Some aspects of the decision-making process by Costa Rican dairy farmers:

1-Characterising farmers' objectives profiles

Cesar Solano

Institute of Ecology and Resource Management, The University of Edinburgh and

Programa de Medicina Poblacional, Universidad Nacional, Costa Rica

Current address: PO BOX 208 Cartago Costa Rica; email cesarsolano@hotmail.com

Mario Herrero

Institute of Ecology and Resource Management, The University of Edinburgh and

International Livestock Research Institute, Kenya, Africa

current address: email m.herrero@cgiar.org

Hector Leon

Informatica y Asesoria Pecuaria S.A.

address PO BOX 1475 7050, Cartago Costa Rica, email infogro@sol.racsa.co.cr

and Enrique Perez.[2]

Medicina Poblacional, Universidad Nacional, Costa Rica and Instituto Interamericano de

Cooperacion para la Agricultura IICA, Costa Rica

address: PO BOX 304-300 Heredia, Costa Rica, email eperez@ns.medvet.una.ac.cr

Abstract

Farmers' Objectives and the population profiles were studied in 91 dairy farms in Costa Rica. Objective's priorities were studied using Rokeach's technique with a mixture of personal, economic and familiar goals. Factor Analysis (FA) combined with a Cluster Analysis (CLA) were used to reduce the number of variables involved and define groups of farmers with similar economic and overall objectives. A Multiple Correspondence Analysis (MCA) was used to graphically represent the relationships between farmers'/farms' characteristics and objective profiles.

The FA and CLA found 6 and 10 profiles for economic and overall objectives respectively. According to the overall objectives, economic oriented farmers are more frequent in the population. However farmers with personal and familiar profiles were also found. MCA showed graphically relationships between farmers'/farms' characteristics and region and the overall profiles.

Introduction

Within Farming Systems Research, the decision-making process, as the human component of the agricultural systems, has been either neglected or oversimplified in many ways. One of these oversimplifications is product of the orthodox economic theory in which the farmer is consider as person acting almost exclusively towards maximisation of the biological and financial outcomes of the farm (Gasson, 1973; Dent, 1995; Ferreira, 1997; Frank, 1997). Recent examples in terms of simulation and multiple criteria decision models (Herrero, 1997; Herrero *et al*, 1999) have made considerable progress in including several goals into the models. However even in these cases, goals have been represented by easily measurable economic objectives such as revenue, cash flow, capital etc. Non-economic objectives have not been taken into account probably due to: the lack of understanding of their relative importance, difficulty of measurement and difficulty of representing them in the models.

The impact of this oversimplified paradigm and misunderstanding of the decision-making process is considered by several authors as the biggest cause of the partial failure of Farming System Research and Extension in creating an big impact on agriculture development (Dent, 1995; Ferreira, 1997).

In order to improve the state of the art in this matter it is necessary to answers the following questions. Which are the objective priorities (economic, non-economic or both)?, Which are instruments and which are ends?, Which are the factors affecting them, Which are the objectives profiles?, Do farmers with different objectives manage their farms differently?.

This present paper, as part of a more general research on decision-making in agriculture, is an attempt to contribute to these issues.

Materials and methods

The sampling

The diagram in Figure 1 summarises the methodology used in this study. A series of interviews during farm visits were made in 91 Costa Rican dairy farmers. Information about resources availability, infrastructure, management and managerial aspects were asked. The latter component included labour characteristics, farmers' objectives hierarchies, decision-making approaches and the rule of the trusted people in the decision-making process. The sample of farms was obtained using a stratified systematic selection from a population of 2081 dairy and dual-purpose farms, which sell the milk to dairy factories. This universe represents 6% of total dairy farms in the country and 50% of the total milk production (Camara Nacional de Productores de Leche, 1998). The first strata level was region: North region (North), Pacific region (Pac), Central Occidental region (Cocc) and Central Oriental region (Cori); the second strata level was defined by three levels of milk yield (amount of sold milk).

Interviews

The interviews were based on Edical (Encuesta Dinamica de Caratecterizacion de fincas Lecheras) which is a computerised questionnaire written in the Delphi object-oriented language. The enumerators were provided with a notebook computer and answers were directly entered into the program. For the managerial aspect, a series of participatory techniques were used to obtain the information. In the case of objectives, a Rokeach's technique was used (Foddy, 1993). It consisted in 17 labels, each one representing one objective, which the farmers ordered from the most important one at the top of the sort, to the less important one at the button of it. The statements were a mixture of economic, personal and familiar objectives (Table 1).

Figure 1

Table 1 about here

Statistical analyses

Factors of objectives, clusters of farms and the assignation of profiles

In order to reduce the number of variables involved in the analyses and to make the interpretation of the arrangements easier, a series of Factor Analyses using a Principal Components Method with a Varimax orthogonal rotation were used (SAS, 1994). Economic, personal and familiar objectives were analysed separately in order to define profiles for each group of objectives. An additional Factor Analysis, using the nine new variables (three for each group of objectives), was performed to obtain other factor scores that represented the overall objective orientation of the farmers. A series Cluster Analysis with the Ward method, using the factor scores as classificatory variables, were used to group the farms according to their economic, personal, familiar and overall objective orientations. Different traits, representing the affinity or oppositeness of each group to the

different objectives were assigned in order to define the profiles. Criteria for the trait were based on Least Square Means and confidence limits. In the case of the overall objective clusters, ranking of objective within each group were calculated in order to interpret the groups' traits.

Relationships between farms'/farmers' characteristics and objective profiles

A series of Multiple Correspondence Analysis were used to find out spatial relationships between the farmers'/farms' characteristics and the objectives profiles. Age, farm size (pasture area), educational level and region were introduced into the analysis. The following categories and label were used: for age, young (ayo), middle age (ami), old (aol); for farm size, small farm (fsma) medium farm (fmed), big farm (fbig); for educational level, none (ednin), primary (edpri), secondary (edsec) and universitary (eduni) and for region, central oriental (Cori), central occidental (Cocc), northern (nort) and pacific (Pacf).

Results and discussion

Factors of objectives, clusters of farms and the assignation of profiles

Table 2 shows the rotated factor patterns for the economic, personal and familiar objectives. Table 3 shows the same for the overall objectives. These tables show which objectives can be considered one-dimensional and therefore summarised into a new variable. For example purposes, only the economic factors will be discussed. FE1 represents the investment desire against saving money for retirement; FE2 represents the economic monetary objectives against the saving money for children education. FE3 is a dimension representing to expansionist non-maximisation orientation against milk quality. According to the clustering statistics 6 and 10 were the best number of groups for economic and overall objectives respectively. Figure 2 shows the dispersion of farmers in the 3-dimensional space of the economic factors.

Table 2 about here

Table 3 about here

Figure 2 about here

Economic profiles

Table 4 shows that *Quality-seekers* (68%), *Income-ensurers* (54%), *Maximisators* (51%), *Intensivists* (46) and *Investors* (32%) are the most common economic traits in the population showing that, in general, Costa Rica farmers have a entrepreneurial orientation. However nearly a half of them are very interested in monetary objective towards the family including saving money for retirement and children education.

Ep3 and Ep5 represent the non-business-oriented farmers with more interests in the family's welfare since they were the farmers who ranked EDUC higher. The former group is attached to expansion of their business while the later are *Intensivists*. Since neither maximisation of incomes/revenue nor obtaining satisfactory incomes were ranked high in Ep5, this profile could be considered the less economic-oriented in all the population.

Ep2 represents a group of farmers more interested in re-investing in the farm, expanding the business, obtaining satisfactory incomes producing the best quality of milk. This combination of traits could be related to farms in earlier stages of development in which maintaining the activity by assuring the cash flow is the most important objective and not necessarily obtaining the maximum income.

Regarding to *Maximisators,* Ep4 represents the most business-oriented group of farmers since they are only interested in obtaining the maximum incomes/revenue in the same scale of business and producing the best quality of milk. They are not even interested in satisfactory incomes but the maximum. Ep1 and Ep6 are also *Income-ensurers* showing that the majority of *Maximizators* prefer to ensure a satisfactory income as well, probably as a step toward maximisation. Ep1 is the only group in which farmers

are attached to saving money for their retirement. This profile could be related to older farmers (see Multiple Correspondence Analysis).

Table 4 about here

Overall objectives profiles

The final cluster analysis showed that 10 groups of farmers are necessary in order to explain more that 60% of the original variation. This result demonstrates the variability of arrangements of the objectives in general. For the purposes of this paper, only the five biggest groups will be interpreted. Table 5 shows the ranking of objective within each cluster for the overall objectives.

The biggest group (GP6) (20%) represents those farmers attached to economic goals PROQ, MAXI, MAXR and INC combined with the personal objective ENVI. This shows that a big proportion of Costa Rican dairy farmers have the desire of maximising monetary incomes through the best quality of milk and, at the same time, producing in harmony to the environment. On the other hand they want to be dedicated hard workers and they are not interested in retirement nor in passing the farm to the next generation.

GP3 (16.7%) shares basically the same goals than the previous group except that this one is less interested in the environment and it is the group that, along with GP2, pays less attention to the milk quality in the population. On the other hand, this group seems to be less intensivists since they are more interested in expanding the size of the business before maximising incomes. These two groups represent the most entrepreneurial orientation since familiar goals occupied a medium to low importance for these farmers.

GP2 (15.6%) are still interested in milk quality but they are not maximisators. On contrary they are more attached to personal goals such as ENVI and REDR, the familiar goal LSIN and the economic goal EDUC. They are dedicated, hard-worker and they are

not interested in passing the farm to next generation. They represent the less entrepreneurial and more familiar farming orientation.

GP1 (10%) is composed by farmers interested in maximising incomes and revenue, probably as a way of obtaining other goals like improving the familiar standard of living and saving money for retirement. They pay less attention to milk quality, reducing risks, being innovative, reinvestments and maintaining their standard of living. They represent those farmers with a balance between economic maximisation and familiar goals with a strong desire of improving the familiar standard of living rather that in maintaining it.

Farmers belonging to the GP10 (7.8%) are milk quality seekers, income maximisators, environmentalists. On the other hand they are more interested in LSMA rather that LSIN showing that they are satisfied with their standard of living. They consider saving money for education and passing the farm to the next generation important goals. They are opposed to re-investment, expand, reducing risks, being innovative, and reducing work. Along with group 1 they have a balance between economic and familiar goals.

In summary it could be said that groups 3, 4, 5, 6 are maximizators entrepreneurs, groups 1 and 10 are farmers with a balance between economic maximising and familiar objectives while groups 2, 7, 8 and 9 are identified with familiar goals. In general terms 50.1% of Costa Rican farmers are maximizator entrepreneurs, 32.2% are familiar-oriented and 17.8% are maximisator-pro-family. These results demonstrate that economic maximisation is the preponderant farming orientation by Costa Rican dairy farmers. However the familiar orientation is still very important for nearly half of them.

Table 5 about here

Relationships between farms'/farmers' characteristics and objective profiles

Although relationships between all the profiles and the farmers'/farms' characteristics were examined, only the overall objectives profiles is discussed. MCA analysis uncovered

several relationships (R) among the farmers'/farms' characteristics variables: big farms, older farmers, low educational level and Pacf region (R1); Medium farms, high educational level, younger farmers and Cori region (R2); Medium farms, low educational level (primary), young to middle age and Nort region (R3); and small farms, medium educational level (secondary) and Cocc (R4).

Figure 3 demonstrates that younger farmers with high educational level in medium sized farms located in the region Cori tend to be more Maximisators-entrepreneurs farmers (Gp3 and Gp4). Older and low-educated farmers in big farms located in the Pacf region tend to be either family oriented (Gp8) or farmers with a balance between economic maximising and familiar goals (Gp10). Gp7 profile (familiar oriented) is likely to be found in small farms of farmers with medium educational level (secondary) in the Cocc region. Variability of profiles (Gp1, Gp2, Gp6 and Gp9), mostly non-entrepreneur, are found in medium farms of young to middle age farmers with low educational level (primary) in the Nort region. Finally Gp5 seems not to be related to any combination of characteristics. However due to its spatial location it could be more related to combination R4.

Figure 3 about here

These analyses provide evidence of the relationships among characteristics showing that region, size of the farm, the age of the farmer and the educational level are related. Causes of the relationships are difficult to obtain. However is it possible to hypothesised that region shapes the size of the farm as a consequence of the land prices and productive capacity of the land. On the other hand educational level could be a result of the availability of education facilities, social values and labour availability in each region. Age could respond to the rate of replacement of farmers and the decline or increment of the dairy activity in each zone. The Pacf region is a good example of a region in which the dairy activity has declined in the last years, so those farmers who remain in the activity are

older people. In contrast, younger farmers in the Cori region are result of the entrepreneurial orientation of the activity so farmers' sons or daughters are taking over the activity. About the relationships between these combinations of characteristics and the profiles, it could be said that they act in a synergetic way providing the social values and structural and personal conditions that partially shape the farmer's attitude towards different objectives.

Conclusions

It is concluded that:

1-Well-defined groups of farmers exist from the economic point of view. It is also concluded that there is a big heterogeneity of goals among farmers and that many groups are needed in order to represent this variability.

2-In general terms it is concluded that Costa Rican farmers have a mixture of goal orientations, from the very entrepreneurial economic maximisation to the very familiar orientations, being the former orientation the most frequent. However mixtures of economic and familiar goals and the very familiar profiles are found in approximately a half of the population showing that other non-economic goals also driving the farmers.

3-A synergetic effect of farms'/farmers' characteristics and the region in which the farms are located seems to shape the farmers predilection towards different goals combination showing the effect of the social, structural and personal dimensions in the definition of the objectives by Costa Rican dairy farmers.

References

Camara Nacional de Productores de Leche. (1998) Cifras importantes. In: Proceeding 1er Conferencia Regional de la Federación Centroamerica y del Caribe del Sector Lácteo, 2 y 3 de diciembre de 1998, San Jose, Costa Rica.

Dent, J.B. (1995) Towards a general paradigm for decision making. In: Central America: Conservation and sustainable development. Proceeding of a workshop on Sustainable of Livestock Production Systems, August 8-11, 1995, San Jose, Costa Rica. *Ciencias Veterinarias*. 1-2 Volumen especial:67-70.

Ferreira, G. (1997) Understarstanding decision making at farm level. PhD Thesis, University of Edinburgh. unpublished thesis.

Foddy, W. Constructing questions for interviews and questionnaires. Theory and practice in social research. Cambridge University Press, Cambridge, 1993. 228 pp.

Frank, B.R. (1997) Adoption of innovations in the North Queensland beef industry. III: Implication for extension management. *Agricultural Systems* (In Press) ver si ya salio.....

Gasson, R. (1973) Goals and values of farmers. *Journal of Agricultural Economics* **24**, 521-538.

Herrero, M. 1997. Modelling dairy grazing systems: an integrated approach. PhD thesis, University of Edinburgh. Unpublished thesis.

Herrero, M; Fawcett, R.H.; Dent, J.B. 1999 Bio-economic evaluation of dairy farm management scenarios using integrated simulation and multiple criteria models. Agricultural Systems. in press.

SAS. 1994. SAS/STAT User's guide, Vol. 1, 890pp.

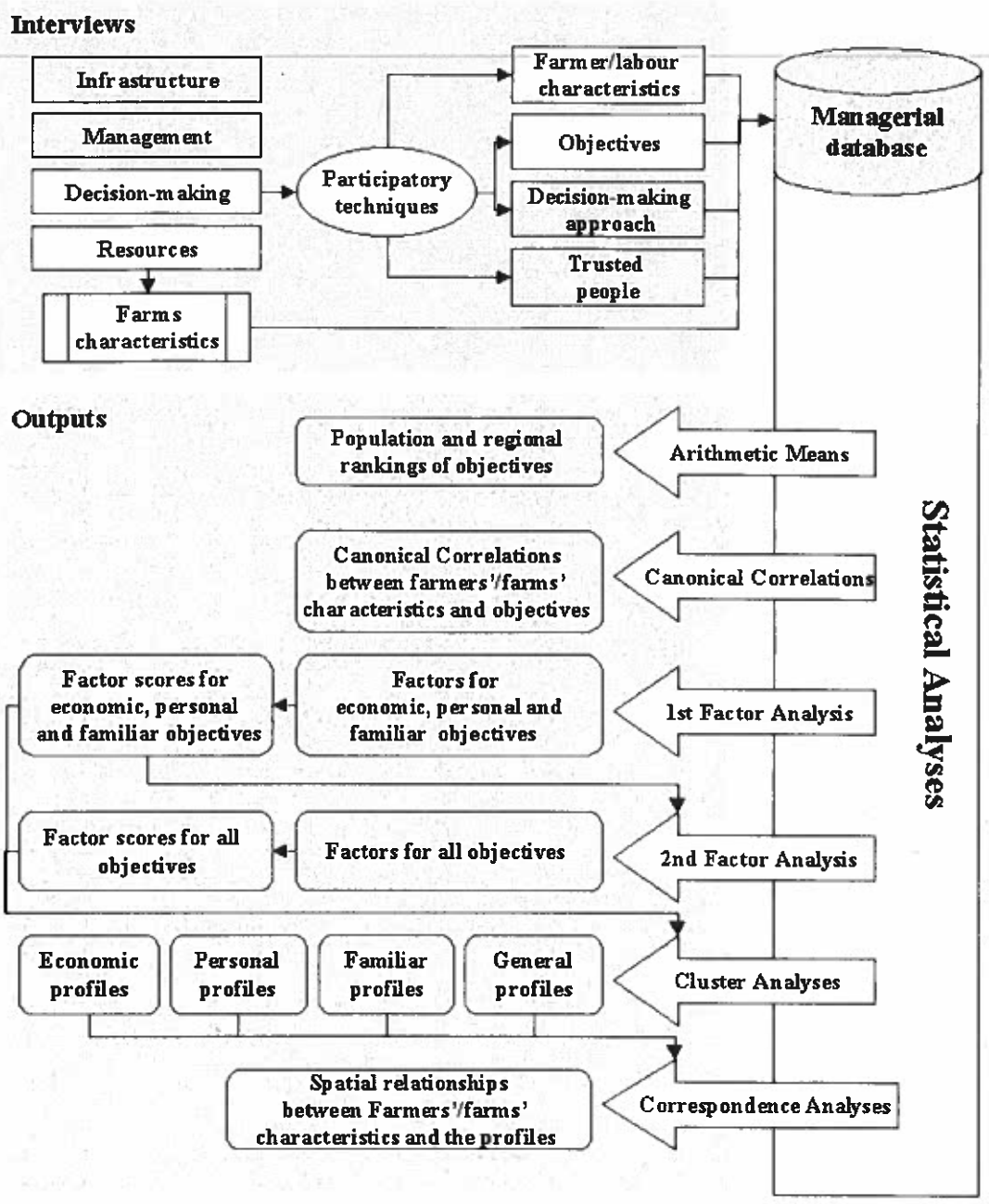

Figure 1: Diagram of the methodology used throughout the study

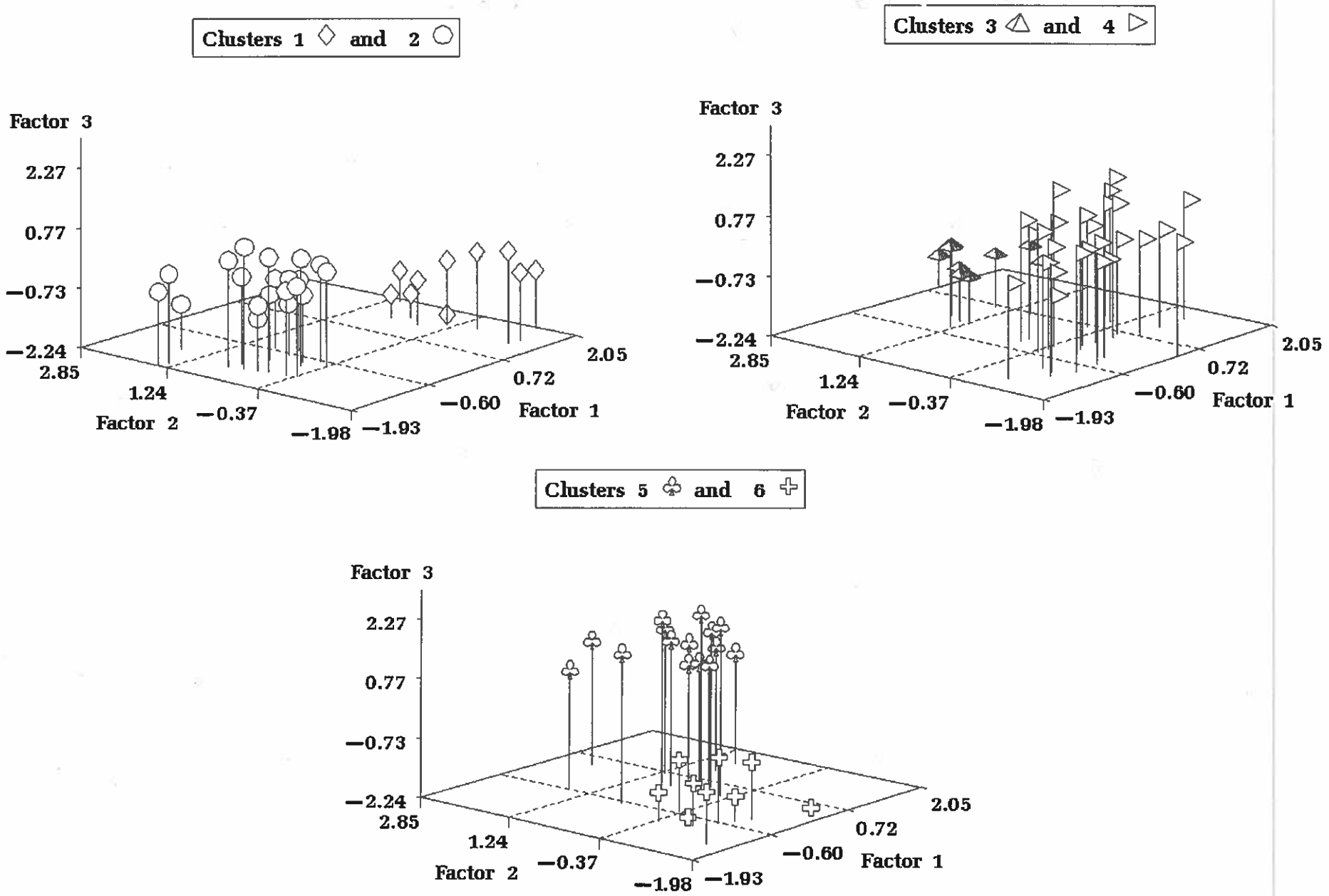

Figure 2: Scatter plots of the farms against the Economic factors and its clusters of membership

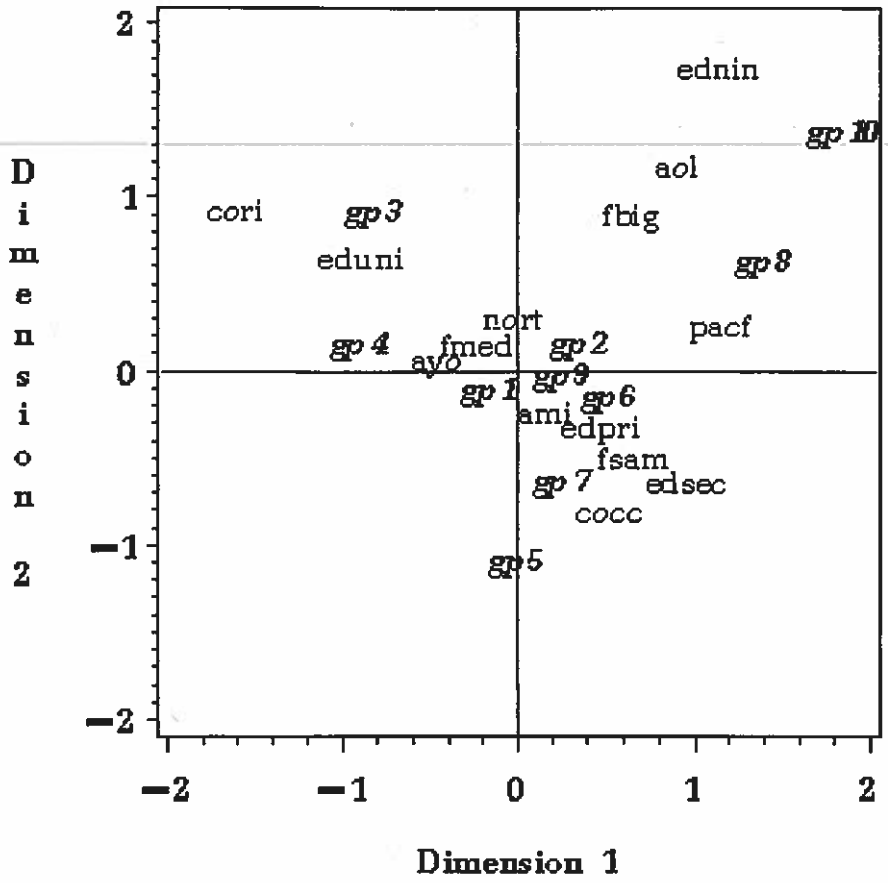

Figure 3: MCA of relationships between farms'/farmers' characteristics and the overall objectives profiles

Table 1: List of objectives evaluated

Objective definition	Code
Economic	
Maximising incomes (cash flow)	MAXI
Having satisfactory incomes	INCS
Re-investing in the farm	INVE
To expand the business	EXPA
Maximising annual net revenue	MAXR
Saving money for the retirement	MONR
Producing high quality products	PROQ
Saving money for children education	EDUC
Personal	
Reducing work and effort	REDW
Reducing risks	REDR
Gaining recognition among other farmers	RECO
Being innovative	INNO
Having time for other activities	TIMO
Producing environmentally friendly	ENVI
Familiar	
Pass the farm to the next generation	INHE
Maintaining the standard of living	LSMA
Improving standard of living	LSIN

Table 2: Rotated factor patterns for economic, personal and familiar objectives, its eigenvalues and determination coefficients

Objective	Factors								
	Economic			Personal			Familiar		
	FE1	FE2	FE3	FP1	FP2	FP3	FF1	FF2	FF3
MAXI	-0.027	0.792	-0.191	-	-	-	-	-	-
INCS	0.067	0.193	0.570	-	-	-	-	-	-
INVE	0.737	-0.161	0.185	-	-	-	-	-	-
EXPA	0.208	-0.314	0.676	-	-	-	-	-	-
MAXR	-0.041	0.660	0.144	-	-	-	-	-	-
MONR	-0.768	-0.141	0.041	-	-	-	-	-	-
EDUC	-0.266	-0.370	-0.289	-	-	-	-	-	-
PROQ	0.481	-0.050	-0.618	-	-	-	-	-	-
INNO	-	-	-	0.098	0.203	-0.731	-	-	-
REDR	-	-	-	0.761	0.236	-0.084	-	-	-
REDW	-	-	-	-0.213	0.769	0.154	-	-	-
TIMO	-	-	-	0.130	0.226	0.790	-	-	-
ENVI	-	-	-	0.731	-0.356	0.160	-	-	-
RECO	-	-	-	-0.342	-0.645	0.186	-	-	-
INHE	-	-	-	-	-	-	0.025	0.997	0.077
LSMA	-	-	-	-	-	-	0.998	0.025	-0.057
LSIN	-	-	-	-	-	-	-0.057	0.078	0.995
Eigenvalue	1.529	1.385	1.295	1.339	1.281	1.214	1.170	1.042	0.788
Difference	0.144	0.089	0.272	0.058	0.067	0.420	0.128	0.255	
Proportion	0.191	0.173	0.162	0.223	0.214	0.202	0.390	0.348	0.263
Cumulative	0.191	0.364	0.526	0.223	0.437	0.639	0.390	0.738	1.000

Table 3: Rotated factor patterns for all objectives, their eigenvalues and determination coefficients

Original Factors	General Factors				
	FG1	FG2	FG3	FG4	FG5
FE1	-0.16437	-0.56237	-0.62262	0.02034	0.08004
FE2	-0.09280	-0.00555	0.19146	0.18103	0.76837
FE3	0.18245	-0.11728	-0.08838	0.74299	0.07218
FP1	0.26518	-0.28655	-0.06295	-0.69372	0.14202
FP2	0.78820	-0.04492	-0.00939	0.22937	0.00901
FP3	-0.04488	-0.17464	0.85795	-0.03600	0.02859
FF1	-0.78971	-0.07796	-0.02958	0.22569	0.02675
FF2	-0.08731	0.02402	0.22842	0.24539	-0.73294
FF3	-0.01419	0.90026	-0.13151	0.05315	0.00686
Eigenvalue	1.5107	1.4137	1.2093	1.0944	1.0656
Difference	0.0970	0.2044	0.1149	0.0288	0.1588
Proportion	0.1679	0.1571	0.1344	0.1216	0.1184
Cumulative	0.1679	0.3249	0.4593	0.5809	0.6993

Table 4: Cluster traits according to affinity or oppositeness to the economic objectives factors

Cluster	n	%	Traits	Labels
1	11	12	*Savers, Maximisators-entrepreneurs, Income-ensurers, Less-Quality seekers*	**Ep1**
2	20	22	*Investors, Expansionists, Income-ensurers, Quality-seekers*	**Ep2**
3	9	10	*Non-maximisators, Pro-family, Expansionists, Income-ensurers*	**Ep3**
4	26	29	*Maximizators-entrepreneurs, Intensivists,, Quality-seekers*	**Ep4**
5	15	17	*Non-maximisators, Pro-family, Intensivists, Non-income-ensurers, Quality seekers*	**Ep5**
6	9	10	*Investors, Mazimisators-entrepreneurs, Expansionists, Income-ensurers*	**Ep6**

Table 5: Ranking of objectives according to the least square means of each objective by clusters of general objectives

Clusters																			
Gp1		**Gp2**		**Gp3**		**Gp4**		**Gp5**		**Gp6**		**Gp7**		**Gp8**		**Gp9**		**Gp10**	
Maxr	2.9	Proq	3.9	Inc	3.8	Proq	1	Maxi	3.2	Proq	2.4	Lsin	1.6	Proq	4	Inhe	2.3	Proq	4.9
Lsin	4.1	Envi	4.9	Expa	4.4	Inve	4.2	Proq	3.2	Envi	4.8	Proq	5.9	Educ	5.5	Expa	2.5	Maxi	5
Maxi	4.2	Lsin	5.2	Maxi	5	Expa	4.2	Inc	3.7	Maxi	5.1	Monr	6.1	Inc	6.3	Proq	5.5	Envi	5.1
Monr	6.2	Redr	5.9	Maxr	5.8	Maxr	6.5	Maxr	4	Maxr	5.4	Inc	6.4	Envi	6.3	Inc	6.3	Lsma	5.9
Proq	6.4	Educ	6.6	Proq	5.9	Innov	6.5	Innov	5.3	Inc	6.7	Expa	6.7	Monr	6.8	Inve	6.8	Educ	7.1
Inc	7	Innov	7	Inve	6.1	Inc	7.2	Lsin	6	Inve	7.2	Inhe	6.9	Maxi	6.8	Innov	6.8	Inhe	7.4
Envi	8.1	Expa	7.4	Redr	8.5	Lsma	7.3	Inve	8.7	Redr	7.5	Maxr	7.3	Timo	7	Timo	8.3	Inc	8.4
Expa	8.3	Inc	8.5	Innov	8.8	Envi	8.3	Redr	8.8	Expa	9.3	Educ	7.4	Maxr	7.3	Redw	8.5	Maxr	8.6
Educ	9	Maxi	8.6	Redw	10	Reco	9.8	Monr	9.8	Educ	9.7	Lsma	8	Expa	7.3	Maxr	9.5	Lsin	8.7
Timo	9.2	Inve	8.8	Lsin	10.1	Redr	11	Envi	10	Lsma	9.9	Maxi	8.1	Redr	7.8	Redr	9.8	Reco	8.9
Inhe	9.8	Maxr	9.2	Monr	10.9	Educ	11.2	Educ	10.7	Lsin	10.4	Innov	9.7	Inhe	9	Educ	10.3	Timo	9.1
Redw	10	Monr	9.9	Timo	10.9	Redw	11.2	Expa	10.8	Innov	10.9	Inve	10	Redw	10.5	Envi	10.5	Monr	10.9
Innov	10.9	Redw	11.7	Envi	11.3	Monr	11.5	Redw	11.3	Timo	11.3	Redw	12.1	Inve	12.5	Lsma	11.3	Inve	11.3
Redr	12.1	Inhe	12.1	Inhe	11.6	Maxi	12.2	Lsma	12.7	Monr	11.8	Envi	13.3	Lsma	12.5	Maxi	11.8	Expa	11.6
Inve	13.7	Timo	12.6	Educ	11.8	Lsin	12.2	Timo	12.8	Redw	11.8	Redr	13.9	Reco	14.5	Lsin	12.8	Redr	12.3
Reco	14.6	Lsma	14.3	Lsma	11.8	Inhe	13.2	Inhe	15.5	Reco	13.8	Reco	14.6	Lsin	14.5	Monr	14	Innov	13.3
Lsma	14.7	Reco	16.4	Reco	15.9	Timo	15.3	Reco	16.5	Inhe	14.9	Timo	15	Innov	14.8	Reco	16.3	Redw	14.3
n	**9**		**14**		**15**		**6**		**6**		**18**		**7**		**4**		**4**		**7**
%	**10.0**		**15.6**		**16.7**		**6.7**		**6.7**		**20.0**		**7.8**		**4.4**		**4.4**		**7.8**