La typologie de explorations agricoles aux Açores

Emiliana SILVA* , Julio BERBEL**

1. Introduction

The main purpose of this paper was to define a farm's typology using the cluster analysis. The cluster analysis is a multivariate procedure for detecting natural grouping in data with similar characteristics and helps find structure in the data (Norusis, 1994). There are some agglomerative cluster algorithms (Jongman et al., 1987; Digby and Kempton, 1991; Dias, 1991; Norusis, 1994; Fernadez- Palacios and Santos, 1996) but in this study the Ward method has been used because of its success in other studies.

There are some applications of cluster analyses, such as Weigel and Rekaya (2000), Silva and Bezerra (2000), Judez and Chaya (1999) , Enes (1999), Solano et al. (1999), Martin and McLeay (1998), Rodriguez et al. (1998), Dentinho and Silva (1996), Dentinho (1994), Delgado and Caldenty (1993), and Avillez (1991).

2. Material and Methods

The Azorean data of Farm Accountancy Data Network (FADN) permit to observe that, in general, farms are small and most of them belongs to the farmers. The mean agricultural area is around 23.7 hectares and the average number of dairy cows is about 23 per farm. The production system is primarily based on grazing, and the main product is milk. Most expenses are on concentrates, annual depreciation, rents and fertilizers (Silva, 2001).

The methodology was based upon Rodriguez et al. (1998). At first, a matrix of 174 Azorean animal farms

Abstract

The objective of this paper was to define types of Azorean farms from a panel data of 174 farms of The European Database of Farm Accountancy Data Network of the Azores, Portugal. This study used cluster analysis, the Ward method. The results allowed the identification of three types of grazing systems of farms as follows: 1) extensive grazing systems (less than 1.4 cows per hectare); 2) moderate intensive grazing system (1.4 to 2.4 cows per hectare); 3) intensive grazing system (more than 2.4 cows per hectare) and three types of animal specialization: 1) beef farms system (more than 0.66); 2) mixed farms system (0.33 to 0.66); dairy farms system (less than 0.33). This enables to define seven types of Azorean farms.

Keywords: Cluster, Ward, Typology, Grazing Systems

Résumé

Ce travail a pour but la définition de la typologie d'exploitations agricoles aux Açores. Cette étude fait appel à 174 exploitations de la base de données européenne du Réseau d'Information Comptable Agricole des Açores, Portugal. Ce travail a utilisé l'analyse par groupe, la méthode de Ward. Les résultats ont permis l'identification de trois systèmes comme suit : 1) le système de pâturage extensif (moins de 1.4 vaches par hectare); 2) le système de pâturage modéré (1.4 à 2.4 vaches par hectare); 3) le système de pâturage intensif (plus de 2.4 vaches par hectare) et aussi trois systèmes de spécialisation animale : 1) le système de production de viande (plus de 0.66); 2) le système mixte (0.33 à 0.66); et 3) le système de production laitière (moins de 0.33). Cela nous permet de définir sept types d'exploitations agricoles aux Açores.

Mots clé*: Groupe, Ward, Typologie, Systèmes de pâturage.*

(from Terceira and S.Miguel islands), sixteen techniques and economic variables were selected. These farmers were selected according to the European Classification (OTE 4). Then, the matrix of data was standardized, and the Euclidean distance, as a proximity or similarity measure, was chosen. Next, a similar matrix was obtained and the Ward method was selected. A dendogram or an analysis tree observed the results. Finally, the clusters were limited and the groups of farms defined.

The software selected for cluster analysis was SPSS, version 8 (Norusis, 1994). The cluster analysis was used into phases: the variables cluster and the cases cluster.

The variables used in clusters were selected by observing that the variables have more impact on sales and cost structure. The animal production was the main product (88.3% milk and 11.7 % beef). In the cost structure, feeding was the most important, the depreciation ranked second, the fertilizer third, and the rent fourth. All the other expenditures were below 6% of the total costs. As a consequence, sixteen variables were selected to form the cases clusters.

Three tests permitted the selection of four groups of variables used in cases cluster:1) Technological variable: milk sales per cow; beef sales per animal; subsidies per animal; fertilizer per hectare; other cash expenses (medicine, artificial insemination and hygiene products); fuel and lubricants per hectare, hired labor per hectare; machinery and building repairs per hectare; depreciation per hectare; land rent per hectare; net income per hectare. 2) Dimension variable: agrarian area; total of animals. 3) Specialization variable defined by Avillez (1989) as the ratio of total animals on the

*CEEAplA - Azores University
**Cordoba University

farms less dairy cows by total of animals. When specialization is higher than 0.66, it is a beef farm; when lower than 0.33, it is a dairy farm, and between 0.33 and 0.66, it is a mixed farm. 4) Intensity variable (Total cows/Hectare).

The cases cluster allows to define a typology of Azorean dairy farms, which means a group of farms with similar characteristics. Following the definition and the selection of the variables by cluster in four groups, the next step was to form the farms cluster. After finding the initial clusters, some limits of intensification, specialization and dimension were forced, because of the diversity of farms in each cluster.

a consequence of this, the intensity of grazing was higher in Cluster III (2.4 cows per hectare) and smaller in Cluster II (1.7 cows per hectare), which was very similar to Cluster I (1.4 cows per hectare).

Table 2. *Cluster characteristics of Azorean farms per cluster*

	Cluster I	Cluster II	Cluster III
Agricultural area (ha)	20.5	23.5	15.5
Total Cows	37.4	39	36.4
Total Cows/ Agriculture area (ha)	1.9	1.7	2.4
Net income/area(euros)	508.77	397.00	830.00
Gross margin/Milk cows(euros)	822.51	755.42	1004.58
Liters of milk/ cow	4202.9	5078.2	5989.9
Feed /Milk cows (euros)	185.55	340.68	236.93
Fertilizer/ha (euros)	110.73	151.14	181.06
Hired labor /ha (euros)	26.44	90.28	43.89

3. Results and discussion

The variable cluster formed four clusters of variables: Cluster I - Cluster of dimension (agricultural area; total number of animals); Cluster II – Cluster of outputs and fixed and variable assets (subsidies per cow; net income per hectare; beef sales per cow; fertilizer costs per hectare, feeding costs per cow, and rent per hectare); Cluster III – Cluster of specialization, outputs and fixed assets (specialization, milk sales and hired labor per hectare);and Cluster IV – Cluster of intensity and fixed and variables assets (intensity, depreciation, fuel and lubricants per hectare, machinery and buildings repairs per hectare and other cash expenses).

Table 1. *Composition of farm groups per island*

Clusters	Terceira		S.Miguel		Total	
	Nº	%	Nº	%	Nº	%
I	48	81.4	11	18.6	59	100
II	17	37.8	28	62.2	45	100
III	45	66.2	23	33.8	68	100
IV	1	100	0	0	1	100
V	0	0	1	0	1	100

These clusters of variables allowed the identification of five clusters of Azorean farms: 1) 59 farms, 2) 45 farms; 3) 68 farms, 4) 1 farm, and 5) 1 farm.

The objective of this study was to define a typology (similar characteristics) of Azorean farms. Then, we considered the farms belonging to Clusters IV and V as outliers, although Lloyd (1993) reports the danger of eliminating the outliers. In this case, simplifying the reality does not seem to be very important to eliminate the outliers.

Figure 1. Clusters Terceira and S. Miguel: intensity and specialization.

The agricultural area was smaller (15.5 hectares) in Cluster III and higher (23.5 hectares) in Cluster II. Cluster I had an intermediate agricultural area (20.5 hectares). The mean number of cows was higher (39) in cluster II, but not with great differences from other clusters (around 37 cows). As

As a result of an intensive grazing system, cluster III provided higher net profit per cow (833 euros), and cluster II provided smaller net profit per cow (397 euros). This result was similar for the gross margin per hectare. The net profit and gross margin for cluster III was influenced by the higher milk production per cow, which was about 6000 liters. Cluster II presented a higher expenditure on the animal feeding with concentrates (around 340.6 Euros), when compared with the other two clusters (more intensive grazing systems).

The expenditures in wages was more elevated (90.28 Euros) in cluster II, mainly composed of S.Miguel farmers. In this island, around 20% of farms had agricultural workers. In Terceira, about 90% of farms are family run.

As a result of a forcing cluster, it was decided that the specialization and grazing intensity define the groups of farms (Figure 1). As it is observed in this figure, dairy farms (specialization smaller than 0.33) are mainly of the cluster II and III. Cluster I had only one farm of beef production (specialization higher than 0.66). Most of the sampled farms are mixed or with dairy specialization. Cluster III is more intensive, and most farms are intermediate (around 2 cows per hectare); clusters I and II are less intensive grazing systems (less than 2 cows per hectare). Also, as observed in figure 1, there are not very limited groups of farms, this means that, independently of the level of intensive grazing systems, there are dairy and beef farms and it is necessary to delimit those groups. For example, dairy milk farms (specialization less than 0.33) are in extensive grazing system (less than 1.4 cows per hectare), in the medium system grazing (between 1.4 and 2.4 cows per hectare) and in the intensive grazing system (more than 2.4 cows per hectare) Because of these reasons it was considered necessary to force the clusters according the intensity of grazing for obtaining more homogeneous farms. Then it was decided to force groups of farm

according to intensity systems grazing:1) less than 1.4 cows per hectare;2) 1.4 and 2.4 cows per hectare and 3) more than 2.4 cows per hectare; and according to milk specialization:1) less than 0.33;2) 0.66 and 3) more than 0.66.

Figure 1. Clusters Terceira and S.Miguel: Intensity and specialisation

Finally, seven main types of Azorean farms were defined (Figure 2):

Figure 2.Typology of Azorean Dairy Farms

Type I –Intermediate grazing systems (1.4 to 2.4 cows per hectare) and mixed system (specialization 0.33 to 0.66)

Type II – Intermediate grazing systems (1.4 to 2.4 cows per hectare) and dairy system (specialization less than 0.33).

Type III – Extensive grazing systems (less than 1.4 cows per hectare) and mixed system (specialization 0.33 to 0.66).

Type IV – Extensive grazing systems (less than 1.4 cows per hectare) and dairy system (specialization less than 0.33).

Type V – Extensive grazing systems (less than 1.4 cows per hectare) and beef system (specialization more than 0.66).
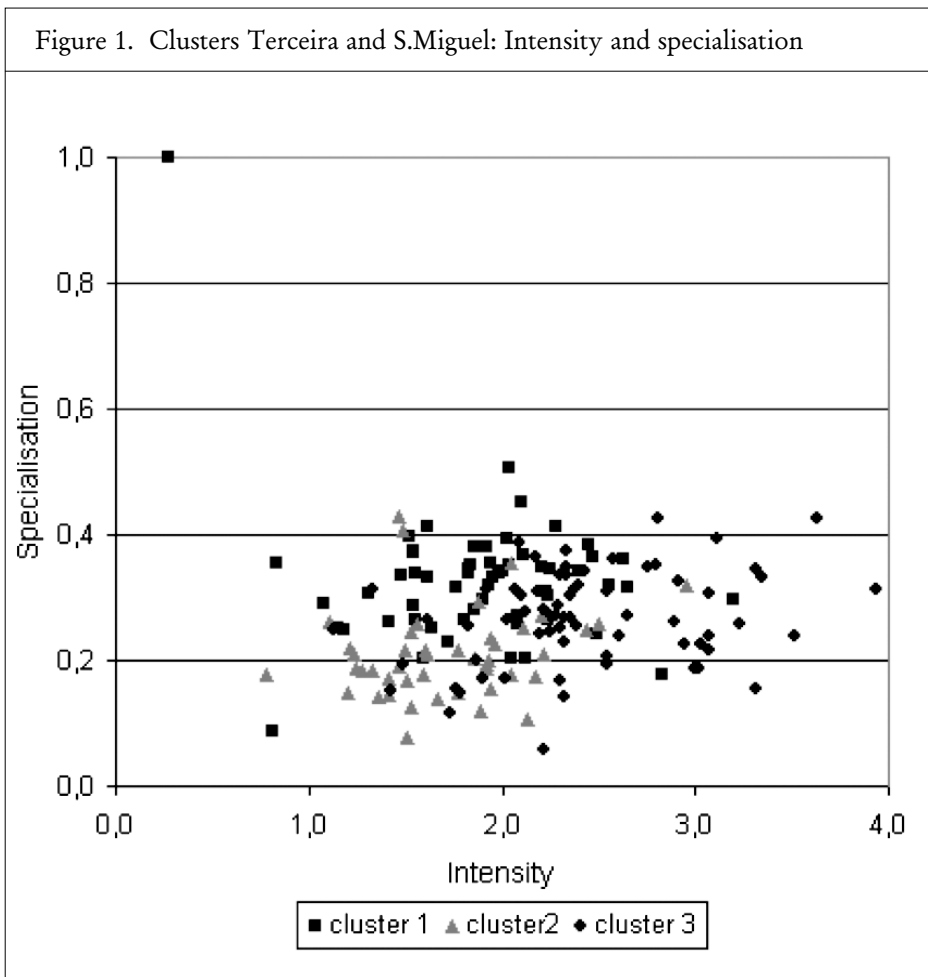
Type VI – Intensive grazing systems (more than 2.4 cows per hectare) and dairy system (specialization less than 0.33).

Type VII – Intensive grazing systems (more than 2.4 cows per hectare) and mixed system (specialization 0.33 to 0.66).
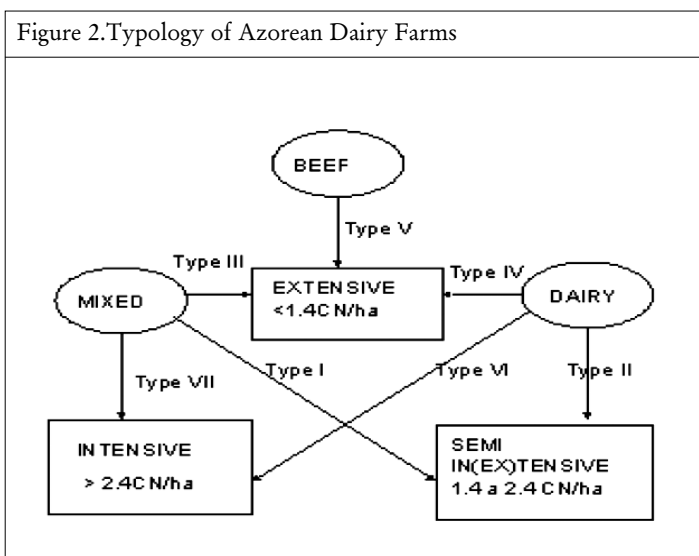
4. Conclusion

The Azorean animal production has mainly three types of farms; extensive grazing systems (dairy, beef or mixed), intensive grazing systems (dairy and mixed) and intermediate grazing systems (dairy and mixed). This allows the development of agricultural policies for a specific group of farmers with different needs, and the development of useful decision models as in the example on the simulation of the effect of an increasing price of feeding (concentrates) and fertilizers on the net profit of different types of farm (intensive, extensive and moderate).

References

Avillez, F., 1991. *Estudo de base microeconómica sobre as perspectivas de desenvolvimento da agricultura dos Açores*. ISA "(in Portuguese)".

Delgado, M., Caldentey, P., 1993. *Segmentación del Mercado de Consumidores del Vino de Córdoba*. Invest. Agr. Econ.8, 2, 209-221 " (in Spanish) ".

Dentinho, T., Silva, E., 1996. *Information Systems of the Azores Dairy Farms*. VIII Congress of the European Association Agricultural Economists, Scotland.

Dentinho, T., 1994. *Information and Communication Technologies and Regional Development. The Case of the Azores Dairy Value Chain*. A dissertation submitted for the degree of Philosophy, University of Newcastle-upon-Tyne.

Digby, P., Kempton, R., 1991. *Multivariate Analysis of Ecological Communities. Population and community*

biology series. Chapman & Hall, 3 ed.

Dias, E., 1989. *Métodos de Estudo e Análise de Vegetação - Comunidades Herbáceas*. Universidade dos Açores "(in Portuguese)".

Enes, I., 1999. *Determinação da Tipologia das Explorações Agrícolas da Ilha Terceira*. Relatório de estágio em Engenharia Zootécnica. Universidade dos Açores "(in Portuguese)".

Fernández-Palacios, J., Santos, A., 1996. *Ecología de las Islas Canarias. Muestreo y Análisis de Poblaciones y Comunidades. Sociedad la Cosmológica*, Islas Canarias "(in Spanish)".

Jongman, R.; ter Braak C., Tongeren, O., 1987. *Data Analysis in Community and Landscape Ecology*. Pudoc. Wageningen.

Judez, L., 1989. *Técnicas de Análisis de Datos Multidimensionales. Ministerio de Agricultura Pescas y Alimentación, Madrid* "(in Spanish)".

Judez, L., Chaya, C., 1999. *Effects of Geographical Stratification in a Farm Accountancy Data Network on the Accuracy of the Estimates*. Journal of Agricultural Economics. 50, 3,388-399.

Lloyd, T., 1993. *Outliers in agriculture: An Intervention Analysis of Agricultural Land Values*. Journal of Agricultural Economics.44, 3, 443-455.

Martin, S., McLeay, F. 1998. *The Diversity of Farmers Risk Management Strategies in a Deregulated New Zealand Environment*. Journal of Agricultural Economics. 49, 2, 218-233.

Norusis, M., 1994. SPSS Professional Statistics 6,1, SPSS, United States of America.

Rodríguez, A., Berbel, J., Ruiz A., 1998. *Metodología para el Análisis de la Toma de Decisiones de los Agricultores.* Madrid "(in Spanish) ".

Silva, E., 2001. *Análisis Multicriterio de la Eficiencia Económica de las Explotaciones Agroganaderas de las Azores (Portugal)*. Universidad de Córdoba " (in Spanish) ".

Silva, E., Bezerra, A., 2000. *Análise Financeira de Explorações Agro-pecuárias dos Açores*. Congresso de Economistas Agrícolas, Lisboa. " (in Portuguese) ".

Solano, C., Bernués, A., Rojas, F., Joaquín, N., Fernandez, W., Herrero, M., 2000. *Relationship between Management intensity and Structural and Social Variables: in dairy and dual purpose systems in Santa Cruz, Bolivia*. Agricultural Systems. 65 159-177.

Weigel, K.A., Rekaya, R., 2000. *A multiple trait Herd Cluster Model for International Dairy Sire Evaluation*. J.Dairy Sci. 83, 815-821