Risk and income risk management issues for organic crops in Greece

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Drawing upon a comparative case study of organic and conventional farming in Western Greece, the aim of this study is threefold: firstly, to explore the organic and conventional farmers' profile through a factor analysis. Secondly, to assess the economic viability of organic cultivation with respect to profitability and risk behaviour, through a Monte Carlo stochastic simulation model. Thirdly, to discuss the necessity for additional income insurance schemes. Research findings indicate that the organic cropping system currently stands out as the most economically viable alternative under the assumption of the existing payments; without payments, however, conventional agriculture would be preferred by all farmers, regardless of their degree of risk aversion.

Keywords: organic crops, income variability, risk analysis, SERF, agricultural policy

1. Introduction

In recent years there has been a growing interest towards organic agriculture worldwide. A growing consumer awareness of food safety issues and environmental concerns have increased the public demand for organic products. The core factors that strengthen the development of the organic sector are the strong consumer demand in combination with a well organised organic production chain, as in conjunction withpremium prices for primary producers. The organically cultivated farmland in EU has increased sharply due, first, to the decision on the legal framework of organic crop production which established trust among food processors and consumers and second, to the support provided by agri-environmental programs. European trade and growth of organic products started in 1993 following the implementation of the EU Regulations 2092/91 and 1804/99 for organic crop production and the organic livestock sector respectively. Today, organic farming is progressing in Europe; at the end of 2005 it covered slightly over 6.1 million hectares in the EU-25, which means that nearly 3.9% of the agricultural land in the EU as a whole was farmed organically. However, the importance of organic farming still varies across Member States.

In Greece, up to the mid 90s the organic sector was of limited importance. However, the Greek organic sector has had a rapid growth. The total organic area in Greece fully converted and under conversion, increased from 591ha in 1993 to 170,186ha in 2006. Organic farming's contribution to the total utilised agricultural area and total number of farms is 5.13% and 1.0%, respectively. Greece over the period 1998-2004 had one of the highest annual growth rates for the total organic area among the Member States (Eurostat, 2005). The average size of organically cultivated area was small, 19.5ha, whereas the EU-25 average was 38.7ha. Major organically produced crops are olive groves (35.3%), cereals (28.8%), forages (13.2%), vine (2.7%) and citrus trees (1.5%) which are mainly concentrated in the regions of Peloponissos and Western Greece.

Farmers face major constraints that make them hesitant to convert into organic. Researchers underline the fact that variability in crop yields is higher in organic farms as farmers cannot intervene with mineral fertilisers, pesticides, synthetic medicines or chemical application (Mahoney et al., 2001; Flaten and Lien, 2005). Sometimes, farmers face extra loss in yields during the phase of conversion to organic because it takes too long to restore the ecosystem to the organic production. In addition price instability is enhanced, compared to conventional farming, mainly due to the small-scale farms, the immature nature of the market for products produced by environmentally friendly practices and the lack of any intervention scheme for price stabilisation. Therefore, income variability due to increased diversity and complexity in organic farming systems is a significant barrier to the technology adoption for many farmers.

The high cost of production is another obstacle for the farmer (Offerman and Nieberg 2000, Lansink and Jensma 2003, Mahoney et al. 2004). Organic farms face extra labour cost comparing with conventional farms (Lampkin 1994, Nieberg and Schulze 1996, Bennett et al. 1999, Smith et al. 2004). Also, the use of specific processing operations increases the production cost. Farmers point to the lack of information and education on organic conversion, as well as toward the insufficient institutional support either for production or post-production and marketing processes. It is also true that technological developments are rapidly evolving and information on the cost and benefits of adopting sustainable farming systems is often imperfect. Farmers feel the pressure of the economic risk during the usual two-year conversion period as they invest more labour and obtain lower yields, without having any opportunity for income compensation (OECD, 2001). Therefore, adopting organic agriculture requires certain sunk investment in physical and human capital (Kurkalova et al., 2001) and farmers may require an attractive premium to adopt organic agriculture. Conclusively, business risk of adopting organic production systems includes the aggregate effect of production, market, along with institutional and personal risk. These types of risks should be considered when comparing economic viability among cropping systems, because most farmers are risk-averse, and there is a need to account for downside risk (Hardaker et al., 2004a).

In this paper, a comparative study of conventional and organic farming is undertaken (lemons and citrus cultivations) in the region of Western Greece, with three distinct objectives. Firstly, we try to describe the organic and conventional farmers' profile through a factor analysis. Secondly, we assess the economic viability of organic cultivation and we explore whether organic agriculture is less profitable and/or involves greater risk than conventional production systems. More specifically, we will see the financial performance and the risk that farmers are taking through a Monte Carlo stochastic simulation model. The last objective is to examine the likely need for income insurance schemes.

This study consists of the following parts: firstly, the economic methods for the comparison of an alternative crop system are described. Then, data and results of the empirical application for the determination of the optimal strategy for Greek organic investors are described. Finally, the paper highlights the importance of incorporating the stochastic simulation Monte Carlo approach in agricultural evaluations and its usefulness for policy implications.

2. Methodology

Organic agriculture is an activity with a lot of risks. Analyzing organic farmers' decision making implies understanding how they rank potential activities with uncertain outcomes. Stochastic Dominance is applied to compare the distributions of net returns between conventional and organic cropping systems in Western Greece. Assume that a farmer must decide whether to invest in an organic f_o, or in a conventional g_c production system with cumulative distribution functions of their net revenues given by $F_o(x)$ and $G_c(x)$ respectively.

Organic dominates the conventional production system in the sense of the first order stochastic dominance (FSD) if

$$G_c(x) - F_o(x) \geq 0 \quad \forall\, x \in \Re \text{, with strict inequality for some } x \in \Re$$

The first rule assumes that the farm operators prefer more of an outcome to less and the income utility function is monotonically increasing. In practice, return distributions of two investment alternatives often intersect, in which case FSD cannot discriminate between the two alternatives.

If we consider investors to be risk averse (the decision maker's utility function is unknown and is monotonically increasing and strictly concave) a choice between distributions could be made by the second order stochastic dominance (SSD) criterion. Formally, the organic dominates the conventional crop in the SSD sense if

$$\int_{-\infty}^{x} G_c(x) - F_o(x) \; dx \geq 0 \;\; \forall \;\; x \in \Re \text{, with strict inequality for some } x \in \Re$$

In words, SSD requires that the area under the cumulative density function for organic is always smaller than the area under the cumulative density function for the conventional crop. So, SSD assumes that the decision maker prefers more income to less and is not risk preferring (that the risk aversion bounds are $0 \leq r \prec +\infty$).

In empirical work it is often found that the SSD is not discriminating enough to yield useful results (Hardaker et al., 2004b). The most general form of stochastic dominance is the stochastic dominance with respect to a function (SDRF), which overcomes this weakness (Meyer, 1977). SDRF classifies decision makers by the characteristics of their Arrow-Pratt risk aversion coefficient $r(x)$ instead of their utility functions. The use of $r(x)$ instead of utility allows more accurate definition of the groups and has increased discriminatory power. In SDRF risk aversion bounds are reduced to $r_L \leq r \leq r_U$, and ranking of risky scenarios is defined for all decision makers whose risk aversion coefficients lie anywhere between the lower and upper bounds r_L and r_U, respectively.

A more transparent and potentially more discriminatory SDRF method which is called stochastic efficiency with respect to a function (SERF) identifies utility efficient alternatives for ranges of risk attitudes (Hardaker et al., 2004b; Richardson et al. 2005, Ribera et al. 2004). SERF orders alternatives in terms of certainty equivalents (CE) as a selected measure of risk aversion is varied over a defined range. SERF can be applied for any utility function for which the inverse function can be computed based on ranges in the absolute, relative, or partial risk coefficient. SERF evaluates CEs for risk aversion coefficients (RACs) between the LRAC and the URAC. Two scenarios, organic (F) and conventional (G) cropping system, can be compared and ranked at each RACi

$F_o(x)$ Preferred to $G_c(x)$ at RAC_i if $CE_{F_{oi}} \succ CE_{G_{ci}}$

$F_o(x)$ Indifferent to $G_c(x)$ at RAC_i if $CE_{F_{oi}} = CE_{G_{ci}}$

$G_c(x)$ Preferred to $F_o(x)$ at RAC_i if $CE_{F_{oi}} \prec CE_{G_{ci}}$

SERF extends the lower RAC and upper RAC case to a large number of RAC's uniformly distributed between two extreme RACs. First the lower RAC and the upper RAC is defined and then the range of the RAC's is divided into 25 equal intervals and the CEs for all risky alternatives at each interval is evaluate. If a CE line in the SERF chart remains positive then rational decision makers will prefer the risky scenario to a risk free alternative. If the CE line goes negative, the decision makers with RACs greater than the RAC where CE equals to zero would prefer a risk free alternative.

Partial ordering of alternatives by utility values is the same as partial ordering them by certainty equivalents. For a risk-averse decision maker, the estimated CE is typically less than the expected money value. The difference between the expected money value and the CE is the risk premium (Hardaker et al., 2004b; Richardson et al. 2005). The risk premium reflects the minimum amount that would have to be paid to a decision maker to justify a switch from conventional to organic.

3. Data

The data used in this study are part of a broader data collection survey on organic agriculture in Western Greece, comprising 189 organic farmers and 178 neighbouring conventional farmers (AGEPRI, 2004). The survey was conducted in 2004, with a structured questionnaire that was completed during face to face interviews. The survey questionnaire covered: a) the physical characteristics of the farm, b) the characteristics of the farmer (age, gender, experience, education), c) cropping patterns (areas of each crop, irrigation, tillage methods), d) input use (pest control, fertilizers), e) economics of the farm enterprise (farm sales, capital assets), f) sources of information and contact with others and g) attitudes toward risk and risk management strategies.

The survey revealed that organic farmers were, mainly male, on average older and less educated but with greater interest in agriculture compared to conventional farmers (AGEPRI, 2004). They mentioned that there is a significant lack of technical-agronomic support to organic farmers as well as a shortage of information provision on the new trends of the food markets. Organic farmers are interested in the future of their farm; they have a successor and they use mainly family labour force. Their income is more diverse compared to conventional farmers but still depends largely on subsidies. The federations of local agricultural cooperatives and farmer groups have played a significant role in promoting organic agriculture in Western Greece. Organic farmers are more optimistic about the future perspectives of organic farming, in relation to conventional farmers. However, the farmer realizes the various problems associated with organic farming (e.g. higher production cost, shortage of available labour force) while these problems seem to be enormous for conventional farmers.

A first factor analysis on thirteen presented sources of risk, using principal component extraction combined with a varimax rotation, resulted in four factors with eigenvalue greater than 1. The Kaiser-Meyer-Olkin measure for the entire set of variables was 0.796, suggesting the matrix was suitable for factor analysis. The four factor solution gave the most interpretable factors and was judged to be most useful. These factors explained 71.1% of the total variation. Table 1 displays the four factors and their respective loading items. The factors 1 to 4 were labeled, *cost management* , *management of uncertainty*, *health* and *institutional changes*. Factor 1, named *cost management* , had high loadings on items of cost, such as variable cost, inputs, labor, and production difficulties. Factor 2 refers to *uncertainty* but to the technical problems attached to the organic agriculture. The application of organic agriculture faces special technical problems, i.e. how to manage production diseases and how to apply the new specialized production techniques. Factor 3, *health* involves the health problems that either producers or consumers face from conventional agriculture. Finally, factor 4 has high loadings on changes in government support payments and changes in price support and was labeled *institutional changes*.

A second factor analysis was applied to determine the attitudes toward organic agriculture and management strategies for risk. The Kaiser-Meyer-Olkin measure for the entire set of the 13 variables was 0.829, indicating a matrix that was suitable for factor analysis. The factor analysis gave three factors explaining 62.1% of the total variation. Table 2 displays the three factors and their respective loading items. Factor 1 was named *Superiority of organic agriculture;* farmers recognised that organic agriculture is superior to conventional. More specifically, organic agriculture received better prices, there is strong demand for organic products and there are perspectives for market expansion. Factor 2 refers to *income safeguarding.* Farmers are interested in income insurance, crop diversification and off farm activities. Finally, factor 3, *Health protection,* presents the interest that farmers place on the health of their labour force. From a comparative point of view, organic farmers believe that organic agriculture is more superior to conventional, they exhibit awareness of the health of their workers but they are not so interested in income safeguarding in comparison with conventional farmers.

The economic analysis was based on enterprise budgets. A summary of the revenue and cost information contained in both conventional and organic samples for lemons and citrus is presented in Table 3. Organic farmers mainly face lower yields and better prices. Organic lemons yield is 19% lower than the conventional one and organic prices for lemons were 16% higher than conventional ones. Also, lemon farmers face a lot of problems with frost and hail, so farmers receive some 100€ per 0.1ha crop loss assistance from the (public) Agricultural Insurance Organization. This payment allows for better management of farmers' income variability. Total production cost for organic lemons was 12.4% higher, compared to conventional production system. More specifically, total variable cost was 11% higher for organic lemon farmers, with organic fertilisers, plant protection and certification to be the important cost factors for them, while labour cost is smaller for organic lemon farmers.

Organic citrus yield is lower (about 3%) than the conventional one. At the same time organic citrus prices are higher (about 43%) than the conventional prices received by farmers. Average revenues of organic citrus are higher compared to conventional due to premium prices and subsidies received from the application of the organic scheme, which compensate for the low yield of organic citrus.

Total production cost for the examined organic crops was higher, 12.6% for organic citrus compared with the corresponding conventional crops. More specifically, fixed cost and land expenses are almost equal for both farming systems. Labour expenses (family plus hired) in organic farming are higher compared with those of conventional farms. Organic citrus labour expenses exceed 17.5% compared with respective conventional farms. Total variable cost is higher in the organic production system mainly due to increased organic fertilizer costs and the certification cost. Organic citrus present 29.4% more variable expenses compared with conventional corresponding farms.

3.1. Specification of stochastic variables

A stochastic simulation model for the hypothetical farm is used to estimate the empirical probability distribution for net return $N\tilde{R}$ per 0.1ha. Net returns are calculated by subtracting all costs from the total returns including total subsidies received for the applied organic scheme:

$$N\tilde{R} = [(\tilde{Y} * \tilde{P}) + S] - VC - F$$

where
$\tilde{Y}$ is stochastic yield for organic or conventional crop
$\tilde{P}$ is stochastic price for organic or conventional crop
S is total subsidies for organic or conventional crop
VC is variable cost for organic or conventional crop
F is fixed cost for organic or conventional crop

The main factors that affect the expected returns for organic cultivations are price, yield and subsidies from Regulation (EC) 2078/92 for environmental protection. Yield and price uncertainties were modelled as stochastic variables, like empirical distributions and were based on the observed farmers' data. A statistical summary of the simulated yields and prices is provided in Table 4. The simulated means are statistically equal to the observed data. Simulated distributions of expected returns were developed in a Simetar environment (Simetar, 2006). Monte Carlo simulation was used to determine the mean and the variance of net returns of each cropping system. Net returns of organic and conventional cropping system were determined by 5,000 Monte Carlo iterations.

4. Results

The stochastic model estimates the probability of each profit outcome to occur, providing the farmer with the profit range, minimum and maximum, and the mean profit. The ranking procedure with the stochastic model allows the inclusion of risk aversion in the analysis. Results of simulating organic and conventional cropping systems given the existing payment scheme and the organic price premium in Western Greece are presented as cumulative distribution functions (CDFs) of the annual total net farm income. To measure risk, the CDFs of average net returns were calculated based on stochastic yield and prices. Cumulative distribution function graphs show the probability (on the y-axis) of net income being less than a particular level (on the x-axis). The CDFs were calculated using Simetar © which is an add-in program that functions under Microsoft Excel ©. Simerar develops a probability distribution of net returns based on the averages and distributions of yields, market prices, costs and subsidies.

The organic lemons have about 36% chance of generating a negative net income when subsidies and crop loss assistance payments are included (Table 5). The mean, minimum, and maximum net income per 0.1ha for organic lemons are 86€, -245€ and 1020€ respectively. The conventional lemons crop system is associated with 34% chance of producing negative net income with mean, minimum, and maximum net income per 0.1ha of 29€, -299€ and 261€ respectively. Without subsidies, the organic cultivation of lemons would not be as effective as the subsidised production. More specifically, the probability of negative net income increases to 55% and the mean net income decreases to 11€ per 0.1ha. These two factors might make farmers more reluctant to convert their cultivation to organic agriculture since the mean net income is lower and the range of possible negative results is very large corresponding to higher variability of economic results. Thus, the organic cultivation of lemons without subsidies has unfavourable economic results in comparison with the conventional production system.

The organic citrus is associated with a 55% chance of expressing a negative annual farm income including subsidies, while the corresponding chance is about 66% for the conventional system (Table 5). The mean, minimum, and maximum net income per 0.1ha for organic citrus are 33€, -394€, 1090€ respectively while for organic citrus without subsidies the corresponding figures are -51€, -478€ and 1006€. Consequently, organic cultivation of lemons with subsidies exhibits advanced economic results. The very attractive point of this cultivation is that the conventional system of citrus is cultivation with high risk. The net income for conventional citrus cultivation ranges from -277€ to 2989€ with mean only 19€ per 0.1ha. The chance of expressing a negative net income is very large, 66%, i.e. the same chance that the organic farmers face without the incentive of subsidies.

According to these results, firstly, the organic cropping system for lemons and citrus show a higher net farm income than the conventional system if organic cultivation subsidies are included in the analysis. Secondly, the net income of the organic system of lemons can be described as the most uncertain one, since the CDF for organic system is less steep than the CDF for the conventional one. Moreover, the organic CDF has a lower minimum and a larger maximum than the conventional CDF. In addition, the high yield uncertainty combined with the organic price premium has a multiplicative effect on the uncertainty of the net farm income of the organic farming system. As far as citrus cultivation is concerned, the CDF for conventional cultivation has larger range than the organic one either with or without subsidies, which means that citrus farmers face a lot of problems. The strategy to convert their cultivation to organic could improve their economic results but up to now they face problems with the niche organic market. Thirdly, under the existing payment schemes, all the abovementioned crop systems show some probability of generating negative net farm income. The alternative cropping system that a farmer would prefer depends on his/her degree of risk aversion. Under FSD, one cannot say whether a risk-averse decision maker would prefer organic to conventional because the net income CDFs cross (Figure 1 and Figure 2).

Under SSD the organic cropping system for both cultivations outperforms the corresponding conventional cropping system since the distribution of the organic cropping system has the smallest total area under the CDF. In order to have a more clear view about a specific group of decision makers we apply the stochastic efficiency with respect to a function (SERF) analysis. A SERF analysis of the two risky alternative cropping systems is summarized in Figure 3 for lemons and in Figure 4 for citrus. The SERF approach provides a graphical explanation of how different groups of decision makers might rank risky alternatives. At all risk aversion levels, from risk-neutral to highly risk averse, farmers would prefer the organic farming system over the conventional system. A risk-neutral farmer would prefer the organic system because it has higher CEs than the conventional system for all degrees of risk aversion. The risk premium for risk averse decision makers who prefer citrus organic cultivation with subsidies over the conventional and organic without subsidies strategy, ranges between 30.12€ and 13.88€ per 0.1ha. Finally, for risk averse lemon decision makers the risk premium ranges between 81.52€ and 51.69€ for organic cultivation over the conventional and organic without subsidies.

5. Conclusions

Nowadays organic agriculture is considered to be a production system with a wide range of benefits for both consumers and producers. In this study, we have tried to determine the profile of organic farmers and their attitudes toward risk and organic agriculture. Also, we assessed the financial performance of organic farming in a major organic area of Western Greece. Through the Monte Carlo stochastic simulation model we have tried to find out if it is the best strategy for producers to switch to organic agriculture or to remain in conventional agriculture taking into consideration the term of risk. Risk is very essential for producers especially in organic agriculture as they face greater risk in comparison with conventional farmers.

Organic farmers are interested in the future of their farm; they consider organic agriculture as a superior farming system, which also contributes substantially to environmental protection. But they face a lot of constraints, lack of information, high cost of production and institutional changes. The economic results show that the organic cropping system currently stands out as the most economically viable alternative and the most preferred alternative for risk-averse producers under the assumption of the existing payments. Without payments, however, organic farming is not economically viable and conventional agriculture would be preferred by all farmers, regardless of their degree of risk aversion. Economic results vary according to the crop under consideration. More specifically, our results indicate that the lemons either organic or conventional produce advanced economic results. Citrus farmers face a higher income variability compared with lemon farmers and a greater probability of negative net income per hectare.

Under the prevailing economic conditions, lemon and citrus farmers need new tools to apply in order to help them to remain in the agricultural sector. Unfortunately, in Greece, the experience with tools of income risk management like insurance is very poor. The switch of farmers to organic cultivation in order to improve their income is a way of income risk management for them. Nevertheless, up to now they face a lot of production and institutional constraints, which without some appropriate economic incentives render the future less attractive. Conclusively, there is an urgent need for research in this area in order to determine the most effective way to improve income stability of Greek farmers.

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Table 1. Perceptions of risk sources about organic agriculture

Sources of risk	Organic mean	Conventional mean	Factor 1 *Cost management*	Factor 2 *management of uncertainty*	Factor 3 *Health*	Factor 4 *Institutional changes*
Variable cost	4.27	4.39	0.818			
Total cost of production	4.17	4.36	0.776			
Cost of inputs	4.19	4.40	0.760			
Labour cost	4.46	4.66	0.757			
Production difficulties	3.91*	4.38	0.666			
Yield Variability				0.767		
Production diseases	3.14*	4.35		0.701		
Technical support	3.41	4.18		0.681		
Producer Health					0.927	
Consumer health					0.923	
Changes in government support payments	4.88	4.83				0.810
Changes in price support	4.71	4.65				0.722
Cost of capital	2.99**	3.85				
Information about organic agriculture techniques	2.37*	3.25				

Mean numbers marked with asterisks show that the mean scores of organic and conventional are significantly at *P<0.05 and **P<0.001, based on independent samples t-tests

Table 2. Statements about organic agriculture and management strategies of risk

Statements	Organic mean	Conventional mean	Factor 1 *Superiority of organic agriculture*	Factor 2 *Income safeguarding*	Factor 3 *Health protection*
Organic demand	4.08*	2.59	0.849		
Perspectives	1.88*	3.68	-0.838		
Premium Prices	4.31*	3.33	0.820		
Organic system easily applied	4.27*	2.77	0.786		
Environmental protection	4.77*	3.46	0.766		
Conventional agriculture make environmental problems	4.51*	3.68	0.581		
Less information	2.37*	3.25	-0.513		
Diversification	4.72	4.75		0.788	
Off farm investments	4.69	4.68		0.783	
Yield Insurance	4.61	4.68		0.746	
Contracts with input suppliers	4.68	4.69		0.737	
Off farm activities	4.82	4.68		0.602	
Health protection	4.88	4.77			0.797

Mean numbers marked with asterisks show that the mean scores of organic and conventional are significantly at *P<0.05 and **P<0.001, based on independent samples t-tests

Table 3. Estimated cost of production and payments per 0.1ha in €, in Western Greece, 2004

	Lemons		Citrus	
	Organic	Conventional	Organic	Conventional
Payments	170.78	100.00	83.67	0.00
Variable Cost				
Fertilizers	55.04	31.31	64.03	32.33
Plant Protection	8.8	7.72	8.03	7.92
Certification	16.39	0.00	14.02	0.00
Other	29.05	27.26	24.26	21.25
Labour	246.06	247.89	188.29	160.14
Land	40.00	40.00	40.00	40.00
Fixed Cost	87.12	74.90	167.04	187.35
Total Cost	482.46	429.08	505.67	448.99

Table 4. Validation of simulated yield and price empirical distribution for lemons and citrus

	Lemons				Citrus			
	Yield		Price		Yield		Price	
	Org	Con	Org	Con	Org	Con	Org	Con
Statistics for simulated								
Mean	1778.48	2006.69	0.22	0.18	2212.72	2442.96	0.19	0.17
SD	931.97	624.79	0.03	0.02	1108.89	1249.98	0.03	0.06
CV	52.40	31.14	13.08	13.69	50.11	51.16	19.59	41.38
Min	416.53	249.84	0.16	0.12	106.27	402.61	0.11	0.11
Max	4500.26	2812.58	0.30	0.21	5242.32	9963.94	0.28	0.34
Statistics for observed farms								
Mean	1777.74	2005.74	0.22	0.18	2227.67	2536.30	0.20	0.17
SD	940.80	658.78	0.03	0.02	1225.79	1690.57	0.04	0.07
CV	52.92	32.84	13.16	13.95	55.03	66.65	21.60	37.77
Min	416.67	250	0.16	0.12	100.00	400.00	0.11	0.12
Max	4500	2812.50	0.30	0.21	5260.87	10000.00	0.29	0.34
t test of simulated means vs. observed means								
P values*	0.996	0.994	0.996	0.978	0.940	0.771	0.985	0.766
Fail/reject Ho**	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail

*P value is the probability (ranging from 0 to 1) under null hypothesis (Ho) of obtaining a test statistic at least as extreme as the observed value; in these cases, the probability to fail to reject the Ho, that the means are equal.

** Fail to reject the Ho that the means are equal at the 0.05 significance level.

Table 5. Mean, minimum and maximum values and the probability of negative net income from cumulative distribution functions under organic and conventional system in Western Greece

	Cropping system	Prob. of negative net income per hectare	Net Income			
			Minimum	Mean	Maximum	Range
Lemons with subsidies	Organic	0.368	-244.77	86.33	1020.42	1265.19
	Conventional	-	-	-	-	-
Lemons without subsidies	Organic	0.556	-320.35	10.76	944.84	1265.19
	Conventional	0.337	-299.00	29.33	261.56	560.56
Citrus with subsidies	Organic	0.553	-394.40	32.58	1089.98	1484.38
	Conventional	-	-	-	-	-
Citrus without subsidies	Organic	0.666	-478.07	-51.08	1006.31	1484.68
	Conventional	0.664	-277.29	19.12	2989.55	3266.84

Figure 1. Cumulative distribution functions of net income under organic and conventional cropping system for Citrus

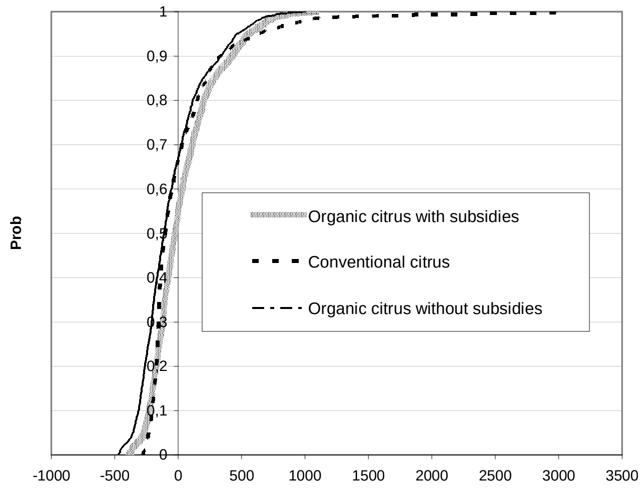

Figure 2. Cumulative distribution functions of net income under organic and conventional cropping system for Lemons

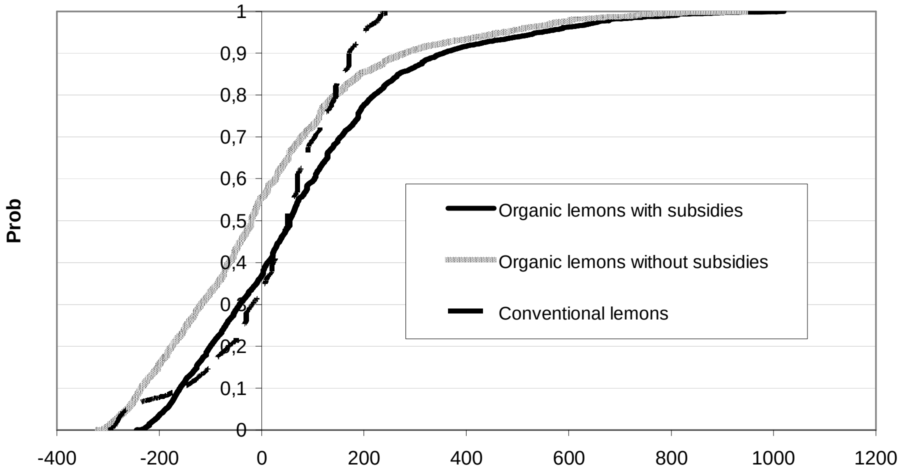

Figure 3. Stochastic Efficiency with Respect to a Function (SERF) Under a Neg. Exponential Utility Function for Lemons

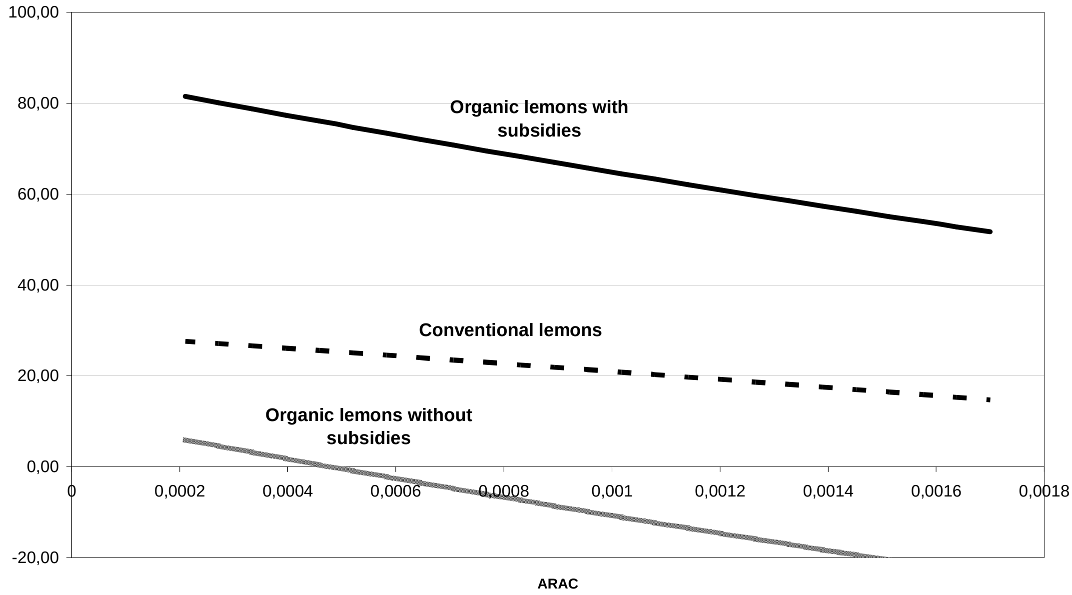

Figure 4. Stochastic Efficiency with Respect to a Function (SERF) Under a Neg. Exponential Utility Function for Citrus