ASSESSING AGRICULTURAL POLICY INCENTIVES FOR GREEK ORGANIC AGRICULTURE: A REAL OPTIONS APPROACH

IRENE TZOURAMANI[1], ALEXANDRA SINTORI[2], AGGELOS LIONTAKIS[2] AND GEORGE ALEXOPOULOS[2]

[1]Agricultural Economics and Policy Research Institute,

National Agricultural Research Foundation, Athens, Greece

tzouramani.inagrop@nagref.gr

[2]Agricultural University of Athens, Department of Agricultural Economics and Rural Development, Athens, Greece

Paper prepared for presentation at the 114th EAAE Seminar
'Structural Change in Agriculture', Berlin, Germany, April 15 - 16, 2010

Assessing Agricultural Policy Incentives for Greek Organic Agriculture: A Real Options Approach

Tzouramani I.[1], Sintori A.[1], Liontakis A.[1] and Alexopoulos G.[2]

[1]Agricultural Economics and Policy Research Institute,
National Agricultural Research Foundation, Athens, Greece
[2]Agricultural University of Athens, Department of Agricultural Economics and Rural Development,
Athens, Greece

The adoption of organic agriculture or livestock involves risk and uncertainty, and to overcome this, well designed schemes are required. Are the current support measures attractive for farmers who wish to convert to organic? At first, this study tries to assess the optimal investment trigger for a new comer into organic dairy sheep farming system and secondly, to evaluate the investment profitability of an existing organic farmer in his attempt to improve his farm. Results indicate that the framework of real options analysis is an appropriate form of analysis if the question of investment profitability is examined under risk and uncertainty and the role of economic subsidies offered to organic farmers is assessed.

Keywords: organic agriculture, dairy sheep farming, real options, agriculture policy

INTRODUCTION

The European Common Agricultural Policy for 2007-2013 and the Hellenic Ministry of Rural Development and Food have introduced new measures and incentives to support the main agricultural sectors in Europe and Greece. Agricultural policy makers aim to provide a balanced relationship among environmental, socio-cultural and economic factors. Encouragement of farmers to convert to organic-farming techniques is therefore an important element of the current policy. However, the evaluation of these new applied measures is crucial for farmers' investment decisions under uncertainty and risk environment.

In Greece, livestock production has always been an important sector of agriculture and its development has been a priority of agricultural policies (H.M.R.D.F., 2007). In particular, sheep farming represents 15% of the total agricultural production value in Greece. It also provides approximately 35% of the total Greek milk production and approximately 17% of the total meat production (Kitsopanidis, 2006). Sheep farming thus provides income to thousands of families and contributes highly to regional economies, especially in isolated and less favored areas. The majority of sheep farms is small, not intensive, family farms, with a high degree of diversification in terms of herd size, capital, and productivity. The annual cost of equipment and buildings is low, as the majority of farms are less capital-intensive. The most common characteristic of sheep farms is that they produce both milk and meat. Approximately 56.8% of the total gross revenue comes from milk production, while the remaining 43.2% comes from meat production (Zioganas, et al., 2001).

The Hellenic Ministry of Rural Development and Food has introduced measures to restructure and support the livestock sector in order to improve its competitiveness, protect the environment, and enhance the quality of life for farming communities in rural areas. Under the Rural Development framework for 2007-2013, two main measures are set to improve sheep farming; measures for organic sheep farming (239591/Oct 2009) and small scale investment subsidy to modernize the sector (Reg. 705/2008 with 7931/ June 2009 decision for implementation). The importance of sheep farming in Greece and the switch towards sustainable systems with emphasis on animal health and welfare as well as food safety and quality are the main driving forces for the restructuring of the sector.

In Greece, sheep farming is mainly concentrated in semi-mountainous and mountainous areas where there is abundance of pastureland. The most common Greek sheep farming systems are the extensive, the semi-extensive and the low intensive (de Rancourt, 2006). The majority of these systems are based mainly on extensive use of non-fertilized natural pasture resources. This extensive and natural system has led to the development of organic farming in Greece exploiting the increased consumer demand for environmentally friendly products associated with animal welfare (Nardone, et al., 2004). Indeed, the production system of sheep farming in the mountainous areas has many of the features of organic farming. These systems have only a few hectares of land, use mainly common grazing, keep the flock and buy only part of the required feed. These farms are less capital intensive, sheep are milked by hand, buildings, equipments, and other structures are very limited.

More specifically, organic livestock farming uses environmentally friendly methods of crop and livestock production, with no use of synthetic fertilizers, growth hormones, growth enhancing antibiotics, synthetic pesticides or gene manipulation (Nardone, et al., 2004). There is a sharp increase in organic certified numbers of animals and farms over the last years. The number of organically breed sheep increased by about 260% from 2002 to 2006, which represented the 2.9% of the total sheep population in Greece and the 9% of the organic sheep population in EU countries (Abando and Rohnerteilen, 2007). The EU regulation no. 1804/99/EC had a significant impact on the increase of the organic livestock farming in Greece. The conversion of conventional dairy sheep faming to organic seems less complicated in terms of management procedures but still farmers' face certain problems during this conversion (Nardone et al., 2004). Greek animal farmers have to face inadequate technical support regarding organic methods, breeding strategies, feed management, disease control, poorly organized markets, lack of skilled personnel, small size of the farm, low educational level of farmers and scarcity of scientific activities and extension services.

Therefore, the conversion to organic farming is associated with many barriers and uncertainties (Pietola and Oude Lansink, 2001; Schneeberger et al., 2002; Abadi Ghadim, et al., 2005; Lien, et al., 2006; Kurkalova, et al., 2006). To overcome the risks associated with these difficulties and uncertainties, policy makers must consider the potential role of economic subsidies in encouraging farmers to make the switch to organic farming. However, in the absence of a reliable methodology for assessing investment decisions in such an uncertain environment we apply real options methodology to define the optimal investment threshold that farmers face from the adoption of organic livestock systems. Real options analysis allows for better investment decisions as uncertainty and risk can be included.

A growing body of studies implements real options in agriculture. Among them, Purvis et al. (1995) examined the role of real options analysis in the adoption of technology in so-called ‘free-stall’ dairy farming under conditions of irreversibility and uncertainty. Hyde et al. (2003) examined optimal investment in an automatic milking system, Tauer (2006) attempted to identify the optimal time for getting in and out of dairy farming and Musshoff and Odening (2008) implement real options in organic agriculture.

This work focuses on the impact of returns variability and of the available policy tools on animal-farmers’ decision on adopting new technology (organic livestock) or improve the existing ones. The study consists of the following parts: first, the theoretical model and the simulation model are presented. Then data and results of the empirical determination of the optimal threshold for investing in organic dairy sheep are presented. The paper concludes with a summary of the main findings and implications of the applied agricultural measures.

METHODOLOGY

Assume that a farmer decides either to start a new organic production system or to continue to produce organically taking into account the role of subsidies and the improvement of the current infrastructure. The available options for the farmer are the following: either to adopt the change or to wait and see if in future the conditions will be modified and the change will be more attractive. The adoption of organic farming system can be considered as an investment. The choice between adopting organic production system or not can be based on the comparison of the investment costs of the new technology I and the present value of its net revenue flow V under certainty

$$V = \int_0^\infty e^{-\rho t} E[(P_t Q_t - C_t + S_t)]dt \qquad (1)$$

in which:

ρ is the real discount rate; t is the time period; E is the expectations operator; P is the output price; Q is the output quantity; C is the variable costs of production; and S is the subsidy.

According to the so-called ‘acceptance rule’, projects are adopted if net revenues are greater or equal to investment costs (that is, if V ≥ I), based on discount cash flow methodology (Gittinger, 1986; Brealey and Myers, 1991).

In practice, the NPV rule often has to be modified because some assumptions are violated (Pindyck, 1991; Dixit and Pindyck, 1994; Collons and Hanf, 1998). It has been argued that NPV does not work properly under conditions of uncertainty. Especially in the case of a decision referred to organic farming, it is obvious that uncertainty of net returns, sunk cost and flexibility of decision making are critical assumptions that are violated. If the farmer is risk-averse, he will choose to adopt organic farming only if he finds the incentives attractive enough, i.e. they overcome the risks associated with the uncertain environment. If he is risk neutral, the farmer is likely to wait for more information on the potential economic ramifications before adopting organic farming. In terms of the acceptance rule, a farmer will convert to a new production system only when the NPV of expected future cash flows exceeds the sunk cost plus the value of the option of making an investment at some time in the future (the so-called option value). Real options methodology gives the opportunity to incorporate the option of delaying investment until conditions are more favourable (Dixit and Pindyck, 1994). In other words, the present value of the expected stream of cash from a project not only has to be positive but it should also exceed the cost of the project by an amount at least equal to the value of keeping the investment option alive (Dixit and Pindyck, 1994).

Dixit and Pindyck (1995) have suggested that capital investments or irreversible investment opportunities are like financial call options. Therefore, a company with an investment opportunity has the option to spend money now or in the future (the exercise price) in return for an asset of some value (the project). According to this view, the value of the opportunity to invest is dependent on two variables: (i) the value of waiting (BR^{β}); and (ii) the value of investing ($\mathrm{R}/\rho - \mathrm{K}$) (Dixit, 1992). This can be expressed as follows:

$$V(R) = \begin{cases} BR^{\beta} & \text{if } \mathrm{R} \le \mathrm{H} \\ \mathrm{R}/\rho - \mathrm{K} & \text{if } \mathrm{R} \ge \mathrm{H} \end{cases} \tag{2}$$

in which:

R equals the expected uncertain returns from the investment; B is a parameter equal to $(H - \rho\mathrm{K})/\mathrm{H}^{\beta}$ (Pindyck, 1991); K is the sunk cost of initiating the investment project; and ρ is the opportunity cost of capital or a risk-adjusted discount rate.

Dixit (1992) described the optimal timing of an investment as a tangency between the value of investing and the value of waiting to invest. The optimal investment trigger is at point ‘H’, where the expected returns from initiating the investment are sufficiently high to make it optimal to proceed. The optimal investment derives from the real options analysis, if the value-matching condition and the smooth-pasting condition are simultaneously satisfied (Dixit, 1992). This can be expressed as follows:

$$\mathrm{H} = \frac{\beta}{\beta - 1}\rho\mathrm{K} \qquad (3)$$

in which:

$$\beta = \tfrac{1}{2}\left[1 + \sqrt{1 + \frac{8\rho}{\sigma^2}}\right] \succ 1 \text{; and}$$

ρK is the Marshallian trigger.

The parameter β is a function of two known or estimable parameters (ρ and σ^2). As the uncertainty of returns from investing increases (β) decreases, the difference between the Marshallian trigger (M) and the optimal trigger increases. Raising the discount rate increases β and reduces the difference between the Marshallian trigger (M) and the optimal investment trigger (H).

A Monte Carlo simulation model is used in the present study to estimate the variance of the value of investing in organic dairy sheep farming. The value of the opportunity to invest (V) is modelled as a geometric Brownian motion process, as follows:

$$\frac{dV}{V} = \mu\, dt + \sigma\, dz \qquad (4)$$

in which:

σ is the proportional variance parameter; and

dz is the increment of Wiener process, $z(t)$.

The relationship between dz and dt is given by $dz = \varepsilon_t \sqrt{dt}$, in which ε_t has zero mean and unit standard deviation. Therefore, changes in V over time are a function of a known proportional growth rate parameter μ, and σ, which is governed by the increment of the Weiner process, dz (Dixit and Pindyck, 1994). It is modelled as the discounted sum of random draws from the distribution of expected returns from investing (R), annualised and projected into perpetuity. More specifically, the opportunity to invest for time t (V_t) is estimated by equation (5) and for a period hence (V_{t+1}) is estimated by equation (6) (Dixit and Pindyck, 1994; Purvis et al., 1995):

$$V_t = \frac{\left[\frac{\rho}{1-\left(\frac{1}{(1+\rho)^{n-t}}\right)} PV_t\right]}{\rho} \quad (5) \qquad\qquad V_{t+1} = \frac{\left[\frac{\rho}{1-\left(\frac{1}{(1+\rho)^{n-t-1}}\right)} PV_{t+1}\right]}{\rho} \quad (6)$$

in which:

$PV_t = \sum_{t=0}^{n} \frac{R_{t+i}}{(1+\rho)^i}$; $PV_{t+1} = \sum_{t=1}^{n+1} \frac{R_{t+i}}{(1+\rho)^{i-1}}$; R = expected returns from investing;

ρ is a discount rate; and t is the time period of the investment.

The trend (μ) of the geometric Brownian motion process can be estimated by $\mu_v \approx \frac{1}{N}\sum_{j=1}^{N}\left[\Delta \ln V_j\right]$, and the variance of the value of the opportunity to invest can be estimated by $\sigma_v \approx \frac{1}{N}\sum_{j=1}^{N}\left[\Delta \ln V_j - \mu_v\right]^2$.

To calculate the statistics μ_v and σ_v from simulation data, the mean of N simulated log differences investing in t and t+1 can be calculated. The difference between the natural logarithms of V_t and of V_{t+1} gives a discrete estimate of the change in the value of the investment opportunity, as occurring over an increment of a geometric Brownian motion process. In the present study, the estimate of this discrete difference was simulated over 10,000 iterations. In each of these iterations, the estimation of equations of present value required n and n+1 draws, respectively, with each draw representing an observation of annual returns from investing. The evaluation of variance of the opportunity to invest was used to estimate the optimum investment trigger under uncertainty and irreversibility.

DATA

In our analysis, three typical investment options were evaluated. The first refers to an organic dairy sheep farmer who wishes to improve his enterprise, the second refers to the establishment of a new organic dairy sheep farm and the third refers to a conventional dairy sheep farmer who wishes to improve his enterprise. In each investment option, we assume a flock of 200 productive ewes which is a common flock size in Greece. Data was collected from 34 conventional and 16 organic selected farms in the region of Macedonia as part of a broader survey of organic and conventional sheep farming in northern Greece (Tzouramani, 2008). In accordance with previous studies (Kerselaers et al., 2007; Lien et al.. 2007; Ribera et al., 2004), the primary data were supplemented with information extracted from the literature and experts in the field (Ministry of Agriculture, 1981; Zervas et al., 2000; Zioganas et al., 2001; Tzouramani and Sintori, 2005; Kitsopanidis, 2006).

The annual ***operating costs*** for a flock size of 200 productive ewes for both organic and conventional sheep farming are presented in Table 1. The feed cost was the major component of total costs in both organic and conventional sheep farming—although it should be noted that the conventional farms had a larger feed cost than the organic farms as the latter utilise pastureland to a greater extent (EC1804/99 for organic farming). Conversely, total land and labour costs were greater in the case of organic farming as a consequence of extra land and labour requirements for the grazing of the flock. Fixed costs (with regard to buildings and equipment) were equivalent in the two forms of farming. The only difference between organic and conventional sheep farming in terms of fixed costs resided in the value of animal capital.

The three different investment options described above were evaluated under four investment scenarios. The base scenario refers to the typical alfalfa yield, while the second and the third scenarios refer to a 30% increase and a 30% decrease in alfalfa yield respectively. Alfalfa yield was selected as it is the main forage produced in sheep farms. As can be seen in Table 1, the feed cost is increased when the alfalfa yield is decreased. This is the result of the increased production cost of the own-produced alfalfa but also the consequence of the additional alfalfa that has to be purchased. On the other hand, when alfalfa yield is increased, the feed cost is smaller because of the reduced production cost and of the limited amount of the alfalfa that has to be purchased. The last scenario refers to the substitution of the purchased soya beans with own produced chickpeas in organic sheep farms. This scenario reflects the increasing interest in chickpeas cultivation, revealed by the conduction of several studies in Greece which indicate that the nutritional value of chickpeas is similar to that of the soya beans (Iliadis, 2006).

Thus, for the existing and the new organic dairy sheep farmer all four scenarios were examined assuming a) both organic and investment subsidies, b) only organic subsidies and finally c) no subsidies. In the case of the conventional dairy sheep farmer, three of the four scenarios were examined (basic, increased and decreased alfalfa yield) under the hypothesis of investment subsidies and the hypothesis of no investment subsidies.

The main factors that affected the expected ***returns*** of dairy sheep farming were milk price and yield, which were modelled as stochastic variables. In the case of the gross production value of meat, uncertainty arose mainly from the price fluctuation, which was incorporated as a stochastic price variable. The gross production value of ewe meat (non-productive ewes) contributed less to the total gross production value of the farm. Moreover, given that the replacement rate of ewes was similar in all types of farms and that the market price of ewe meat was stable, the uncertainty associated with fluctuations of yield and price of ewe meat was not considered in this study.

For conventional milk, the relevant distributions were calculated using historical data (1999–2003) from 22 farms in the region of Macedonia extracted from the Greek Farm Accountancy Data Network (FADN) sample. Time-specific and farm-specific effects were removed from the panel data using the two-way fixed-effect model (Lien, 2001; Flaten and Lien, 2005). Because the residuals of the OLS were found to be normally distributed, the conventional milk yield distribution was considered to be normal. For conventional milk price distribution, all the observed prices of the above panel were deflated using the proper price indices. The two-way fixed-effect model was also used to correct the conventional milk price panel data. Because the residuals of the regression model were found to be normally distributed, the price distribution for conventional milk was also considered to be normal.

The stochastic milk yield and milk price variables were simulated by 1,000 Monte Carlo iterations. Hypothesis tests were performed to determine whether the simulated stochastic variables reproduced the de-trended historical data. These tests failed to reject the null hypothesis that the simulated means and variances were statistically equal to the de-trended historical data at a 95% confidence level. In addition, milk yield and price data were tested and no correlation between them appeared.

Milk yield and price distributions for organic farming were represented by triangle distributions, due to a lack of historical data (Tzouramani, 2008). The maximum, minimum, and mode milk yields of organic sheep farming were 135 kg, 50 kg, and 84.4 kg respectively, whereas the minimum, maximum, and mode milk prices were €0.75, €1.1, and €0.91 respectively.

Lamb meat prices for both organic farming and conventional farming were also stochastic and they were represented using the triangle distribution. For organic farming, the minimum, maximum, and mode lamb meat prices were €3.5, €5.5, and €4.5 respectively; the equivalents for conventional farming were €3, €5, and €4.1. The above stochastic variables were simulated by 1,000 Monte Carlo iterations.

The necessary information for the estimation of the ***initial investment*** in both organic and conventional sheep farming was obtained through interviews with experts in the field (agriculturalists and entrepreneurs). The cost of the initial investment is shown in Table 2 (for a typical modern farm). The animal capital refers to 200 productive ewes and 13 rams. In this analysis it was assumed that a typical stable was made of prefabricated metal and included resting and milking areas. It was also assumed that the farm owned a barn for the storage of fodder.

It should be noted that the value of animal capital is smaller in the case of organic farming because the flock usually consisted of indigenous breeds of sheep that are resistant to disease and better adapted to the natural environment (although their milk production is lower).

As mentioned above in this study we examined three investment options. In the case of the existing organic and the existing conventional sheep farmer, the small cost investment indicated in Table 2 was examined. We have assumed that the farms are already established but they lacked basic equipment such as milking machine. The small cost investment includes the construction of a milking area and the purchase of a milking machine, an ice basin and some additional equipment for the preparation of the ration. This small scale investment can almost entirely be subsidised under the Reg. 705/2008 with 7931/2009 decision for implementation. In the case of the new organic dairy sheep farm, the full cost investment indicated in Table 2 is examined. Approximately one third of this investment can be subsidised under the Reg. 705/2008 with 7931/ June 2009 decision for implementation[1].

RESULTS

The real options approach is applied to investigate the role of subsidies, investment subsidies and stochastic factors taking into account irreversibility, flexibility and uncertainty in Greek organic dairy sheep farming. The economic performance is very important since competitiveness is a core target for Greek agriculture and the availability of agricultural funds is very limited. In this work, the real options methodology is applied to evaluate three main investment options that involve: a) an already established organic dairy sheep farm, b) a new organic dairy sheep farm and c) an existing conventional dairy sheep farm. Organic subsidies and investment subsidies for agricultural sectors are essential for profitability and play significant role in farmers' adoption decision.

At first, Monte Carlo simulation was used to determine the expected mean and variance of expected net annual returns of the project. Net annual returns were determined by 1,000

[1] This measure refers to the subsidizing of the investment. Additionally, organic farmers are entitled to the organic subsidies 239591/October 2009

Monte Carlo iterations through Simetar Software (Simetar, 2008). For the organic dairy sheep farmer, expected net annual returns are equal to 6,807€ (without organic subsidies) and 14,463€ (with organic subsidies) while for the conventional dairy sheep farmer the corresponding expected net annual returns are equal to 11,905€, under the basic scenario (Table 3). Under the scenario of organic chickpea production the net annual expected returns doesn't have a significant difference in comparison with the basic scenario, 6,791€ (without organic subsidies), 14,447€ (with organic subsidies). Under the scenario of alfalfa expansion produce, the net annual expected returns increase to 7,419€ (without organic subsidies) and 15,075€ (with organic subsidies) while under the scenario of alfalfa reduction, the expected net annual returns are reduced to 6,023€ (without organic subsidies) and 13,688€ (with organic subsidies).

The annual sunk cost for investing on a new dairy sheep faming was estimated to 145,775€ for the organic production system. The annual sunk cost for improvement of an existing dairy sheep farm either organic or conventional refers to 50,800€. The annuity is calculated assuming a long run loan of ten years' duration and 6.35% rate of interest. The annual amount of outlay for the investment can be reduced by 50,000€ via the rural development programs (Reg. 705/2008 with 7931/2009 decision for implementation).

Under the baseline analysis, it was assumed that an organic dairy sheep farmer could use a real discount factor of 8% on his/her investment. Real options analysis suggests that organic investors have to use a different discount rate. To measure the effect of uncertainty on the optimal investment behavior, the existing organic dairy sheep farmer has to use a modified hurdle rate, which corresponds to 15.85% and 12.98% without or with organic subsidies under the basic scenario. The corresponding modified hurdle rate for a new comer in organic dairy sheep activity is 13.97% and 12.97% without and with organic subsidies respectively. For a conventional farmer the corresponding modified hurdle rate is equal to 12.66%. Organic subsidies are crucial factors for the variability of returns, as indicated by higher values of ρ'. Uncertainty is clearly greatest if organic subsidies are omitted.

Under the real options analysis, the net annual expected returns of the investment have to be $\frac{\beta}{\beta-1}$ times the corresponding annual sunk cost. Under the basic scenario, for the existing organic dairy sheep farmer, net annual expected returns have to be 1.9816 times and 1.6220 times the corresponding annual cost with and without organic subsidies. For the new organic dairy sheep farmer, net annual expected returns have to be 1.7461 and 1.5358 times the corresponding annual cost without and with organic subsidies. For the conventional farmer the net annual expected returns have to be 1.5828 times the annual cost.

Table 3 presents the optimal investment trigger (H) for a ten years project life referring to the existing, the new organic and the corresponding conventional dairy sheep farmer under all the scenarios referring to feed composition. For an existing organic dairy farmer, organic subsidies are crucial and would support the application of a small investment cost for the improvement of the farm. It is obvious that due to the fact that the Hellenic Ministry of Rural Development and Food gives the opportunity to dairy sheep farmers to apply for financing small investment plans, they should react towards this direction immediately and modernize their farm. Meanwhile, the establishment of a new organic dairy sheep faming under the available investment programs does not seem to be an attractive option, so farmers have to delay this investment. The initial sunk cost for a new comer in this industry is high and without investment subsidy for it, the project is rather not attractive. Organic subsidies improve results but without subsidies in support of the initial sunk cost, the investment is still not profitable. Finally, regarding the existing conventional dairy sheep farmers, the variability of their returns is lower than the corresponding organic farmers. For conventional dairy sheep farmers the expected annual returns are marginal to support a small investment plan in order to modernize their farm. So, they have to take the opportunity to apply for the financial support of improving their situation under the current program.

Conclusions

In this work, real options analysis was employed to assess the effectiveness of applied agricultural policy for organic livestock farming in Greece. Three potential investment opportunities (the improvement of an organic dairy sheep farm, the establishment of a new organic dairy sheep farm and the improvement of a conventional sheep farm) were evaluated in order to suggest possible actions by farmers.

The general finding of this analysis is that organic subsidies play important role in farmers' adoption decision. Empirical results suggest that organic dairy sheep farming either with or without investment subsidies are not an attractive project to apply if organic subsidies are not present. Moreover, organic dairy sheep farmers face greater variability of expected net annual returns due to milk yield and price variability. The driving force of the sharp increase of the number of certified animals and farms over the last years was mainly economic due to organic subsidies. For farms located in Least Favored Areas, organic production seems to be often the only possibility to survive. Therefore, a well established organic market would be a powerful key to protect Greek farmers from the global competition.

The best strategy for existing organic farmers and existing conventional dairy farmers is to apply for the improvement cost plans that agricultural policy measures offer. The use of milking machine will have several effects, i.e. it will increase work efficiency at the farm; improve the quality of milk and the quality of farmers' life. The analysis point out that there is need for further investment subsidies in order to have a higher proportion of new players in organic dairy sheep farming. Organic dairy sheep farming has a significant sunk cost and high variability of expected net returns which drive farmers to keep alive this option until attractive subsidy investment measures or other conditions will prevail in the future.

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Table 1. Annual operating cost per ewe flock for organic and conventional dairy sheep farming

	Organic				Conventional		
	Basic	**Chickpea**	**-30% alfalfa**	**+30% alfalfa**	**Basic**	**+30% alfalfa**	**-30% alfalfa**
Land	5.41	5.41	5.41	5.41	2.76	2.76	2.76
Labor	39.81	39.81	39.81	39.81	37.12	37.12	37.12
Variable Cost	62.80	62.88	66.67	59.74	101.06	95.77	107.20
Feed Cost	*58.74*	*58.82*	*62.54*	*55.74*	*98.95*	*93.80*	*104.96*
Purchased Hay	17.53	17.53	20.76	13.09	18.73	15.75	25.38
Purchased Corn	9.3	9.30	9.3	9.3	10.18	10.18	10.18
Other Purchased Concentrates (Grains and Milk Replacers)	2.27	-	2.27	2.27	22.26	22.26	22.26
Produced Grains	7.89	10.24	7.89	7.89	19.86	19.86	19.86
Produced Hay	12.66	12.66	13.23	14.1	17.27	13.13	16.63
Salt, Mineral etc.	0.44	0.44	0.44	0.44	2.00	2.00	2.00
Other*	8.65	8.65	8.65	8.65	8.65	8.65	8.65
Variable Capital Interest	1.32	1.32	1.39	1.26	2.11	1.97	2.24
Certification cost	2.74	2.74	2.74	2.74	-	-	-
TOTAL OPERATING COST	108.02	108.1	111.89	104.96	140.94	135.65	147.08

*Veterinary and medicines, Fuels, Lubricants, Water, Electricity, Certification cost etc.

Table 2. Initial investment and improvement cost for organic farming

	Initial cost (€)	**Improvement Cost (€)**
A. Buildings*		
1. Stable (590 m^2)	57,000	-
Resting Area (450m^2)	45,000	-
Milking Area (140m^2)	12,000	12,000
2. Barn (150m^2)	13,500	-
Total	70,500	
B. Equipment*		
1. Milking Machine	28,000	28,000
2. Mill and Mixer	7,800	7,800
3. Troughs (14)	2,800	-
4. Waterers (14)	3,000	-
5. Ice basins	3,000	3,000
5. Others	4,920	-
Total	49,520	
C. Animal Capital		
1. Ewes (200)	24,000	
2. Rams (13)	1,755	
Total	25,755	
TOTAL	**145,775**	**50,800**

* We assume that the initial investment in buildings and equipment is common in conventional and in organic sheep farming

Table 3. Expected Returns, Optimal trigger and hurdle rate under each scenario

	Expected Returns	Optimal Trigger	ρ′
Basic Scenario			
Existing Organic dairy sheep farming			
Without organic & investment subsidies	6,807	13,905	15.85%
With organic subsidies – no investment subsidies	14,463	11,382	12.98%
With organic & investment subsidies	14,463	179	12.98%
New Organic dairy sheep farming			
Without organic & investment subsidies	6,807	35,159	13.97%
With organic subsidies – no investment subsidies	14,463	30,925	12.29%
With organic & investment subsidies	14,463	20,318	12.29%
Existing conventional dairy sheep farming			
Without investment subsidies	11,905	11,107	12.66%
With investment subsidies	11,905	175	12.66%
Scenario Chickpea			
Existing Organic dairy sheep farming			
Without organic & investment subsidies	6,791	13,897	15.84%
With organic subsidies – no investment subsidies	14,447	11,365	12.96%
With organic & investment subsidies	14,447	179	12.96%
New Organic dairy sheep farming			
Without organic & investment subsidies	6,791	34,939	13.88%
With organic subsidies – no investment subsidies	14,447	30,877	12.27%
With organic & investment subsidies	14,447	20,286	12.27%
Scenario +30% alfalfa			
Existing Organic dairy sheep farming			
Without organic & investment subsidies	7,419	13,706	15.63%
With organic subsidies – no investment subsidies	15,075	11,336	12.92%
With organic & investment subsidies	15,075	179	12.92%
New Organic dairy sheep farming			
Without organic & investment subsidies	7,419	34,775	13.82%
With organic subsidies – no investment subsidies	15,075	30,850	12.26%
With organic & investment subsidies	15,075	20,268	12.26%
Existing conventional dairy sheep farming			
Without investment subsidies	13,358	10,909	12.44%
With investment subsidies	13,358	172	12.44%
Scenario -30% alfalfa			
Existing Organic dairy sheep farming			
Without organic & investment subsidies	6,023	14,280	16.28%
With organic subsidies – no investment subsidies	13,688	11,399	13.00%
With organic & investment subsidies	13,688	180	13.00%
New Organic dairy sheep farming			
Without organic & investment subsidies	6,032	35,393	14.06%
With organic subsidies – no investment subsidies	13,688	30,874	12.27%
With organic & investment subsidies	13,688	20,284	12.27%
Existing conventional dairy sheep farming			
Without investment subsidies	10,678	11,565	13.19%
With investment subsidies	10,678	182	13.19%