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Abstract

The aim of this study is the elicitation of farmers' goals through a multi-criteria weighted programming model. This is pursued in the area of Ancient Epidaurus (Peloponnesus), where farming systems comprise various combinations of tree crops, such as olive-, orange- and mandarin- groves. The analysis is carried out at the level of four representative farms, whose members have a multiplicity of on- and off- farm employment opportunities.

Research findings indicate that farms with tree crops aim at the achievement of multiple goals. Both components of the composite entity *family farm/farm household* are represented at the decision-making process, by means of including manifold objectives. Minimization of variable expenses and attainment of a living standardareprioritized as the most important ones. The identification of sets of hierarchical goals for different types of farms/households goes beyond the conventional-simplistic hypothesis of profit maximization in all different farm entities, pointing towards a satisficing behavior.

Key-Words: Farmers' objectives, goal programming, satisficing, bounded rationality, Argolida, Greece

Introduction

The decision-making process of farmers has been the subject of a rather extensive literature for quite a long time. Although simplistic hypotheses about farmers' behaviour abound, farm management practices and behavioural patterns of farmers have been studied in an effort to determine the specific values which affect the setting of goals in farming.

It has been firmly documented in the literature that the decision-making process of farmers involves numerous goals, objectives and values. The complex nature of farming activity as well as the incorporation of the farm operation into the farm holding [family] necessitates a thorough examination of economic as well as non-economic values and objectives in agriculture.

The recent change in the objectives of the Common Agricultural Policy from productivity increases and market regulation to public goods provision from agriculture and rural development concerns, has led to a renewed interest in the study of farmers' values, goals and objectives.For example, following a behavioral approach, it is discovered that different groups of farmers adopt different viewpoints on decision making, having different values. This has an obvious effect on applying environmental policies that are incentive-based (Pedersen *et. al.* 2012).

Early studies on the subject matter tried to examine farmers' values in the context of farm management (Ashby, 1926; Johnson, 1960) and to find out whether these values relate to farm business productivity (Hobbs et al., 1964). Also, Mitchell (1969) tried to measure farmers' values in the UK, whereas a study conducted by Petrini (1970) in Sweden asserted that economic as well as non-economic goals can be expressed in terms of profit maximisation.

A seminal work undertaken by Gasson (1973) is undoubtedly a landmark on the topic. The multi-faceted nature of farming may manifest itself in various dimensions, such as instrumental, social, expressive and intrinsic. Gasson's findings indicate that farmers rate the intrinsic aspects of their activity as the most important, ranking the way of life, the performance of work tasks and independence higher than expressive, instrumental or social dimensions of farming. These aspects are also diversified among different groups of farmers.

More recently, a remarkable literature has shown that the mere profit maximization hypothesis can not serve as the only feature for depicting the complexity and the multiple nature of farmers' objectives (e.g.: Costa and Rehman 2005; Bergevoet et al. 2004; Robinson et al. 2003).

Apparently, this investigation broadens the scope of the conventional notion of economic rationality which, through profit maximization, allegedly dictates economic behaviour of farmers.

It has also to be noticed that the priority of risk minimization over yield or profit maximization has emerged in the study of mixed mountain farming systems; specific agro-ecological practices of these systems act to minimize risk and reflect the existence of a contextual rationality (MacDonald, 1998; Rhoades, 1986).

Moreover, as Greek agriculture is characterized by a high sectoral and spatial heterogeneity, the exploration of farmers' objectives assumes more importance in such a highly heterogeneous farming context.

Among the methods that have been used for pinpointing the objectives of the agricultural holdings, the multi-criteria methods hold an eminent place.

The current study aims atdetermining the elicitation of farmers' objectives by means of a multi-criteria weighted programming model. Ancient Epidaurus (in Argolida, Peloponnesus) has been selected as the study area, where the farming systems comprise various combinations of tree crops, such as olive-, orange- and mandarin- groves with the absence of annual crops;also, the members of agricultural holdingshave a multiplicity of on- and off- farm employment opportunities.

The studyis divided in five parts. After presenting the theoretical framework and the use of the multi-criteria weighted programming for exploring the objectives of an agricultural holding, the area and the data of the study are shortly presented. This is followed by the implementation of the model, the results and conclusions.

Theoretical framework

The research on the objectives of the farm, in most cases, is based on the hypothesis that the farmers attempt to maximize profits, responding to marginal changes on the prices (Willock et. al., 1999). The neo-classical theory of the firm is proposing the axiom of the "economic man", who is unboundedly rational, possess complete information and is able to act in an optimum way in order to realize his objective,i.e the maximization of profit.

Alternative approaches have been proposed for explaining the actions of agents and the production units in an economy. According to the satisficing principle, agents are not looking for the optimization of some economic variable but instead for the simultaneous attainment of a satisfying level of one or more of those variables(Simon, 1979 and 1986;Marris, 1992). The application of this principle to the firm theory is leading to the argument that the producers are facing profit, not as an optimizing objective but as a constraint. From the moment the firm satisfies this constraint, ensuring a critical level of profit, then it tries to attain other objectives. In this framework, the decision making process of a producer is adequately modeled as a combination of hierarchical objectives. In this way, in contrast with the neo-classical theory, the assumptions are that the agent is equipped with bounded rationality and with limited computing capacity, does not possess complete information for achieving its goals and also holds bounded cognitive skills.

The models that simulate the farmers' behavior, like the mathematical programming models, considerfarms’ objectives as exogenous. However extensive research has shown that the farmers are using simple rules and limited information from the detailed data of their accounting system. That means that the pursuit of their aims is in fact described by a gradual adjustment of the aim itself, which is based on how they perceive the economic environment of their farm. The above argument has been pointed out since 1980s and an endogenous evolutionary objective function has been proposed (Brossier et al., 1991). The maximization of a solid-defined objective should be replaced with the pursuit of satisfying multiple and often conflicting objectives.

Apart from the very significant contribution of Brossier et al. (1991), satisficing and bounded rationality have been also used, in order to explore the decision making process for setting agricultural product prices in the CAP context (Fearne, 1989) and more recently for interpreting the farmers' financial management decisions (Musshoffand Hirschauer, 2011).

The use of multi-criteria analysis in exploring the objectives of a farm

While the conventional optimization methods are dealing with a single objective, goal programming relaxes the constraint functions and adopts the satisficing/fulfillment philosophyinstead of the optimizing one. The satisficingprinciple expresses the willingness of the decision maker to find a practical, applicable and feasible solution to his decision problem, instead ofautopian-optimum solution to an oversimplified model of this problem(Ignizio and Romero, 2003). In this context, the goodness of fit of each solution is not determined, by the conventional optimization objective function, but rather by anachievementfunction, that actually measuresthe non-achievement of the problem's multiple goals. Depending on how the non-achievementis measured, there are many different forms of the goal programming problem.

For defining the multiple objectives and their hierarchy, that is their relative importance, we adopted an indirect technique that has been proposed by Sumpsi et al. (1996) and has been further elaborated by Amador et al. (1998). The methodology is based on weighted goal programming and has been used in many case studies, like Gomez-Limon and Berbel (2000), Arriaza and Gomez-Limon (2003), Gomez-Limon et al. (2003)and Gomez-Limon and Riesgo (2004). In Greece, this methodology has been applied for evaluating the effects of pricing water use (e.g. Manos et al., 2007· Latinopoulos, 2004) and for estimating milk supply from sheep farms (Sintori et al. 2010).

In this paper, the technique is used for estimating utility functions for tree crop farms. As far as we know, it is the first time that this is attempted in a Greek case and it is of great importance since tree cultivations represent a significant part of the Greek agricultural production.

The first step on this method is to define a tentative set of aims and to create the pay-off matrix by consecutive optimizations of the classical mathematical programming decision model of the farm for each one of the above objectives. The pay-off matrix elements and the observed values of the objectives are used to form a system of q equations that when solved will give us the weights of the individual objectives.

$$\sum_{j=1}^{q} w_j f_{ij} = f_i \quad i = 1,2,\ldots,q \qquad (1)$$

where

$$\sum_{j=1}^{q} w_j = 1$$

where w_j the weight measuring the relative importance attached to the i-th objective, f_{ij} the value achieved by the i-th objective when the j-th objective is optimized and f_i the observed value achieved by the i-th objective.

Usually an exact non-negative solution to the above system of equations does not exist and the optimal solution is approximated with the distance metric (L metric) so as to minimize the deviation of the solution from the observed values. In a general form by combining metrics L1 and L∞, the solution can be derived from a linear programming mathematical model (Amador et al., 1998).

$$Min D + \lambda \sum_{i=1}^{q} \left(\frac{n_i + p_i}{f_i}\right) \qquad (2)$$

subject to the following constraints:

$$\sum_{j=1}^{q} w_j f_{ij} + n_i - p_i = f_i \quad i = 1,2,\ldots,q \qquad (3)$$

$$\sum_{j=1}^{q} w_j f_{ij} + f_i D \geq f_i \qquad (4)$$

$$-\sum_{j=1}^{q} w_j f_{ij} + f_i D \geq -f_i \qquad (5)$$

$$\sum_{j=1}^{q} w_j = 1 \qquad (6)$$

Apart from the weights (w), the model comprises the following variables: the negative deviation, i.e. the under-achievement of the i-th objective with respect to a given target (n_i, the positive deviation i.e. the over-achievement of the i-th objective with respect to a given target (p_i, the maximum deviation of i-th objective with respect to a given target (D). The λ parameter is measuring the substitution rate between the various objectives in the utility function.

The derived weights can be employed to derive the farmer's utility function, which has the following form:

$$u = -Max\left\{\frac{w_i}{k_i}\left[f_i^* - f_i(x)\right]\right\} + \lambda \sum_{j}^{q} \frac{w_i}{k_i} f_i(x) \qquad (7)$$

where k_i is a normalizing factor that is activated when the various goals are measured in different units. A range of utility functions can be derived from (7), depending on the λ value. If λ=0 then the utility function becomes a Tchebycheff function , implying a complementarity relation between the different objectives. In that case only the maximum deviation is minimized under the (4),(5) and (6) constraints. If λ is very large, an additive and separable utility function is derived. According to (2) the sum of the positive and negative deviation is minimized under (3) and (6) constraints. For small values of λ the utility function can be considered an augmented Tchebycheff function.

The next step is to verify the model, i.e. to measure how accurately the objective function can reproduce the farmer's decision making. We solve the (Amador et al., 1998):

$$MinD + \lambda \sum_{i=1}^{q} \frac{w_i}{k_i} f_i(x) \qquad (8)$$

subject to constraints

$$\frac{w_i}{k_i}\left[f_i^* - f_i(x)\right] \leq D \;\; i = 1,2,\ldots,q \qquad (9)$$

$$\mathbf{x} \in \mathbf{F}$$

For determining the final functional form of the farmer's utility function, the results of the maximization of (8) for various levels of λ, are compared to the observations of the objectives and the closest value is selected thus resulting in a utility function form.

Case study

Ancient Epidaurus, seat of Epidaurus municipality, is a coastal area with a natural port, with 2000 permanent residents and 10000 total population on the summer period. There are 383 farms in the area with a total area of 7339 $ha \cdot 10^{-1}$. The average size is 24,4 $ha \cdot 10^{-1}$of which 18,1 $ha \cdot 10^{-1}$(about the 3/4) are olive trees. The typical farm has a gross profit of 19274 € on average and 59% of those families include members with off-farm employment. Furthermore the off-farm income accounts for 67% of the total family income (on-farm income is 33%). The typical farm household members are offering 2,6Annual Work Units (AWU) of which only 14% on-farm (86% is on off-farm activity). Lastly the typical farm is employing 0,54AWU on average, of which 1/3 is non-family employment.

The dataset has been derived from extensive fieldwork in a representative sample of 70 farms. Agriculture in the area is comprised solely from tree crops (non-irrigated and irrigated olives, orange and tangerines). There are no annual crops. The data collected in 2006, except for the case of olive trees, where the data refer to the average of 2005 and 2006 due to the problems arising from the olives alternate bearing property.

The case study model

The choice of the decision variables of the model is mainly affected by the particularity of the type of agricultural activity on the case study area. Generally, in an optimization problem, a farmer owns the land and has to choose between alternative annual crops in order to maximize an objective function that models his main objective, usually the total gross profit. However, in the present case study, the farmer's owned land and the allocation to the various crops are fixed for long periods, since the average lifespan in the case study area for an olive cultivation is 52 years, whereas for orange treesand for tangerine trees is 53 and57 years, respectively. Therefore, in our case, the decision variable for the farm is not the alternative crops land allocation but: i) the allocation of the family members available work units to the various tree crops and to off-farm activity and ii) the volume of non family labor to use in those various tree crops. The proposed goals for the case study farms are presented in table 1. The mathematical formulation of those objectives, as well as a Venn-diagram for family/hired labor, are presented in the appendix.

#	criterion	direction
1	Net Family Labor Income for on and off-farm activity	max
2	Farm Family Income	Max
3	Gross Farm Profit	Max
4	Net Farm Profit	Max
5	Household Income	Max
6	Family Standard of Living	Max
7	Family employment to on-farm or off-farm activities	Max
8	Farm variable costs	Min
9	Satisfying a household's needs	Max

Table 1, The proposed farmers' objectives

The total population of the 70 farms has been divided into four homogeneous groups, through factor and cluster analysis. In particular, three common factors were derived from a factor analysis that was applied to a set of eight variables. Those three factors are explaining 73,3% of the total variation of the initial variables. F1: the dynamics of the farming activities (it is comprised of "on-farm employment" variable, "employment for direct selling of products to open-air markets" and "total utilized land" variables), F2: the family members' off-farm employment (comprised of "number of working and equivalent adult members of household" and "off-farm working hours of household members" variables) and F3: the contraction of the farm (combination of "age of the farm head" and "high participation of foreign labor in the farm" variables).Subsequently, these three factors were used in a cluster analysis, which yielded four homogeneous groups of farms.

Then, the suggested methodology was applied to four representative farms, one for each of those homogeneous groups.

Results - Discussion

For the utilization of the described methodology the pay-off matrix was determined, and nine initial (tentative) objectives were grouped to the five new objectives that are presented in table 2.

Initial Objectives	New Grouped Objective	direction	Code
1, 5, 6, 9	Household standard of living		w1: st liv
2, 3	Farm Gross Profit	Max	w2: gm
4	Farm Net Profit	Max	w4: net prof
7	Family employment to on- or off-farm activities	Max	w7: flab
8	Farm variable costs	Min	w8: wcap

Table2, Objectives grouping

Then, the weights attached to each objective were determined in order to better reflect the preferences of farmers and to minimize deviations from the observed values, achieved by each objective.

		high	low	mode
st liv	w1_50	7%	12%	7%
	w1_34	23%	9%	21%
	w1_5	31%	24%	24%
	w1_6	33%	30%	31%
gm	w2_50	0%	0%	0%
	w2_34	42%	28%	43%
	w2_5	0%	4%	1%
	w2_6	0%	0%	0%
netprof	w4_50	3%	9%	4%
	w4_34	0%	0%	0%
	w4_5	0%	0%	0%
	w4_6	0%	0%	0%
flab	w7_50	11%	28%	25%
	w7_34	0%	24%	0%
	w7_5	0%	0%	0%
	w7_6	0%	0%	0%
wcap	w8_50	58%	68%	64%
	w8_34	35%	40%	36%
	w8_5	69%	73%	75%
	w8_6	67%	70%	69%

Table3, Objectives weights

The five objectives seem to have varying importance for the decision making process of each farmer. In three of the four farms the most important objective is the minimization of the variable costs, whose weight ranges from 64% to 75%. The relative importance of this objective compared to the maximization of the gross profit has also been stressed in previous studies, such as that of Piech and Rehman (1993).

The second most important objective is the attainment of the standard of living of the household that is assigned a weight of roughly 25% . This objective denotes the pursuit of the household to cover the living expenses of its members. This is achieved by measuring the total family income (from all sources), converting it to equivalent (according to the size of the household) income and finally comparing this with the equivalent income of the average household of the broader region, that is reported in the National Household Survey. The above finding is of particular interest for the additional reason that the contribution of the subsidies in the economic results in the case study area is negligible, thus a “guaranteed” income is absent.

As far as the farm’s "34" decision making process is concerned, the most important objective is the maximization of the gross profit, followed by reducing variable costs and by ensuring the standard of living. In this farm the high rate of employment of its members to direct marketing concerns mainly the buying and reselling of products (as the farm actually has limited production), thus displaying “enterpreneurial” characteristics (see table P2 at the Appendix).

It is also worth mentioning the hierarchy of the objectives for farm “50”. In this farm, the most important objective is reducing the variable costs (weight is 64%), followed by maximizing the family on-farm and off-farm employment (25% weight), ensuring the standard of living (7%) and finally the maximization of gross profit (4%). As shown on table P2 of the Appendix, this farm has the largest cultivation area, is the most labor-intensive (in terms of human labor on the farm and on direct marketing), displaying at the same timea considerable off-farm employment of its members. As a household, it has the largest volume of on-farm and off-farm family employment. Compared to farm “34”, the different ranking of objectives can be attributed to the much higher proportion of variable to total costs and to the higher ratio of the Farm-Family Income to total Household Income (table P2).

Previous studies have shown that for business-oriented farms the objective of maximizing the gross profit is an important element of the producer’s utility function (Sintori et al., 2010). In our study this objective is present only to one of the farms (“34”), which is not the largest in land size but employs twice as labor units compared to the average farm. It is interesting that the objective of reducing variable costs has the lowest weight in this farm, a fact that could be explained by the relative low ratio of variable to total costs (table P2).

Furthermore in this farm the weights of the objectives are the most equally distributed compared to the rest of the farms, since its members are employed to on-farm and off-farm activities and to direct marketing.

On the other hand, in farm "50", a mainly "agricultural activity- oriented" farm (the largest in land size and labor volume compared to the rest of the sample), the objective of maximizing gross profit is absent and the maximizing net profit is present with negligible weight. In contrast, the minimization of variable costs is the most important objective, since they account for 54% of the total costs, a relatively high ratio (table P2). Also, only in this farm the objective of maximizing total household labor is weighted as relatively important. This could be explained by the fact that 3/4 of total income is derived from farm activity, compared to 1/3 for the average farm in the area.

We have also included two small-sized farms that employ almost exclusively hired labor. The first ("5") is managed by a retired person - a common case across the country - and the second ("6") consists of members that are not employed in agriculture. Possibly that can elucidate the high importance of the minimizing variable costs objective (75% and 69%) that is complemented by the standard of living objective.

Conclusions

This study is using a multi-criteria analysis in order to elicit the farmers' objectives in an area with tree crops. The decision variables are the allocation of the household members' labor in on-farm and off-farm activities, as well as the proportion of family and hired labor in the farm activities.

The application of the proposed methodology to the case study farms resulted in grouping the initial nine objectives to five. The relative importance of the goals reveals that both elements of the composite entity "farm business/farm household" are represented in the decision making process through the main goals of reducing variable costs and the achievement of a living standard comparable to that of the broader region. The varying hierarchy of objectives across the farms, accounted for by a series of farm particular characteristics, is another important finding.

It seems that the farmer goals are formed in a context that goes beyond the simplifying assumption of the maximization of gross or net profit. The assumptions of bounded rationality and satisficing seem to be present with different hierarchies of multiple goals.

The explanation of the presence of those different hierarchies of the goals need to be addressed in further research.

Nevertheless, the application of the methodology to all 70 farms would provide a more comprehensive understanding of the situation and assist in the interpretation of the current results. Beside this, further issues could be investigated, such asi) the use of additional initial objectives, like the short-term and long-term farm economic sustainability and the minimization of risk, ii)the use of a non-linear programming mathematical model, iii) the differentiation of the analysis according to the income level of the household (84% of the 70 households has a high income status, only 1 out of 70 is a poor household and 14% is in a middle income status) iv)the differentiation of the analysis according to the stage of the farm life-cycle, since the multiplicity of the objectives of the farmer can be adjusted during that life-cycle, v) the exploration of the objectives of the different members of the household, and vi) an inter-temporal analysis, since the case study was examined at an unusually high price period (olive oil price was over 4 €/kg), which is not the case over the long term.

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Appendix

The farmer's decision problem is modeled as a mathematical programming problem where the farmer has to decide the allocation of labor to on-farm or off-farm activities and the corresponding use of hiredlabor for the tree crops. The problem can be expressed as following:

Minimize or Maximize OBJECTIVE (see table XX)

subject to the following constraints

$fL_c + forL_c \leq \ MaxHL_c \cdot La_c \quad \forall c$	[Maximum Labor per Crop]
$fL_c + forL_c \geq \ MinHL_c \cdot La_c \ \forall c$	[Minimum Labor per Crop]
$fL_j \leq \ fM \cdot \mathrm{MaxFL_j} \forall j$	[Maximum Family Labor outside farm]
$\sum_j fL_j \leq \ fM \cdot \mathrm{MaxFL}$	[Maximum Total Family Labor outside farm]
$\sum_{c \cup j} fL_{c \cup j} \leq \ fM \cdot \mathrm{MaxL}$	[Maximum Total Family Labor]
$fL_{c \cup j} \geq 0, forL_{c \cup j} \geq 0$	

Since we are examining the applicability of various farmers' objectives, the OBJECTIVE function is taking one of the form that is thoroughly explained in table XX.

Below we present an analytical explanation for the above notation.

Sets		
c :	A set of available tree crops (irrigated olives, non-irrigated olives, tangerines, oranges)	
j :	A set of family members' off-farm activities. The set includes: Direct Selling of agricultural products (DS), Off-farm self-employment (SE), Off-farm wage-employment (WE)	
Decision Variables		
$fL_{c \cup j}$	Family labor employed to on or off farm activities	HrsHE[1]
hL_j	Hired labor employed to agricultural activities	HrsHE
Data		
PR_c:	Agricultural production per hour of human	Kg / HrsHE
PP_c:	Product price	Euro / Kg
La_c:	Owned land of tree crops	Hectares
$MaxHL_c$:	Maximum human labor per land area unit for each tree crop activity	HrsHE / Hectare
$MinHL_c$:	Minimum human labor per land area unit for each tree crop activity	HrsHE / Hectare

[1]HrsHE: hours of human employment

$\mathrm{MaxFL_j}$:	Maximum human labor per family member for each off-farm activity	HrsHE
MaxFL :	Maximum human labor per family member for off-farm activities	HrsHE
MaxL :	Maximum human labor per family member for any activity	HrsHE
SU_c:	Agricultural subsidies per tree crop	Euro / Kg
fM :	family members	number
fMEq :	Equivalent Number of family members(using the 'modified OECD scales', (Hagenaars et al., 1994), which assign weights of 1.0, 0.5 and 0.3 to the household head, each of the remaining adults (aged 13 or more) and each child in the household (aged up to 13) respectively.	number
$I_{c\cup j}$:	Net income of labor	Euro / HrsHE
$EXPC_c$:	Explicit cost for each tree crop, hire dlabor costs are excluded(cash expenses plus depreciations)	Euro / HrsHE
$VARC_c$:	Variable cost per hour for each crop, hired labor costs are excluded	Euro / HrsHE
$FIXC_c$:	Fixed cost per hour for each crop, hired labor costs are excluded	Euro / HrsHE

OPC_c:	Opportunity cost for family employment within the farm	Euro / HrsHE
hLW_c:	Wage of hired labor for each tree cultivation	Euro / HrsHE
$AvgRegStd$	Average regional standard of living (mean equivalent household income) in Peloponnese region	Euro
Shortcut notation		

$TL_c = fL_c + hL_c$	Total labor employed to agricultural activities
$REV_c = (fL_c + hL_c) \cdot PR_c \cdot (PP_c + SU_c)$	Revenue from on-farm activities

In this section we present the mathematical formulation of the multiple farmers' objectives

Farmers' Objective	Maximize or Minimize	Functional Form	Short Explanation
Farm Family Income (FFI)	max	$\sum_c REV_c + fL_{"DS"} \cdot I_{"DS"} - \sum_c [TL_C \cdot EXPC_c] - \sum_c [hL_c \cdot hLW_c]$	The tree cultivation revenue plus the sales of owned produce to the market by family members minus the explicit costs and minus the wages for hired labor
Net Family Labor Income (NFLI)	max	$\sum_{c\cup j} fL_{c\cup j} \cdot I_{c\cup j} + \sum_c hL_c \cdot I_c - \sum_c [hL_c \cdot hW_c]$	The net income of the family members work from every source plus the income of the hired labor to the on-farm tree crops minus the wages for hired labor
Gross Farm Profit [margin] (GFP)	max	$\sum_c REV_c + fL_{"DS"} \cdot I_{"DS"} - \sum_c [TL_C \cdot VARC_c] - \sum_c [hL_C \cdot hW_c]$	The tree crops revenue plus the sales of owned product to the market by family members minus the variable costs and minus the wages for hired labor
Net Farm Profit (NFP)	max	$GFI - \sum_c [TL_C \cdot FIXC_c] - \sum_c [fL_c \cdot OPC_c]$	The Gross Farm Income minus the fixed cost per hour and minus the opportunity cost for family members' agricultural activities
Household Income (HI)	max	$FFI + fL_{"SE"} \cdot I_{"SE"} + fL_{"WE"} \cdot I_{"WE"}$	The Farm Family Income plus the income from off-farm activities (either self employed or waged) of the family members

Family Standard ofLiving (FSL)	max	$(NFLI + fL_{"SE"} \cdot I_{"SE"} + fL_{"WE"} \cdot I_{"WE"})/fMEq$	The Net Family Labor Income plus the income from off-farm activities (either self-employed or waged) of the family members divided by the equivalent family members
Family Employment (FE)	max	$\sum_{c \cup j} fL_{c \cup j}$	The hours of family members employment, either to on- or off-farm activities
Farm Variable Costs (FVC)	min	$\sum_{c} [TL_C \cdot VARC_c] + fL_{"DS"} \cdot VARC_{"DS"}$	The total variable costs of the farm agricultural activity plus the variable cost of selling to the local market
NeedsSatisfaction (NS)	max	$NFLI - AvgRegStd$	The Net Family Labor Income minus the average regional standard of living income

farm survey id	Age of the Farm Operator (years)	Utilized Agricultural Area (ha·10^{-1})	Equivalent Household Members	HouseholdAdultWorkingMembers	On-farm Labor (Hours)	Hired/Family on-farm Labor	On-farm Family Labor in direct marketing (Hours)	Off-farm Family Labor (Hours)	Total Family Labor [on- and off-farm] (Hours)	Variable Costs/Total Costs	Variable Costs/Gross Receipts (*)	Total Costs/ Gross Receipts(**)	Farm Family Income/ Household Income
50	65	86	2,3	3,3	3.453	35%	3.036	3.789	7.140	54%	23%	42%	75%
34	62	15	2,5	4,0	1.840	35%	2.464	4.800	8.464	34%	18%	54%	34%
5	73	11	2,0	2,0	368	100%	0	0	0	20%	24%	117%	70%
6	60	17	2,3	3,1	301	92%	0	6.404	5.400	44%	37%	84%	7%
Σύνολο Εκμ/σεων	57	24	2,1	2,6	925	33%	346	4.035	4.998	35%	14%	40%	33%

Table 4, Dataset properties

(*) A value of<100% indicates the short-term economic sustainability of the farm

(**)A value of<100% indicates the long-term economic sustainability of the farm

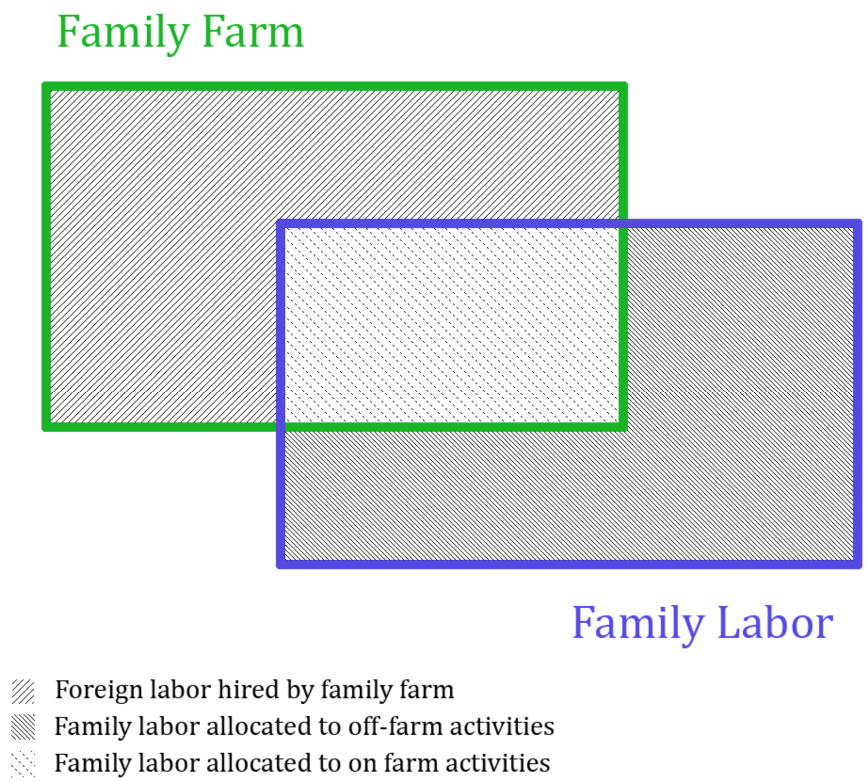

Figure 1, A Venn diagram showing the relationship of the decision variables of a farm