Innovative vs Conventional Farmer Profiles

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Abstract
The adoption of agricultural innovations depends on a variety of personal, social, cultural and economic factors, as well as on the farmer's subjective perceptions of the nature and the particular characteristics of an innovation.
The objective of this paper is to look into the profiles of innovative and conventional farmers and study their motives for adopting or not adopting new production technologies. The intention is to identify differences between farmers who have adopted an innovative technology and those who state the reasons that would make them adopt it. For this purpose, two groups of apple farmers are chosen, one certified in Integrated Crop Management (ICM) and the other group farming conventionally. The study area is Western Macedonia and primary data were collected through personal interviews in the year 2010-2011. The sample was selected with random sampling and sample size consists of 72 ICM apple farmers and 63 conventional apple farmers.
Research results show that innovative farmers are younger, more educated and with less farming experience. Farmers who have already adopted ICM ranked 'Improvement in quality' and 'easier distribution of product' as the two most important factors for adoption. Conventional farmers, rank 'better prices' and 'lower cost of production' as the two most important factors that would induce them to adopt that technology. Protection of the environment ranks last in importance for conventional farmers and one but last for ICM farmers.
To encourage the adoption of ICM we need to change the perception of conventional farmers with the help of extension services, a steady information flow and lifelong training.

Keywords: innovations, Integrated Crop Management, adoption factors, apple farming, Greece

JEL classifications: Q01 - Sustainable Development Q12 - Micro Analysis of Farm Firms, Farm Households, and Farm Input Markets

Introduction

The adoption of agricultural innovations is an issue of great importance for the development of the agricultural sector and has been continuously researched for a variety of products and locales in an effort to find some universal rules or a minimum number of adoption factors that could successfully predict farmer behavior most of the times (Feder and Umali,1993; Sunding and Zilberman,2001).A series of personal, social, cultural and economic factors, along with the particular character of an innovation influence its adoption. If the farmer recognizes that the particular innovation will improve the possibility to achieve his economic, social and environmental goals he will endorse it (Pannell et al., 2006, Howley, et al 2012).

Apart from the socio-economic, demographic and institutional factors Adesina and Baidu-Forson (1995), propose to include farmers' subjective perceptions of the characteristics of new agricultural technologies when studying adoption, suggesting that it has received very limited attention so far. Their results based on two different technologies examined in Burkina Faso and Guinea indicate that farmers' subjective preferences for the characteristics of new agricultural technologies are very important determinants of adoption behavior.

The results of Negatua and Parikhb (1999), appear to support an interaction between adoption and perception of technology characteristics that goes both ways. The study relies on data from 96 wheat farms in Ethiopia and investigates both the significance of the impact of farmers' perceptions regarding grain yield and marketability of product for the adoption decision and how perceptions themselves are influenced by the decision to adopt new technology.

A number of studies explore technology adoption and diffusion taking into account farmers’ perceptions regarding the risk of future yields and Sauer and Zilberman,(2010) go forward by modeling simultaneously the effects of risk, of social interaction, of past innovation experiences and of the sequential nature of adoption decisions. Howley, et al (2012) emphasize the role of heterogeneity in structural farm and farmer characteristics as explanatory variables for the adoption of technological innovations.

Abadi Ghadim and Pannell (1999) developed a framework of adoption of an agricultural innovation that incorporates the dynamic nature of the adoption decisions. The role of learning by doing and the impact of that learning on personal perceptions of the innovation are emphasized. It has been shown that the benefits accruing from successive trials of an innovation are twofold, namely skill improvement and better decision making.

Another aspect is the role of moral and social concerns in farmers' decision to adopt innovative technologies such as integrated crop protection and organic farming, a subject that has been investigated empirically for fruit-growers and vegetable producers in France (Mzoughi, 2011). The results indicate that although economic factors are central, a significant number of farmers value moral and social factors as well. More specifically, social concerns are important for both production technologies adoption, i.e integrated crop protection and organic farming, moral concerns increase the probability of organic farming adoption only, and farmers who give great importance to economic factors such as lower production costs, are less likely to adopt organic farming. The study offers an explanation as to why farmers decide to adopt ecologically-friendly practices.

Knowler and Bradshaw (2007), did a recent review of previous research papers in order to identify independent variables that have a wide application in the adoption of conservation agriculture. They looked at 31 separate analyses of conservation agriculture adoption where 170 significant variables have been used, and reached the conclusion that there are few if any variables that can have a universal application. For that reason they claim that emphasis should be given to results that can be useful for local management.

The objective of this paper is to compare the profiles of innovative and conventional farmers and investigate their reasons for adopting or not adopting new production technologies. To identify differences between farmers who have opted for an innovative technology and those who state the reasons that would make them adopt it. Two groups of apple farmers in Greece are chosen for the purposes of this research: one certified in Integrated Crop Management (ICM) and the other group farming conventionally.

Integrated Crop Management is a cultivation system based upon the rationale of a joint use of all available means and inflows in order to achieve the best economic result for a farm and at the same time to secure the quality of products, the producer and consumer's health, without causing environmental degradation (IOBC, 2010).

Within the European Union 5.4 million hectares are cultivated under the integrated management system (European Commission, 2008). In Greece, over the past few years, significant efforts have been made towards the integrated crops management. Nevertheless, integrated agriculture prevails in only a small percentage of the total farmland that is approximately 29,300 hectares (Ministry of Rural Development and Food, 2010).

Methodology

The research area is Western Macedonia and in particular the prefectures of Florina and Kozani. The collection of primary data was done by personal interviews and with the use of structured questionnaires during the year 2010-2011. In order to ensure maximum research reliability and effectiveness, two different questionnaires were laid out, one for each separate case, i.e. ICM and conventional apple farmers. Questions were identical or similar for each producer group, while their number differed per case. The sample selection of 72 ICM apple farms and 63 conventionally managed farms was made via the stratified random sampling method, which is considered to be the most effective for farm sampling (Siardos, 1997).

According to the method of stratified random sampling distribution by Neyman, the sample size results from the relationship:

$$n = \frac{(\Sigma N_h s_h)^2}{N^2 D^2 + \Sigma N_h s_h^2}$$

And its distribution in the strata by:

$$n_h = \frac{N_h s_h}{\Sigma N_h s_h} \cdot n$$

where,
n= the total sample size in all strata
n_h= the sample size in each stratum
N_h= the sampled population in each stratum
N= the total population

s_h = standard deviation of the values of the variable in each stratum, estimated from preliminary sampling
D = desired standard error that is given by D = d / z, where d = the desired accuracy - subjectively determined and z = the reliability coefficient, which is usually taken equal to 3.

Data are analysed with the help of descriptive statistics, and statistical significance is examined with the use of chi-square and t-tests. In addition a non-parametric test the Friedman's test is used on the data. The Friedman's test makes no assumptions about the underlying distribution of data. It is a two-sided analysis of variance with one observation for each cell, which controls the null hypothesis that k related variables come from the same population. A comparison of the average scores of variables can determine whether a statistically significant difference exists between them, (Siegel, et al 1988). More specifically, the data is arranged in a table consisting of j rows and i columns. Following that, data is ranked across the rows and the mean rank is computed and compared for each column.
The Friedman test supposes a model of the following type:

$$X_{ijk}= \mu+ \alpha_i+ \beta_j+ \varepsilon_{ijk}$$

where μ is an overall location parameter, α_i is the column effect, β_j corresponds to the row effect, and ε_{ijk} represents the error. The test ranks the data within each level of B, and tests for a difference across levels of A. The p value is for the null hypothesis that α_i=0. A *p* value that is found to be sufficiently low leads to the conclusion that at least one column-sample median is significantly different compared to the others (Hollander and Wolfe, 1999; Gibbons and Chakraborti, 2005; http://www.mathworks.com/help/stats/friedman.)Data processing was performed using the statistical package SPSS 14.0 for statistical analysis.

Results

The analysis of the ICM sample data shows that 17% of farmers are up to 35 years old, 46% are from 36 to 50 years old, 32% are from 51 to 65 years old, whereas 12,5% are above 66 (Graph 1). In terms of education, 44% has only few years of schooling (primary school and Gymnasium,) another 46% has completed the Lyceum and 10% has higher education diplomas from Technological Education Institutes and Universities(Graph 2). Among ICM farmers, the majority (58%) has farming experience less than 20 years whereas less than a fifth of producers have experience for more than 30 years (Graph 3). Nearly all (97%) come from a farming family, the majority (67%) has attended a seminar about farming and an even larger majority (71%) has completed an educational program regarding ICM. Nearly two thirds of the sample has farming as their main profession.
ICM farmers were asked their opinion regarding the effects conventional farming has on various environmental factors, on product quality and on the health of producers and consumers. The results reported, in table 1, indicate a more or less uniform view among them that conventional farming has a negative impact on the environment, on soil and water pollution, yet environmental concerns rank low as an adoption factor for the ICM technology (table 9). Half of the sample thinks that product quality is negatively affected, whereas the majority believes conventional farming has repercussions on farmers' and consumers' health.

Table 1: Effects of conventional farming according to ICM farmers

	Very negative/ negative	None	Very positive/ positive
	%	%	%
Environment	94,5	5,6	-
Soil	95,8	4,2	-
Water	93,1	6,9	-
Quality	50,0	22,2	27,8
Farmers’s health	65,3	27,8	6,9
Consumers’s health	75,0	18,1	26,4

The study of the sample data with the conventional farmers reveals that 11% of farmers are up to 35 years old, 48% are from 36 to 50 years old, 29% are from 51 to 65 years old, whereas 13% are above 66 (Graph 1). In terms of education, the majority (61%) has only few years of schooling (primary school and Gymnasium,) another 29% has completed the Lyceum and 10% has attended higher education, either Technological Education Institutes or Universities(Graph 2). Among conventional farmers, a fourth has farming experience less than 20 years whereas 37% of producers have experience for more than 30 years (Graph 3). All come from a farming family, a small majority (58%) has attended a seminar about farming and 93,5% of the sample have farming as their main profession.

Apple farmers were asked about the sources of information they use when facing problems of any type during cultivation and from the results it appears that the majority of ICM farmers turn to the private sector for technical assistance and only about 22% relies on experts from the extension services. Conventional farmers equally turn to these two sources of information, yet twice as many use the extension services 44%. Although producers consider other producers as an important source of agricultural information and assistance (Feder et al, 2003) this source of information is found to be small (1,4%)in the particular sample. One explanation is that as the complexity of the message or information increases they tend to prefer more specialized sources of information.

Table 2: Sources of information

	ICM farmers	Conventional farmers
	%	%
Experts in private sector	61,1	41,3
Experts from extension services	22,2	44,4
Other farmers	1,4	12,7
Cooperative	6,9	-

Nobody	8,3	1,6
Total	100,0	100,0

Even though less than a fifth of ICM farmers resort to experts from the extension services, those who do, consult with them quite frequently. The great majority of conventional farmers make regular use of this source of information (table 3).

Table 3: Frequency of communication with extension services

	Very often/ Often	Rarely	Never
	%	%	%
ICM farmers	54,1	23,6	22,2
Conventional farmers	74,7	23,8	1,6

Farmers were asked about their intention to continue farming in the future and a remarkable percentage of ICM farmers (30%) answered they intend to stop farming (table 4). Technical and economic analysis of ICM and conventional apple farming has shown unsatisfactory economic results for ICM farmers and may be a reason for this result (Oxouzi et al, 2012).

Table 4: Intention to continue farming in the future

	ICM farmers	Conventional farmers
	%	%
Yes	69,8	91,7
No	30,2	8,3
Total	100,0	100,0

The comparison of the two samples of apple producers, ICM and conventional, has shown that there are statistically significant differences between them with respect to the variables 'Age', 'Education' and 'Farm experience'. It appears that in the young farmers category (age below 35) there are significantly more ICM farmers (17%) than in the sample with conventional producers (T-test:t(133)=2,128, p=0,035).In terms of Education a significant larger percentage of conventional farmers has less years of schooling that ICM farmers (T-test:t(133)=2,522, p=0,013). As regards farming experience the category with the newest entries in farming (less than 10 years are mostly ICM farmers. In contrast, in the category with the most experienced farmers (over 31 years) there twice as many conventional than ICM farmers (T-test:t(133)=4,111, p=0,000).The cross tabulation of the variable 'Farmers' experience'and the choice of farming system ICM/conventional is presented below in Table 5.

Table 5: Farmers' experience

	Experience (years)			
	0 -10	11- 20	>21	Total

	%	%	%	
ICM farmers	23,6	34,7	41,7	100
Conventional farmers	7,9	17,5	74,6	100
Total	16,3	26,7	57,0	100
Pearson Chi-Square	15,211	df (2)	p=0,000	

The results show that a clear majority (77%) of all farmers who are relatively new to the farming profession (0-10 years) opted for ICM. It can be suggested that farmers who entered the profession more recently appear to be more open to innovative technologies. The majority of conventional farmers (75%) appear less likely to want to change farming methods. However, among all experienced farmers (>21 years,) 39% opted for ICM which is also a sizeable participation in the new technology. Table 6 presents the cross tabulation of the variable 'Full-time farming'and the choice of farming system ICM or conventional.

Table 6: Full-time farming

	Full-time farmers		
	Yes	No	Total
	%	%	
ICM farmers	70,8	29,2	100
Conventional farmers	93,7	6,3	100
Total	81,5	18,5	100
Pearson Chi-Square	11,593	df(2)	p=0,000

Most of those who are not full-time farmers (84%) have adopted ICM. Although emphasis should be on fulltime farmers, there is an indication that part- time farmers may be more open to innovations.
This may be due to the fact that the adoption of innovative technologies involves taking a risk which full time farmers may not be willing to take given that farming is the only source of income for them. This conclusion is confirmed by research carried out by of Marra et al. (2003) and Green and Kremen (2003), according to which a limiting factor for the adoption of new technologies is the risk and uncertainty associated with implementation and expected results.
Table 7 presents the social characteristics of the two groups of farmers and outlines differences and similarities that shape their profile.

Table 7: Profile of innovative and conventional farmers

Innovative farmer	Conventional farmer
1.Social characteristics	

Average Age: 46.2 years	Average Age: 50.7 years
Average schooling time: 10.6 years	Average schooling time: 9.5 years
Farm experience: 20.9 years	Farm experience: 30.5 years
Comes from an Agricultural Family	
Occupied with farming by family tradition	
Attended seminars	
Member of a cooperative or a producer group	
Their main occupation is farming	
No second job	

Starting with the common characteristics, both groups have an agricultural family origin and started farming because of a family tradition. They have attended specialized seminars for farming and are members of a cooperative or a producer group. Both groups have farming as their main occupation and have no other job. The profiles of innovative and conventional farmers are different in a statistically significant manner in several characteristics. ICM farmers are on average somewhat younger and with slightly more schooling time. Except for, as was shown before, the differences are more marked when examining separate categories for both of these variables. Differences even out when average values are taken. Innovative farmers have significantly less farm experience than conventional ones indicating perhaps that a lot more effort is needed to convince highly experienced farmers to change farming methods and introduce innovations.

Table 8: Characteristics of farms

2. Characteristics of farms	
ICM farms	Conventional farms
Average total area: 62 str.	Average total area: 73.3 str.
Average area with apples:32 str.	Average area with apples: 29.2 str.
Family members employed on the farm: 2,0 on average	Family members employed on the farm: 2,1 on average
Average distance from urban center: 16.3 km	Average distance from urban center: 9.34 km

Table 8 above, presents the farm characteristics of the two groups of ICM and conventional farmers. ICM farms are smaller on average but have a larger area planted with apples and are located further away from urban centers than conventional ones. Both employ the same amount of family labour. Farmers were also asked to rank in order of importance the reasons that made them adopt ICM farming or in the case of conventional farmers the reasons that would make the adopt this alternative farming system. Table 9 shows these factors for ICM farmers as well as the result of the Friedman test.

Table 9: Adoption factors – ICM farmers

Adoption factors in order of importance –ICM farmers	Mean score	Friedman test
Improvement in quality	2,88	chi² = 33.924 d.of f. = 5 p = 0,000 N = 72
Easier distribution of product	3,16	
Lower cost of production	3,26	
Higher prices	3,38	
Protection of the environment	3,85	
Subsidies	4,47	

Based on the choice made by producers for the ranking of incentives that made them adopt this alternative system of production, from 1 (first choice) to 6 (last option), it follows that the improvement in the quality of the output produced has the first place, easier distribution of the product the second place and lower cost of production the third (table 9). In contrast, according to the results, environmental protection (5th) and subsidies (6th) were not strong incentives to enter the integrated management.

It is worth noting that there is no clear ranking of the variable "higher prices" so it is difficult to interpret the priority given by producers regarding this factor as an inducement to enter integrated management. The above ambiguity can be treated with the Friedman test, where the average score of the adoption factors is estimated and the order of priority is then determined.

Looking at the average scores achieve by the various factors that prompted producers to adopt integrated management of apples it can be seen that there is a statistically significant difference in the average rating of factors between producers (x^2= 33.924, p= 0,000). According to the results of the Friedman test the option "quality improvement" has the lowest average rating (2.88) and represents on average the major reason producers enter the system of integrated management. Following that, with higher average scores are the factors "easier distribution of the product" (3.16), "lower production costs" (3.26), "higher prices" (3.38) and "environmental protection" (3.85). Finally, the highest average rating and therefore the last in importance factor for adopting integrated crop management is "subsidies" with an average score of(4.47). Table 6 shows the ranking of the factors that would make conventional farmers adopt this alternative farming system, as well as the result of the Friedman test.

Table 10: Adoption factors – Conventional farmers

Adoption factors in order of importance – Conventional farmers	Mean score	Friedman test
Higher prices	2,49	chi^2 = 73.476 d.of f. = 5 p = 0,000 N = 63
Lower cost of production	2,63	
Subsidies	3,16	
Easier distribution of product	3,69	
Improvement in quality	4,28	
Protection of the environment	4,75	

Based on the choice of producers for the ranking of incentives that would induce them to enter this alternative production system (from 1: first choice until 6: last option), it is clear that achieving higher market prices and lower production costs are the main incentives for potential future involvement of conventional producers with integrated management, ranking in the first and second place respectively. It should be noted that there is no clear distinction of the order of priority between the third, fourth, fifth and sixth choice of conventional producers regarding their potential participation in the integrated crop management system. Once more, the order of priority can be determined by the Friedman test and the estimation of the average score of the adoption factors.

The examination of the average scores achieved by the various factors that would make them adopt this technology, indicate that there is a statistically significant difference between them as regards their average ratings (x^2= 73.476, p= 0,000). According to the results of the Friedman test, the option "higher prices" has the lowest average rating (2.49) and represents the most important reason for conventional producers, on average, to enter the system of integrated management. Following that, with higher mean scores are the factors "lower production costs" (2.63), "subsidies" (3.16), "easy distribution of the product" (3.69) and "improvement in quality" (4, 28). Finally, the highest average rating and therefore the last option for adopting integrated crop management is "environmental protection" with an average score of (4.75).

Table 11: Reasons for adopting ICM

Reasons for adopting ICM (in order of importance)	
ICM farmers	Conventional farmers
Improvement in quality	Higher prices
Easier distribution of product	Lower cost of production
Lower cost of production	Subsidies
Higher prices	Easier distribution of product
Protection of the environment	Improvement in quality
Subsidies	Protection of the environment

Conclusions

The present paper set out to make a preliminary comparison of the profiles of innovative and conventional apple farmers and their reasons for adopting or not adopting integrated crop management in apple cultivation in Western Macedonia.

The profiles of innovative and conventional farmers are different in a statistically significant manner in several characteristics. Innovative farmers are younger, more educated and with less farming experience. The latter may go both ways. On the one hand experience will improve the farmers' skill and will increase the opportunity cost of not cultivating the conventional way but on the other hand better skills increase the possibility of the innovation becoming profitable (Abadi Ghadim, and Pannell, 1999).

In terms of their motivations farmers who have already adopted ICM ranked 'Improvement in quality' and 'easier distribution of product' as the two most important factors for adoption. Conventional farmers, on the other hand, rank 'better prices' and 'lower cost of production' as the two most important factors that would induce them to adopt that technology. Protection of the environment ranks last in importance for conventional farmers and one but last for ICM farmers. Similar are the findings of (Mzoughi,2011)with the French fruit and vegetable producers focusing mainly on the financial aspects of the technology.

Integrated crop management is a production technology associated with quality products. Moreover, ICM certification offers added-value to the products in terms of both perceived quality by consumer and several marketing advantages, especially regarding distribution channels. It contributes towards product differentiation and strengthens the power of negotiation for producers.

A sizable percentage of ICM farmers consider leaving farming due possibly to the unsatisfactory economic results from farming. Research has indicated that the percentage of cost reduction they have achieved from ICM adoption does not outweigh the reduction in farm gross returns and farm income (Oxouzi et al, 2012). Policy measures are needed that would assist them in achieving further cost reductions in the direction of curtailing input costs. The forthcoming 'Greener CAP' opens also some possibilities for an increase in the subsidies for environmental friendly technologies such as ICM. The current level of 50 euro/ha does not compensate the 100 euro/ha cost for ICM certification.

To further encourage the adoption of ICM effort must be given towards changing the perception of conventional farmers. This can be achieved with the help of extension services, a steady information flow and with lifelong training for farmers.

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Appendix

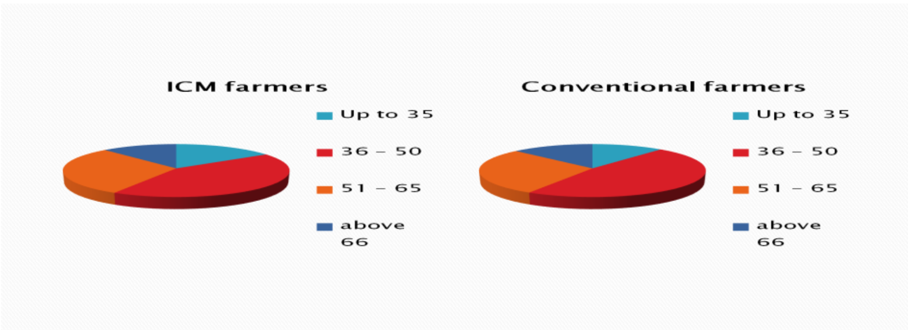

Figure 1: Age

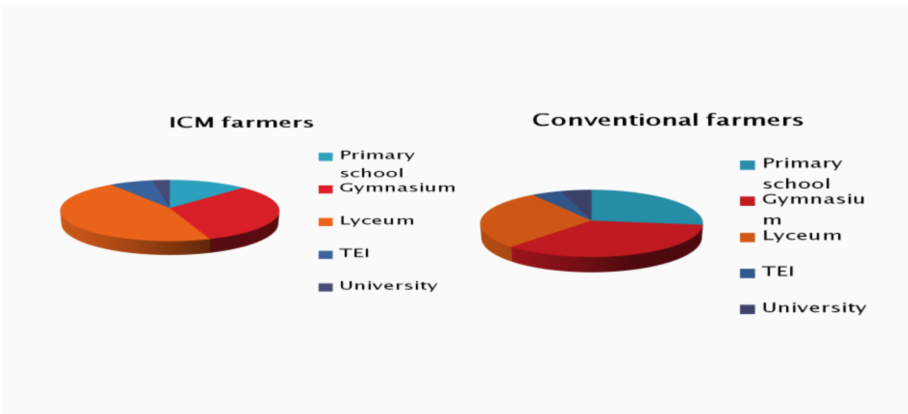

Figure 2: Education

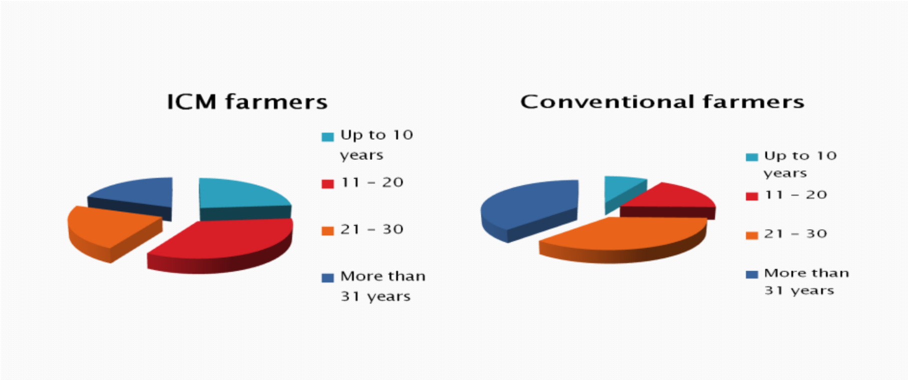

Figure 3: Farm experience

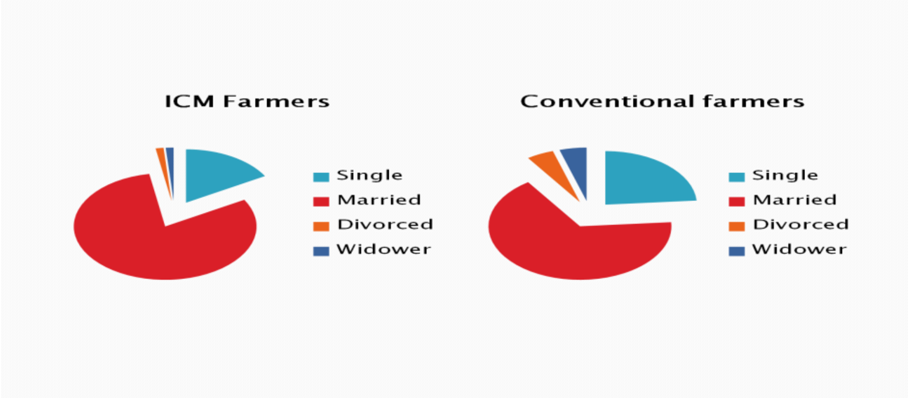

Figure 4: Family status