Sustainability in Farming Certified Quality Products – Determinants of Adoption

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Abstract
In recent years, two well-established market trends are, the rising interest in local traditional goods and the increase in production and consumption of goods produced by sustainable agricultural systems. The Protected Geographical Indication *(PGI) Prespa beans and Protected Designation of Origin (PDO) saffron are traditional agricultural products cultivated solely in the region of Western Macedonia, Greece. The aim of this paper is to determine the factors influencing the decision to adopt or not sustainable methods of agriculture, by two groups of farmers who produce PGI beans and PDO saffron. The logit model was used, to uncover the factors that affect the likelihood of adopting sustainable agriculture and descriptive statistical measures were employed to reveal the social characteristics of farm leaders. Results indicate that the individual and farm structural characteristics, the frequency of communication with agronomists and access to information, affect the decision of farmers who produce quality labeled products, to adopt sustainable agricultural methods.*

Keywords: Beans, Integrated Crop Management, Logit Model, Organic Farming, Saffron

Introduction

After World War II, the requirements for ample and low-priced agricultural supply to satisfy consumer demand and the need for self-sufficiency in the production of foodstuffs, led to the prevalence of intensive agriculture, which still remains at the present time the most widespread agricultural production system. This trend has resulted in the decline of agricultural diversity which was typical of rural areas (Roep & de Bruin, 1994), in the marginalization of areas where farming was unprofitable due to natural handicaps and in the greater intensification of farming in highly productive lowland areas (Long & van der Ploeg, 1994). Furthermore, the implementation of the intensive model in agricultural production led to the abolition of "local knowledge" and the loss of connection between farming practice and locality (Jenkins, 2000)

resulting in the globalization of food production and the prevalence of foodstuffs for mass consumption(Renting et al., 2003).

Efforts in recent years within the European Union to promote and support quality schemes such as Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) have underlined the link between quality and region of origin and have contributed significantly, both to production and food consumption (Parrot et al., 2002). Consumers now recognize and positively assess the geographical origin of food products (Dimara & Skuras, 2003) and are interested to know about the origin and the method of production, not only for reasons of health and safety but also to satisfy a current "nostalgia" for authentic products of times passed. The association with a place of origin can be seen as a quality attribute of a product, regardless of any other certification (Karagkiozi, 2011).

Today, local traditional products are considered as cultural capital after enabling the local rural areas to have more social and economic benefits (Tregear et al., 2007; Ventura & Milone, 2000; Brunori & Rossi, 2000) utilizing and incorporating local elements with some specific geomorphologic characteristics associated with the specific region (Tregear et al., 2007; Bessiere, 1998; Nygard & Storstad, 1998; Marsden et al., 2000).

Moreover, the environmental impact of modern agricultural practices and the increased use of non-renewable resources, led to several initiatives to promote the adoption and dissemination of more sustainable agricultural technologies (De Souza et al., 1999).

Hence, at present, the increase in production and consumption of local traditional goods and foods produced by sustainable agricultural systems (organic - integrated crop management) is one of the major market trends and the interest of producers and consumers for such products is growing.

The PGI Prespa beans and PDO Kozani saffron are traditional agricultural products encountered, in Greece, only in Western Macedonia. They are an essential element of the agricultural economy in this region, play an important part in local traditional gastronomy and can contribute significantly to rural development.Therefore, the analysis of the factors concerning the adoption of sustainable agricultural practices in the cultivation of local traditional products, such as Prespa beans and saffron, is of particular interest, because it can contribute to a further adoption of quality assurance schemes by producers and subsequently to the socio-economic development of the region.

Materials and Methods

The survey was conducted during the period 2012-2013 in Western Macedonia, by means of a specially designed questionnaire, which was completed by visiting researchers. To achieve the objectives, technical and economic data were collected from a total of 252 farms (173 farms in integrated - organic management of saffron or bean and 79 farms under conventional management). To calculate the sample size, the method used was stratified random sampling.

In qualitative response models, the variable to be explained, Y, is a random variable with a limited number of outcomes. In binary response models more specifically, it takes the values of one and zero which correspond to the particular event under consideration occurring or not, respectively. In these models attention is given primarily in the response probability for various values of X. The selection, adoption of a new technology or innovation can be described by the following probability function (cumulative probability distribution function), which gives the probability of adoption (Gujarati, 2003; Greene, 2000; Wooldridge, 2010):

Probability of adoption = $P(Y_i = 1) = 1/(1 + e^{-(\beta_0 + \beta_{1x1} + \ldots \beta_{ixi})})$ (1)

If P is the probability of adopting a new technology - innovation, then 1 – P is the probability of non adoption of that technology - innovation:

$$1 - P_i = 1/1 + e^{Z_i} \quad (2)$$

Taking into account the relations (1) and (2) we can write:

$$P(Y_i = 1)/(1 - P(Y_i = 1)) = 1 + e^{Z_i}/1 + e^{-Z_i} = e^{\beta_0 + \beta_{1\chi 1} + \ldots \beta_{i\chi i}} \quad (3)$$

Where $P(Y_i = 1)/(1 - P(Y_i = 1))$ is the ratio of probabilities, the probability of adoption to the probability of non adoption and it varies with changes in the independent variables X_i.

The logit transformation of the probability of adoption $P(Y_i = 1)$, can be expressed as (Cramer 2004;Wooldridge 2010):

$$L_i = Log[P(Y_i = 1)/(1 - P(Y_i = 1))] = Z \quad (4)$$

Where $Log[P(Y_i = 1)/(1 - P(Y_i = 1))]$ is the logarithm of the ratio of probabilities. With this transformation the logarithm of the ratio of probabilities is a linear function of independent variables X_i, therefore, the model becomes the classical linear (in parameters) regression model. The econometric model will be then estimated to derive the coefficients β_i that measure the effects of the explanatory variables X on a particular probability.

The Hosmer and Lemeshow test $\hat{C}$ is a statistical test used for the goodness of fit of logistic regression models. The statistic $\hat{C}$ has the distribution of Pearson's Chi^2. A Chi^2 value that corresponds to a level of statistical significance a> 0.05 indicates that the logistic regression model is well adapted to the data. Another, complementary measure for assessing the goodness of fit of the logit model to the data is the correct classification of observations between different groups (conventional and sustainable farms). Two groups are formed using the predicted probabilities, and then, observed and fitted counts of successes and failures in these groups are compared using a Chi^2 statistic. It refers to the number of observations correctly and in correctly identified by the likelihood of an event (e.g. adoption or non-adoption of sustainable farming). If the estimated probability is greater than 0.5, then the farmer has adopted organic or integrated management, while if the probability is less than 0.5, the farmer continues to apply conventional farming techniques (Hosmer & Lemeshow, 2000).

The profile of conventional and sustainable farmers

Evidence indicate that the majority of producers occupied in either conventional or sustainable farming of saffron and beans is mainly men

(69.6% and 53.2%, respectively), married (87.3% and 87.9%, respectively) and having on average 2.7 and 2.5 adult family members, respectively. The age varies between the two groups. Organic and integrated producers are from 25 to 69 years old, with the majority in the sample being up to 45 years old (56.6%) and with anaverage age of 44.8 years. In contrast, the age of conventional producers is between 28 and 74 years, with 64.6% of the sample being over 50 years and a mean age at 55.7 years.

The level of education of integrated and organic farmers is satisfactory (average years of education about 13 years), with 29.5% of them having a high school diploma, 21.4% having completed nine years of education and 23.7% being graduates of a vocational or professional school. It is worth noting that 17.4% are higher education graduates (University or Technological Education Institutes) whereas a small percentage, 8.1%, have completed only up to six years of primary education.The reverse is observed in the case of conventional producers, with 51.9% of farmers having completed, on average, nine years of education, 26.6% high school, and only 10.2% being graduates of higher education.

In the sample, 90.8% of farmers engaged in organic or integrated production of local traditional products originate from a farming family, are members of a cooperative or a producer group (70.5%) have done in the past a farm improvement plan (90.8%) and practice agriculture as their main occupation (58.4%). In the group of conventional farmers 83.5% also comes from a farming family and is a member of a cooperative or a producer group (57.0%), but most farmers have not previously implemented a farm improvement plan (79.7%) and do not have agriculture as their main occupation (67.1%).

It is worth noting that the majority of both conventional and sustainable producers (89.9% and 94.8%, respectively) practices single crop farming, that is the cultivation of beans and saffron is their only source of income derived from agricultural activity.

In terms of the employment of family members, in both groups of conventional and sustainable farmers about two family members assist on the farm.

In the group of producers who have adopted sustainable agricultural production systems, 53.8% cultivate up to 30 str. of saffron or beans(1 ha=10 stemmas), 9.2% from 31 to 60,whereas larger farms above 61 str. of saffron or beans are managed by 37.0% of producers. It should be noted that the mean area under integrated or organic management exceeds 42 str.

The farm size under conventional management is relatively small in the study area (17 str. on average) and varies from 2 to 20 str. for the majority of producers (72.2%). It should be noted that the large difference in the average farm size between the two groups of producers, sustainable and conventional, may be explained by the fact that farmers who opt for a sustainable system are, in their majority, full time farmers unlike conventional producers who have agriculture as a secondary profession.

Logit model to determine the factors for adopting sustainable methods of agriculture

The logit model is used for the assessment of factors influencing the decision of some producers to adopt environmentally friendly and sustainable agricultural production systems for the production of local traditional products, in this case PDO saffron and PGI beans. The comparison concerns the two groups of farmers, conventional and sustainable ones, the latter having adopted either organic farming or integrated management. The logit model is defined as follows:

Log [P(y=1) / (1 – P(y = 1))] = β_1AGE36-50 + β_2AGE >51 + β_3EXPERIENCE+ β_4FARMER+ β_5INVESTMENT PLAN+ β_6AREA+ β_7GROSS PROFIT + β_8EXPERTS+ β_9COOPERATION + β_{10}HIGHER EDUCATION+ β_{11}SEC.EDUCATION + β_{12}FAMILY MEMBERS+ β_{13}QUALITY+ β_{14}OTHER CROPS (5)

The variables in the model describe certain characteristics of the individual producer (e.g. age, education, etc.), reflect attitudes or motivations of producers, reveal farm structural characteristics (e.g. area, family members) and show potential access, source and intensity of information (e.g. communication, etc.). The specific variables that are included in the logit model in order to investigate the motivation behind the adoption of organic or integrated crop management are outlined in table 1.

Table 1: Definition of variables used in the logit model

Dependent variable	Category	Description
Adoption of sustainable Farming system	Binary	1 = YES 0 = NO
Independent variables		
Age 36-50	Binary	1 = 36 – 50 years old 0 = otherwise
Age>51	Binary	1 = >51 years old 0 = otherwise
Experience	Continuous	Years of conventional farming until the time of adoption or years up until the time of the survey, if the producer has not adopted.
Farmer	Binary	1 = farming the main occupation 0 = otherwise
Investment Plan	Binary	1 = Implemented Investment Plan 0 = otherwise
Area	Continuous	Area with saffron or beans in stemmas (1ha=10 str)

Gross profit	Continuous	Gross profit from saffron or bean farming in €
Experts	Binary	1 = frequent communication with agricultural experts 0 = otherwise
Cooperation	Binary	1 = member of a cooperative or producer group 0 = otherwise
Higher Education	Binary	1 = Higher Education graduates 0 = otherwise
Sec. Education	Binary	1 = Secondary Education 0 = otherwise
Family members	Continuous	Number of family members
Quality	Binary	1 = characteristic of the certified product 0 = otherwise
Other crops	Binary	1 = Farms that cultivate other crops as well 0 = otherwise

Results and Discussion

Descriptive statistics of the independent variables incorporated in the model are presented in table 2. The mean values and standard deviations of the variables are given for both groups of producers conventional and sustainable.

Table 2: Descriptive statistics of the sample (252 farms)

Variables	Sustainable (173)		Conventional (79)	
	Mean value	SD	Mean value	SD
Age 36-50	1.15	0.98	1.16	0.99
Age>51	0.99	1.41	1.04	1.43
Experience	16.51	9.02	32.06	11.55
Farmer	0.58	0.49	0.33	0.47
Investment Plan	0.91	0.29	0.20	0.40
Area	42.03	49.06	17.04	9.24
Gross profit	1096.48	443.68	1079.62	506.58
Experts	0.80	0.39	0.63	0.48
Cooperation	0.71	0.45	0.57	0.49
Higher Education	0.41	0.49	0.22	0.41

Sec. Education	0.21	0.41	0.29	0.46
Family members	2.53	0.95	2.68	0.98
Quality	0.59	0.49	0.51	0.50
Other crops	0.05	0.22	0.10	0.30

Table 3 presents the results of the estimation of the regression equation (5)

Table 3: Results of the Logit model

	Odds Ratio	Robust Std. Error	z	P > z
Age36-50	0.29	0.12	-2.91	0.004
Age>51	0.53	0.15	-2.20	0.028
Experience	0.88	0.02	-4.15	0.000
Farmer	8.93	7.67	2.55	0.011
Investment Plan	65.92	44.46	6.21	0.000
Area	1.03	0.01	1.75	0.081
Gross profit	0.99	0.00	-2.35	0.019
Experts	5.14	3.66	2.30	0.021
Cooperation	8.28	11.74	1.49	0.136
Higher Education	9.44	7.79	2.72	0.007
Sec. Education	0.65	0.54	-0.51	0.612
Family members	0.62	0.14	-1.98	0.048
Quality	4.95	2.58	3.06	0.002
Other crops	0.31	0.32	-1.11	0.267
N	252	Wald chi^2 (9)		70.00
Prob> chi^2	0.000	Pseudo R^2		0.6632

Diagnostic tests have been performed and indicate a good fit of the model. According to the observations classification table, it can be seen that 84.8% of conventional and 93.2% of sustainable producers (in either organic or integrated management) are correctly predicted by the model, an element that leads to the conclusion that the model is well adapted to the data. Overall, the Logit model was able to predict and classify correctly 91.7% of producers (Table 4).

Table 4: Classification of Observations

Observed	Predicted		CorrectPrediction (%)
	Conventional	Sustainable	
Conventional	67	9	84.8
Sustainable	12	164	93.2
Total rate			91.7

This conclusion is confirmed by the Hosmer and Lemeshow test, where the valuex^2= 3.79 corresponds to a significance level of a =0.875 and suggests a goodness of fit of the model to the dataset.

According to results (table 3), the variables that were found to have a statistically significant influence (5.0% significance level) on the possibility of adopting sustainable forms of agriculture are: age, agricultural experience, farming as the main occupation, the implementation of farm improvement plans, gross profits, working with agronomist, farmer participation in a cooperative or producer group, education, number of family members, quality as an important criterion to adopt sustainable forms of agriculture and farming additional crops other than saffron and beans.

According to the results, age is an important factor for the adoption of innovative forms of production, such as organic or integrated crop management. Producers over 36 years old are less likely to implement sustainable methods for the cultivation of local traditional products than younger producers (20-35 years). Specifically, there is a lower probability by 71.0% and 53.0% (odds ratio: 0.29 and 0.53, respectively) for farmers aged 36-50 or over 51 years,to adopt sustainable agriculture, compared with those aged 20 to 35 years.

The years of experience in farming appear to have a negative effect on the probability to adopt alternative farming methods. In particular, for each additional year of experience in the agricultural sector the probability of adopting alternative farming systems is reduced by 12.0% (odds ratio: 0.88). Thus, the longer in agriculture the less likely it is to adopt environmentally sustainable systems for the production of local traditional products.

The years in farming as a main occupation have a positive influence in the probability of adoption sustainable methods for the production of local traditional crops. Farmers, whose saffron and bean cultivation is their main occupation, are 8.93 times more likely to adopt sustainable farming techniques than producers engaged in agriculture as a secondary profession.

The implementation of farm improvement plans appears to have a significantly positive effect on the probability of adoption and producers who have completed such plans in the past are 65.92 times more

likely to adopt sustainable farming, than producers who have not carried out improvement projects.

Gross profits from the cultivation of saffron or bean appear to have a negative influence on the decision of producers to apply sustainable management systems. Specifically, the increase in gross profit by one unit (1 €), reduces the probability of adoption by 1.0% (odds ratio: 0.99). Thus, producers who, compared with others, achieve a lower gross profit from conventional farming are more likely to implement sustainable production systems.

Regular communication and cooperation of producers with agronomists appears to have a positive effect as it increases the likelihood to adopt alternative farming systems by 5.14 times. Likewise, the level of education exerts a positive influence on the willingness to adopt, with farmers who are higher education graduates (at least 16 years of education) being more likely by 9.44 times to join the system of organic or integrated crop management, than producers who have completed only six years of education.

It should be noted that the factor 'number of family members' has a negative influence on adoption. Specifically, the increase in the number of family members by one person reduces the probability for adoption by 38.0% (odds ratio: 0.62). Therefore, as family size increases the probability to remain in conventional farming also increases.

The perception of farmers that certification of a product and the associated standards in production that have to be met within such a scheme, contributes to producing crops of better quality positively affects the probability of adoption. In particular, it is more likely by 4.95 times for those who share that belief to adopt organic or integrated management for the production of local traditional crops.

The area under cultivation is found to influence in a positive way the decision of producers only at a 10.0% significance level. Specifically, increasing the area under cultivation by one unit (one str.), increases the probability of adoption by 1.03 times which means that producers who grow more saffron or beans, are more likely to adopt environmentally sustainable farming systems.

The variables "cooperation", "secondary education" and "other crops" were not found to have a statistically significant influence (5.0% or 10.0% significance level) on the decision of producers to join sustainable production systems. However, an indication is given by the sign of z, as to the direction of the effect these variables may have on the probability of adoption. According to the results in Table 3, the negative sign obtained for the variables "secondary education" and "other crops" indicates that they reduce the probability of adopting sustainable methods for the production of local traditional crops.On the contrary farmer participation in a cooperative or a producer group seems to have a positive effect on the adoption probability.

Conclusions

In recent years, there has been a renewed interest by consumers for local traditional products of geographical origin that are at the same time cultivated with environmentally friendly methods. This trend led to the adoption of sustainable production systems such as organic farming or integrated crop management by a rising number of farmers producing quality labeled products. The PDO saffron and PGI Prespa beans are traditionally cultivated products encountered only in Western Macedonia, Greece and are produced both in a conventional or sustainable manner.

The results of descriptive statistics show a differentiation between integrated - organic and conventional farmers, in terms of individual and farm characteristics, confirming studies, which want organic farmers practicing agriculture as their main occupation, being younger and better educated, compared to conventional producers. Furthermore, farmers practicing sustainable methods cultivate more than twice as much land as conventional producers. The common feature in both study groups is that they are members of a cooperative or a producer group and come from a farming family.

The model results indicate that individual and farm structural characteristics, the frequency of communication with agronomists and access to information are adoption incentives that significantly affect the decision to enter and stay in sustainable farming.

Specifically, it appears that producers aged between 20 and 35 years who have farming as their main occupation,carried out farm improvement plans, cultivate more land, have regular contact and cooperation with agronomists, have a smaller number of family members, believe that certification helps to create a quality product, gain higher gross profits, have less farming experience and have completed at least 16 years of education, are more likely to adopt sustainable forms of agriculture to produce local traditional products.

The analysis of factors affecting the adoption of sustainable agricultural practices in farming local traditional products is important because it can contribute, via better targeted policy measures, to the preservation of local plant varieties and hence biodiversity. Farmers producing under quality assurance schemes could also be encouraged to gain further added value by converting production to environmentally friendly agricultural practices which would bring apparent benefits to the socio-economic development of the region.

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