FARM DECISION-MAKING IN A MULTIFUNCTIONAL CONTEXT: THE CASE OF CONVENTIONAL AND ORGANIC FARMING IN KERKINI DISTRICT, GREECE

MICHAEL VASSALOS
Department of Agricultural Economics,
University of Kentucky, USA.
E-mail: vassalosmichael@uky.edu

CARL R. DILLON
Department of Agricultural Economics,
University of Kentucky, USA.

PAVLOS KARANIKOLAS
Department of Agricultural Economics,
Agricultural University of Athens,
Athens, Greece.

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Abstract

Multifuncionality has become a central concern at both conceptual and empirical levels. In this study, a comparative evaluation of the economic performance of conventional and multifunctional farms (mainly organic farms) was conducted for Lake Kerkini region (North Greece) with the use of mixed integer non-linear programming method. Economic performance was evaluated in terms of farm income, resource allocation, production level etc. The results indicate that multifunctional farms have overall better economic performance and young farm managers are keener to adopt multifunctional farming than the older ones.

Key words: Greek farming, multifunctionality of farming, farm, farm decision making and age of farmers

Framing the Issue

An interesting strand of the literature on multifunctionality refers to the attempts that have been made from scholars to operationalise the notion of multifunctional agriculture at the farm level.

Using mathematical programming methods at the farm level, Havlík *et al*. (2005) analysed the impact of various policy instruments on the production of environmental goods, related to agricultural commodities, in view of the uncertainty in output prices and farmers' risk aversion. Additionally, Wilson (2008), conceptualizes the idea of multifunctional transitional processes over time and, introduces the notions of multifunctional path dependency and decision-making corridors.

Multifunctionality is integrated in the policy impact analysis from Buysse *et al.* (2007), with the use of three different, farm-level, mathematical programming models. Moreover, Wilson (2009), suggests that the farm level is the most important spatial scale for the implementation of multifunctional action 'on the ground'; this argument stems from the analysis of different interlinked 'layers' of multifunctional decision-making ranging from the farm level to the national and global levels.

Finally, Aguglia *et. al*. (2009), explore the adoption of diversification and multifunctionality as possible alternative strategies to the agricultural "productivist" model.

The Greek literature is quite poor with regard to studies about the economic performance of multifunctional farms and the joint ness between commodity and non-commodity outputs. Recent references on various multifunctional aspects of Greek agriculture include: Barrio and Vounouki (2003), Louloudis, et al. (2004), and Karanikolas *et al.* (2007). These studies illustrate that multifunctional activities are more efficient and can help family farming, as well as, rural communities to improve their overall performance.

Greek agriculture is a highly diversified sector. This diversification results from the high fragmentation of farm holdings, the topography and natural features of Greek landscape (83% of the agricultural area is situated in less favored areas or mountain areas), the multitude of farm holdings (860,000 holdings) and, last but not least, from the scarce resource endowments. Moreover, 36% of all farm holdings have an economic size of less than 2 European Size Units, 67% of holdings occupy less than one Annual Working Unit and 76% use less than 5 ha of agricultural area. The chief goods produced are wheat, corn, olive oil, fruits and vegetables. The age and sex distribution of farm holders is another important aspect of Greek agriculture; 25% of the holders are women, 55% are aged 55 or more (37% are aged 65 or more), and only 7% are younger than 35 years. Finally, only 15% of farm holders are full-time farmers.

The purpose of this study is first, to illustrate whether or not multifunctionality can be a reasonable economic choice for Greek farmers and, second, to examine possible differences in farming decisions between younger and older farm managers.

Methodology and data

To achieve the goals of this study, a mixed integer non-linear programming (MINLP) method was implemented. A general specification of the model follows:

$$(1)\quad \text{Max:}\quad \sum_j R_j X_j - \sum_j C_j X_j + (HSAMT \times HS) + (LSAMT \times LS)$$

Subject to:

$$(2)\quad Ax \le B$$

$$(3)\quad HS + LS \le 1$$

$$(4)\quad DI = \frac{X_{"cows"} \times [10 + (6 \times \gamma)] + X_{"sheep"} \times 1.5}{PST}$$

$$(5)\quad HSAMT = (200 \times X_{"cow"}) + (25 \times X_{"sheep"})$$

$$(6)\quad LSAMT = (25 \times X_{"cow"}) + (6.25 \times X_{"sheep"})$$

$$(7)\quad DI - 1.8HS - M \times LS \le 0$$

Where, j represents the possible enterprises for conventional and organic producers. Regarding the objective function coefficients, R_j represents the gross revenue (in €) calculated at the prevailing market price of the j^{th} enterprise. C_j represents the production cost (including variable costs) of one unit (stremma or head) of the jth enterprise. The decision variable includes X_j which represents the stremmas or head produced of the jth enterprise. Finally, HSAMT represents the high subsidy amount (€) and LSAMT represents the low subsidy amount (€) of livestock subsidies. Binary variables (HS, LS) were created in order to choose between high subsidy and low subsidy payments.

There are six resource constraints in the model: capital availability (€), three types of land availability (dry, irrigated and pasture land in stremmas), labor (available working hours) and machinery availability (available operating hours). Resource endowments include available area of irrigated land, pasture land and dry land in stremmas, capital availability in Euros, labor and availability in operating hours of machinery. A is the matrix of technical coefficients and B is the vector of resource stocks.

Regarding accounting constraints, DI represents the density index of livestock productivity, γ is the weighted average of the number of cows between six and twenty-four months age and is calculated based on life expectancy and livestock replacement assumptions[1] (for this study $\gamma = 0.8$). Equation (7) establishes the density index dependent requirements of receiving either a high subsidy (HS) or a low subsidy (LS) but not both. Thus, if DI is less than 1,8 then HS=1 and LS=0 , otherwise, the DI is not restricted as M represents a very large number.

The data used in this study come from two sources. Firstly, from the National Statistical Agency of Greece and secondly, from, questionnaire based, interviews with the leaders of the farms during the period June-July 2007.

The samples used for this study consist of 25 organic farms, 10 of which engage in eco-tourist activities, and 45 conventional farms respectively. All the organic farms of the area are included in the sample. The choice of the conventional operations was made with the method of stratified random sampling. Organic and conventional farms were divided into three groups with main criterion the land availability for agricultural activities: Firstly, *small farms*, consisting of 10 organic and 18 conventional farms respectively with less than 50 stremmas available. Secondly, *medium farms*, comprising 9 organic and 16 conventional farms respectively, which have between 50 and 100 stremmas available. The third group, *large farms* consists of 6 organic and 11 conventional farms which have more than 100 stremmas available for agricultural activities.

For each one of these groups an "average" conventional and organic farm operation was estimated based on the data coming from the questionnaire. The characteristics of

[1] The assumptions made are: life expectancy of cows twelve years, cows are replaced at nine years and culled at three years. Calves are sold at twenty months of age

the "mean farms" are presented in Table 1. Descriptive statistics regarding important characteristics of decision makers are presented in Tables 2 through 5.

Table 2 shows that the leaders of organic farms are quite often between 30-39 years old. The age of the manager turns out to be an important factor for decision making. This is so because, younger decision makers are less risk averse and have a bigger planning horizon. From Table 3 it can be seen that, as the size of the farm expands the percentage of the farm managers with off farm activities is declining. Additionally, it can be seen that the percentage of farm managers with off farm activities is higher in conventional enterprises. This is not unexpected because organic enterprises are more labor intensive.

Another important point is related to the education level of farm managers (Table 4). Specifically, as the farm size gets bigger, the education level of managers in both organic and conventional operations increases. This improvement can be attributed to the complexity of problems that have to be answered by the managers of bigger farms.

From Table 5, it can be seen that organic producers prefer direct selling of their products while the conventional producers in their majority prefer selling their products to vendors. This difference can be attributed to some of the factors mentioned above (younger decision makers, higher education level) and to the fact that marketing channels regarding organic products in Greece have not been fully developed yet. In addition to that, producers said that by direct selling they can avoid the middle-men thus increasing their profits.

Results and Discussion

The results regarding income, shadow prices, slacks and decision variables, for all the types of farms examined in this study are shown in Tables 6 and 7.

From Table 6 it can be seen that, the level of maximum income for all farm sizes (small, medium, large) is greater for organic farms. The incomes estimated from the model are higher than the average income estimated from the questionnaires. This difference can be attributed to several possibilities: 1) the model does not depict the fragmentation of the farm holdings, 2) farm managers may have multiple objectives besides maximizing farm income (for example reducing risk and volatility of income), and 3) the model is static and does not take into account the loss of income from the transition periods. Despite these differences, the model results are not unreasonable and they can act as a good indicator for the difference in economic performance between organic and traditional enterprises.

Another important point is the high shadow prices of pasture land (which has the characteristics of a free good in the examined area) for conventional farms. Since shadow prices indicate the marginal value product of pasture, why do producers not use more pasture to increase their income? The answer to this question comes from the milk quotas imposed by the Common Agricultural Policy of Europe (CAP). If the operation has more animals or more production than the limit placed by CAP then the monetary amount of subsidies will decrease drastically. Greek farmers prefer to have a stable monetary amount of subsidies than to take the risk of increasing production and lowering subsidies without knowing if the extra production can cover the loss of subsidies. Consequently, shadow prices of pasture land likely reflect the subsidies given to cattle producers. In contrast to conventional farms, organic farms do not use all their available pasture land. This is so because organic products have higher returns than the conventional ones so the model allocates the limited amount of labor to crops or to trees instead of cattle.

Furthermore, from Table 6, it can be seen that irrigated land for small conventional farms has a high shadow price. But, the high cost of asset fixity (i.e. irrigation systems) and the extra labor needed substantially reduce this value. Additionally, medium and large conventional farms have higher slack of irrigated land compared to dry land (Table 6). This is due to the more labor intensive nature of farming in irrigated land, which, in conjunction with the limiter amount of available labor leads the model to allocate more labor to dry land.

Moreover, it can be seen (Table 6) that there is a slack of capital and operating machine hours for all the types of enterprises examined. The former, is a result of self-insure methods adopted by the farmers, while, the latter, can be contributed to “lumpy-assets”. Specifically, if farmers can not find the machine that exactly fits with their needs they prefer to buy a bigger one, which, may be useful if they decide to expand their operation in the future.

Fourthly, regarding labor, the average wage of an unskilled worker in the examined area (7 € per hour) in conjunction with the shadow prices of labor for conventional and organic farms (7 and 11 € per hour respectively) justifies why there is a substantial big number of organic farms with hired workers, while, conventional enterprises, despite the slack of agricultural area, do not hire off farm workers.

The model results suggest that small and medium producers should have three enterprises and large producers optimally should have two types of enterprises if they are conventional and three types if they are organic (Table 7). But, the questionnaire results show that small producers (organic and conventional) have on average five enterprises while large and medium producers have three. Two reasons justify this difference. Firstly, small producers have multiple goals beyond the maximization of net farm returns (i.e. equal distribution of the available family labor through the year, cultivation of some products to cover family needs, diversification of enterprises in order to have income even if some type of crops fail etc.). Secondly, farm holdings are highly fragmented (in average every farm has 4 different land parcels). Each parcel of land has different characteristics (e.g., different slope, different yield) that affect the decisions of farm managers, but, the model does not consider these spatial characteristics and differences.

Regarding production levels, Table 7 shows that organic farms should keep the same enterprises as their size gets larger and increase the number of stremmas or the number of head. Meanwhile, the model selects different type of enterprises for the different size of conventional farms.

Another difference between the model results and the questionnaire is the production mix, especially for medium and large conventional operations. Specifically, cotton and tobacco, which are two of the main types of enterprises according to the questionnaire, are not chosen from the model. Three reasons justify this difference: A) The reduction in cotton and tobacco subsidies made these crops less profitable, B) the vast majority of farmers who continue to cultivate those crops are more than 60 years old. A main goal of this group of farmers is to decrease the volatility of their farm income. This objective in conjunction with the high level of risk aversion of elderly farmers and their short planning horizon prevent them from changing their set of enterprises, C) A change of enterprises would require new investments in capital and machinery which is a costly procedure that farm managers especially on smaller farms want to avoid.

Finally, the reduced cost ranking estimated from the model for each of the possible enterprises is consistent with actual enterprise choices made by the managers.

Conclusions

The results of this study indicate that, for every farm type, multifunctional farms have better economic performance than the conventional ones. Moreover, the results illustrate that young farm managers are keener to adopt multifunctional farming compared to older ones. This difference can be attributed to the longer planning horizon of the former and to the fact that older managers have learned to operate under a different environment.

Finally, the structural characteristics of the farms, along with the CAP measures and the existence of multiple objectives, beyond maximization of net farm returns, justify the differences between the model results and the observed facts.

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APPENDIX

Table 1 - Characteristics of the "average farms" by farm size

Size	Type	Irrigated land	Dry Land	Pasture	Capital	Labor	Tractor
		------------Stremmas----------			-€-	-----Hours -----	
Small	Organic	40	0	10	900	1200	150
	Conventional	18	20	15	850	800	120
Medium	Organic	70	0	15	1200	2000	300
	Conventional	33	27.5	20	1600	1400	180
Large	Organic	95	0	15	2000	2600	400
	Conventional	45	45	30	3000	3000	400

Source: Questionnaire results

Table 2 - Age of Primary Decision Makers

	Small farms		Medium Farms		Large Farms	
	Organic	Conventional	Organic	Conventional	Organic	Conventional
30-39	70.0%	33.3%	47.5%	30.7%	30.0%	53.8%
40-49	20.0%	26.4%	22.5%	38.4%	50.0%	23.0%
50-59	10.0%	32.4%	30.0%	23.0%	20.0%	15.6%
60+	0.0%	7.8%	0.0%	7.6%	0.0%	7.6%
Mean	40	47.7	43.6	40	42	41.4

Source: Questionnaire results

Table 3 - Percentage of Primary Decision Makers With Off Farm Activities

Small farms		Medium Farms		Large Farms	
Organic	Conventional	Organic	Conventional	Organic	Conventional
60.0%	70.0%	23.0%	30.0%	15.0%	23.0%

Source : Questionnaire results

Table 4 - Educational Level of the Decision Makers

Education	Small farms		Medium Farms		Large Farms	
	Organic	Conventional	Organic	Conventional	Organic	conventional
Illiterate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Primary School	50.0%	57.8%	37.8%	53.8%	50.0%	23.0%
Secondary School	40.0%	26.5%	12.5%	30.7%	30.0%	38.4%
High School	10.0%	15.7%	37.5%	7.7%	0.0%	38.4%
University	0.0%	0.0%	12.5%	7.7%	20.0%	0.0%

Source: Questionnaire results

Table 5 - How Products Are Sold

Size	Type	Sold to vendor	Direct sales	Consumed by the family	Used in the ecotourism activities of the farm
Small	Organic	20.0%	60.0%	10.0%	10.0%
	Conventional	57.8%	21.1%	21.1%	0.0%
Medium	Organic	30.0%	70.0%	0.0%	0.0%
	Conventional	76.9%	23.0%	0.0%	0.0%
Large	Organic	10.0%	90.0%	0.0%	0.0%
	Conventional	69.0%	20.0%	0.0%	11.0%

Source: Questionnaire results

Table 6 - Economic results and slack levels by farm type and size

		Small		Medium		Large	
		Organic	Conv	Organic	Conv	Organic	Conv
Net Returns-Model (Survey Results) - €		30,786 (26,530)	24,435 (20,802)	53,403 (44,200)	32,660 (27,700)	60,945 (50,638)	50,803 (45,655)
Irrigated Land	Slack – str*	4.7	(-)	3.4	9	5	13
	Shadow Price	(-)	482	(-)	(-)	(-)	(-)
Dryland	Slack - str	(-)	2	(-)	3.5	(-)	13
	Shadow Price	(-)	(-)	(-)	(-)	(-)	(-)
Pasture	Slack	0.815	(-)	4.08	(-)	2.5	(-)
	Shadow Price	(-)	237.74	(-)	196	(-)	270
Labor	Shadow Price	11.5	7	11.47	7.48	11.36	6.69
Tractor	Slack - hrs	18	16	79.26	68	115	228
Capital	Slack -€	505	358	696	821	332	1683

Source: Model results, *str stands for stremmas

Table 7 - Production level results by farm type and size

Size	Type	Tare-Dry	Tare-Irr	Trefoil	Olives	Cows	Sheep
		--------------Stremmas			--------------	-----Head	-----
Small	Organic	(-)	26.667	(-)	6.667	3	(-)
	Conventional	14.2	(-)	3.7		(-)	8
Medium	Organic	(-)	28.33	(-)	8.6	1	(-)
	Conventional	24	21	(-)		4	6
Large	Organic		33.3	(-)	33.3	4	(-)
	Conventional	20	21	(-)	11	8	(-)

Source: Model results