.09	−0.20	−0.40	−0.11	0.11	−0.14	0.22	−0.04	0.14	−0.02	−0.10	1

Appendix B. Diagnostic Plots for the Estimated Model

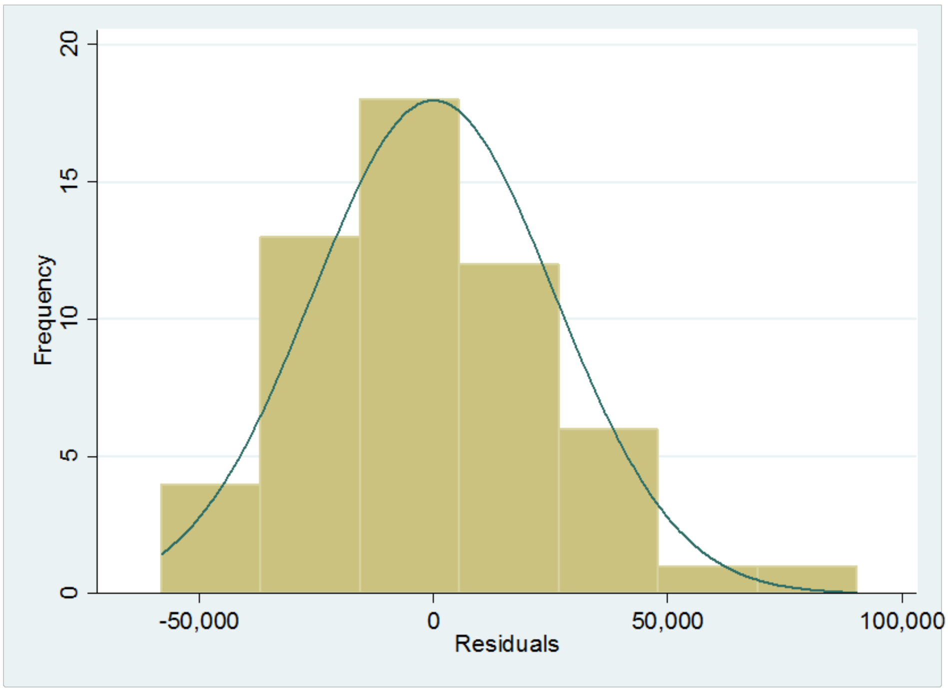

Figure B1. Histogram.

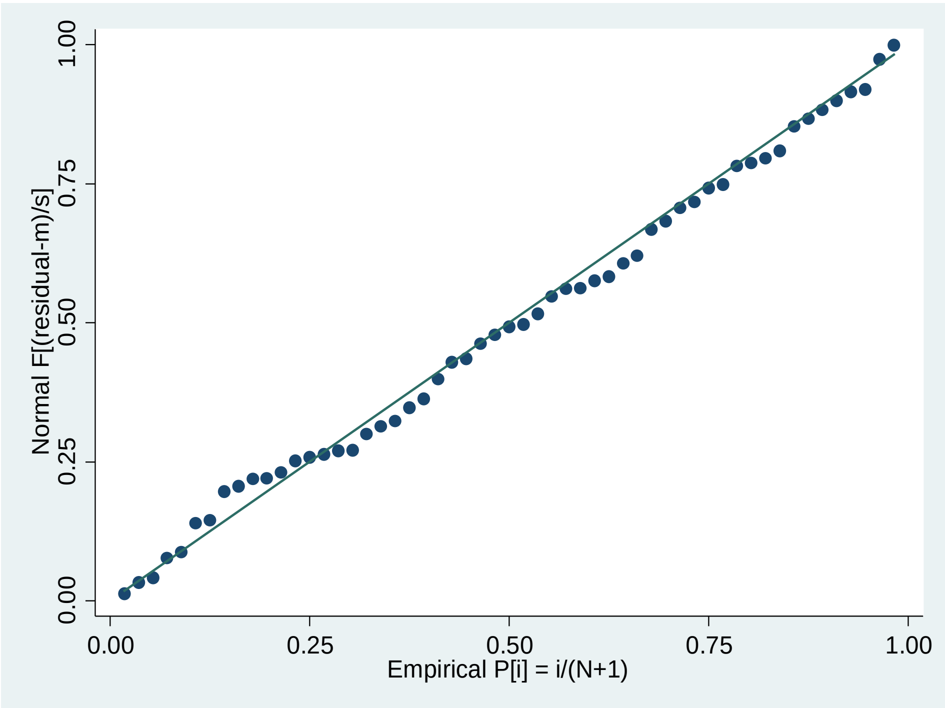

Figure B2. Normal P-P Plot Regression Standard Residual.

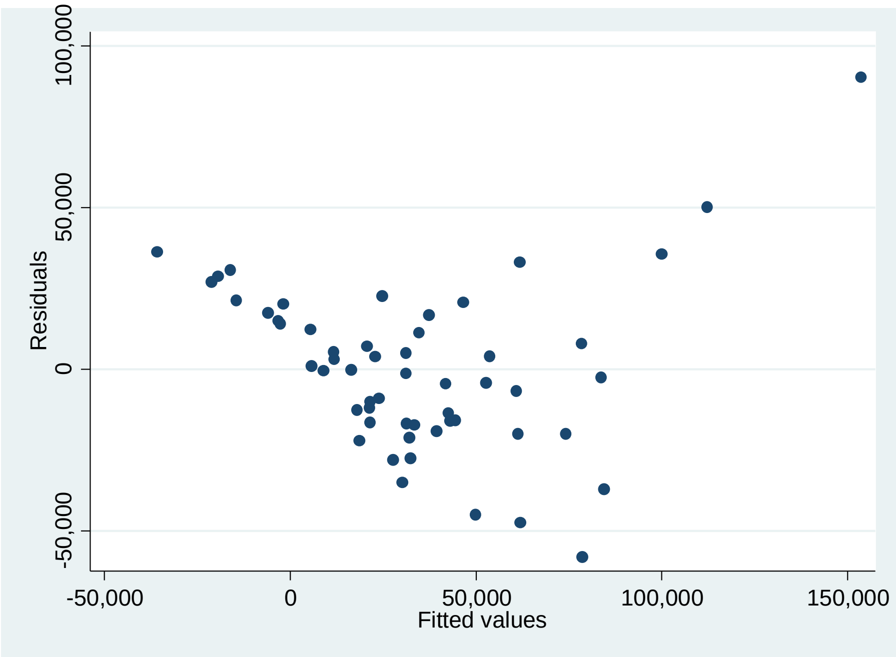

Figure B3. Scatterplot.

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