

Typification of dairy farms according to criteria of a socioeconomic nature: an illustration in “El Páramo” of Leon (Spain)

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TYPIFICATION OF DAIRY FARMS ACCORDING TO CRITERIA OF A SOCIOECONOMIC NATURE: AN ILLUSTRATION IN “EL PÁRAMO” OF LEON (SPAIN)

Abstract

The impossibility of carrying out an individual analysis and of finding solutions for each agricultural business, makes advisable the use of classification techniques that allow the identification of groups with common characteristics. The aim of this study is clustering dairy farms in an agricultural region located in the north of Spain, known as “El Páramo”. To this end, a survey has been carried out on a representative sample of dairy farms, and subsequently, a Cluster Analysis has been made, which has resulted in five groups of farms being clearly defined from a social and economic point of view.

Keywords: Farming systems research, Cluster Analysis, Dairy farms.

JEL: Q12

1.- Introduction

Research into agriculture presents a certain difficulty; although each farm has its own specific characteristics, problems and decisions, which require different solutions, unfortunately, in practice, it is unfeasible to carry out an individualised analysis of each farm, and it is necessary to bring the agricultural businesses with similar characteristics together into homogeneous groups, in such a way, that a series of common recommendations can be made (Byerlee *et al*, 1980). There are international classifications that try to specify the regional typologies and classifications of the agricultural systems, and which recognise the importance of basing the typification on quantitative methods, since, according to experts, qualitative-type methods may lead to different results (Kostrowicki, 1977). Recently, developments in information technology have extended the application of different data analysis techniques of a high statistical complexity. Among the most frequently used procedures are, factor analysis, multiple discriminant analysis and cluster analysis (Gómez, 1999). We may find different applications of this last one to the dairy sector (Solano *et al*, 2001).

2.- Objectives

This study aims to carry out a typification of the different dairy farming systems in one of the most representative agricultural regions of the north of Spain: El Páramo, in Leon, as previous attempts at carrying out a classification of the production tendencies in this area (Franco, 1986), have not been focused on a specific typology, are based on empirical knowledge, and made in a period (1986) that has little to do with the farming situation today, with different CAP reforms implemented and an important restructuring affecting the dairy sector. Thus, the decision was made to carry out a classification that does not introduce subjective-type elements and that covers the existing time vacuum in which the political and economic situation of the sector has evolved.

3.- Material and Methods

Survey design

A survey was designed and subsequently carried out on farmers who manage cattle farms in order to obtain data regarding the economic, social and technical situation of these farms.

The framework of the survey was the census of cattle farms drawn up from data from the campaigns for disease eradication in ruminants, carried out in 2001. The choice of this framework guarantees the minimization of the different types of error that can be found in a framework (Santos *et al*, 1999).

Once the survey framework had been decided, a questionnaire model was drawn up; this was mostly made up of a series of open questions with the purpose of obtaining the most important data of a socioeconomic nature, as:

- Surface area (hectares) of the farm (total, unirrigated, irrigated).
- Type of production: corn, beetroot, fodder, grazing, scrub and uncultivated
- Number of head of cattle
- System of ownership: surface area in ownership or leased.
- Degree of capitalization: Buildings and installations: own machinery and implements: Valuation of own working capital; own land capital;
- Debts: Loans.

- Type of employment: temporary workers, permanent workers, family.
- Production Value: Sales, subsidies, taxes on products, stock variations, re-use and personal consumption.
- Costs.
- Net surplus from the farm, net income from the business and business profit.

With regard to the method of carrying out the survey, a personal-type survey was chosen, and was carried out throughout 2002.

With regard to the sampling method, different aspects must be taken into account, such as: the statistical framework available, the duration of the research, the available budget, the questionnaire model, the way the questionnaire is administered, and even the statistical objectives with regard to the degree of accuracy of the estimates to be achieved (Santos *et al.*, 1999). In this study, the type of sampling chosen has been simple random sampling.

The sample size was determined in accordance with this method, taking into account that a larger sample does not always produce better results. On the contrary, after a certain size, the error is scarcely reduced whereas there is an increase in costs and there may also be an increase in errors unrelated to the sample. On the other hand, the research must find a compromise between the cost of a large sample and the reliability of the results (Grande & Abascal, 1995).

The sample has been obtained by means of stratified sampling, and optimum affixation was chosen for distribution of the sample on the strata as a whole. In order to do this, the population had previously been divided into homogeneous strata, with the size of the farm being used as the variable of reference in the classification.

The reason for this choice is due to the framework available, the type of estimator and the fact that stratified sampling is more accurate than simple random sampling, or rather, it achieves the same accuracy with a smaller sample size. Moreover the choice of optimum affixation, compared with other methods such as proportional affixation contributes to reduce the error and, therefore, the costs are lower (Grande & Abascal, 1995).

While taking into account the distribution of the population and the object of the study, the most suitable sample size and the subsequent sample affixation were calculated, according to expression (1):

$$n_i = \frac{W_i \cdot S_i}{\sum_{i=1}^h W_i \cdot S_i} \cdot n \quad (1)$$

The standard error or sample error, given by the estimator variance (the average, in this case), can be calculated using the formula established for Stratified Sampling, using the following expressions (Snedecor & Cochran, 1971):

$$\text{var } \bar{x} = \sum_i \frac{W_i^2 \cdot S_i^2}{n_i} \cdot \left(1 - \frac{n_i}{N_i}\right) \quad (2)$$

$$e = k \cdot \sqrt{\text{var } \bar{x}} \quad (3)$$

Tests were made with different sample sizes and the corresponding sample error was calculated for all of them. Finally, a sample size made up of 40 farms was chosen, distributed according to table 1, with a sample error of 0.62, an absolute error of 1.24, and a relative error of just over 4%.

Table 1. Distribution of the total census and the sample of cattle farms in the moors of Leon.

STRATUM	TYPE	N _i	n _i
From 0-10	Dairy farm	59	5
From 11 to 20	Dairy farm	45	4
From 21 to 50	Dairy farm	61	15
From 51 to 100	Dairy farm	28	9
From 101 to 150	Dairy farm	11	5
From 151 to 200	Dairy farm	4	1
>200	Dairy farm	1	1
TOTAL		209	40

Statistical treatment: Cluster Analysis

Once the survey data had been carried out, the answers to the questionnaire were processed using Excel to calculate some economics variables such as the value of the output or the different resources or costs, as well as the results of the financial accounts. Later, a group analysis was carried out using the socio-economic variables obtained through the questionnaires and the upcoming calculus operations carried out. Among the different group analysis techniques, one of the techniques most frequently used to determine the different typologies of farms and agricultural production systems is cluster analysis (Köbrich *et al*, 2002). Here a hierarchical-type Cluster Analysis has been chosen to cluster the different dairy farms analysed.

4.- Results

Five groups of farms have been identified when using Cluster Analysis. Some characteristics of them will be described afterwards.

Group 1

This group is made up of a total of 4 farms of mixed cattle-agricultural production, with a slight predominance of cattle production over agriculture. Agriculture, however, still plays an important role and account for 39% of the production, a percentage only surpassed by group 3. In this group, subsidies on crop products account for 8% of the total production.

The farms cover a usable farmland surface area of around 16.2 hectares, all of it as property, and which is divided into irrigated land (15%) and unirrigated land (85%), with the latter clearly predominant. On the unirrigated land, cereals are the pre-eminent crop, which together with fallow land, occupies most of the usable farmland, with only a small area being used for grazing. With regard to the irrigated land, corn is the main crop and occupies over half of the area, with the rest of the land given over to meadows.

What stands out about stock farming is its small size, with scarcely 7.1 head of cattle. However, livestock undoubtedly plays an important part in production as it accounts for 61% of the total agricultural output value, with 85% of the animal output corresponding to milk production. Crop output at the basic price contributes 39% to the total output (31% from the production at the market price and 8% from subsidies on products). In this group, intra-unit consumption can be highlighted, accounting for 17% of the total output.

Intermediate consumptions account for almost one half of the total output, and make up the stratum in which they have the least relative weight, after group 3.

Own capital has a value of 73,625 €, with the importance of land capital standing out as it accounts for 82% of this value. No great investments in machinery or buildings have been observed. Neither is there excessive dependence on a capital loan, since the relation between loaned capital and own capital is only 4%. The small amount due to consumption of fixed capital demonstrates the little importance of capital invested in building and machinery, and also indicates the presence of capital with a high ageing rate.

Running these businesses, in 50% of the cases, we find people who are working in agriculture as a secondary occupation (retired people or those with another job). The entrepreneur has an average age of 57 years old. They do not employ salaried employees but rely solely on the help from family

members. The net operating surplus from these farms is around 9528.51€ and the net entrepreneurial income 9296,07 €

Group 2

This is the most numerous group. It is made up of a total of 18 farms (47% of the total). It deals with mixed agricultural-stock farms, with a usable farmland surface area of 15.68 hectares (similar to the previous group), of which over half corresponds to the cultivation of corn, and the rest divided up among cereal, meadows and grazing land, sugar beet and fallow land. The position of irrigated land stands out as it accounts for 86% of the usable farmland surface area, a higher percentage than in the previous group.

As in the previous group, animal output stands out (71% of the total agricultural output), accounting milk production for 83% of the animal output. Subsidies for crop products account for 5% of the agricultural output, whereas the average figure for subsidies on livestock products is 52.89 €, indicating the sporadic existence of calves being fed well past the usual age, in order to get the correspondent subsidy.

The consumption of fixed capital due to the machinery is 2446.12€, a very different amount from those in the previous group. Likewise, interest on capital loan doubles the amount of the previous group, indicating a higher degree of capitalization, although, with regard to capital, own land capital still stands out at 49%, whereas machinery and buildings account for 33% of the fixed assets.

In this group, capital invested in livestock (18%) has greater importance compared with the previous group. This is quite logical if we take into account that the average farm has a total of 36.27 head of cattle, taking third place after groups 5 and 4.

The rate of debt is 4%, similar to that of the previous group. However, there is an important increase regarding intermediate consumption, which is rightly associated with the larger size of the farms. This amount reaches a relative importance of 61% (expressed on the total output value).

The businessmen running these farms have an average age of 45, with farm management being their main activity. They rely on family labour for practically all of the work.

Unlike the previous group, where there were no costs for rented cultivated land or grazing land, in this group rents reach a value of 1560.28 € due to the leasing of farmland, although there is also some leased grazing land with the purpose of achieving the fodder area necessary to be entitled to subsidies for the premium for cattle. The net income level obtained on these farms is 25776,91€ which is considerably higher than in the previous group.

Group 3

Integrated by a total of 8 farms, this group is made up of mixed farms, as in the case of the previous two groups. However, in this group there is a predominance of agriculture over livestock. Thus, while agriculture accounts for 54% of the total production, livestock only accounts for 46%, with milk production standing out, as in the previous cases.

The average surface area of the farms is 45.47 hectares, of which over half is irrigated land, and with 38% of the surface area dedicated to the cultivation of corn, which occupies almost 70% of the irrigated land. This group is leader with regard to the area given over to this crop. Together with meadowland, sugar beet production stands out and is totally concentrated in this stratum, together with the previous group. However, in this case, the area dedicated to this crop is over twice as large.

On unirrigated land, fallow land and cereal production are the most important, accounting for 9.9 hectares, with these farms having the greatest area of fallow land. This fact is related to the subsidies obtained for herbaceous-type crops; in order to receive these subsidies, a certain percentage of area has to be withdrawn from production. In this group, agricultural subsidies reach their highest level.

The area of rented land stands out: almost three quarters of the land is leased, which is indicative of the farmers' interest in increasing the average size of their farms without making new investments, which would increase their level of debt. With regard to livestock farming, the average size of 24.95 head of cattle is smaller than that of the previous group. Intra-unit consumption is at around 10% and intermediate consumption accounts for around 47% of the total output.

Compared with the other groups, there is an increase in the capital invested in the farm, both in buildings and machinery investments, with the latter having the greatest weight on the capital as a whole. However, in this group, dependence on loaned capital is considerably lower.

The average businessman is a 45-year-old farmer, whose main activity is farm management and who does not use any kind of paid employment.

Group 4

This group is a stratum consisting of six mixed farms with 74 head of cattle, the largest of all the farms. The usable farmland surface area is 25, 92 hectares, of which 80% is irrigated land, mostly dedicated to the cultivation of corn (56% of the total usable farmland area). The area given over to fodder also stands out, and this group is the leader in this concept. The regime of property for the land increases, and this fact is obviously reflected in the interests due to the own capital, placing this group at a second place in importance after group 5.

Animal production regains importance and accounts for 80% of agricultural output, with milk production being the most important output. Crop output, however, has less relative weight, and likewise, logically, crop subsidies.

One important difference in this group regards to the value of intra-unit consumption, which reaches its highest level, indicating the farmers' interest in combining both productions, on a basis of reducing costs, at the same time as agricultural production is replaced by livestock production.

Here we find the youngest and most dynamic businessmen; they have an average age fewer than 35 and are professional farmers. In this stratum, there are farms contracting paid employees, being in this group the highest rate for this indicator.

The intermediate consumptions account for practically half of the agricultural output, while the farms' net operating surplus is 71981.67€ and the net entrepreneurial income 68529.09€

Group 5

This is a group that was added at the end of the process of clustering and is a potential atypical case. It is integrated by a total of 3 farms, characterized by the non-existent or minimal agricultural activity. However, livestock plays a considerably more important role than on the rest of the farms. The farms in this group basically differ of the resting groups in their average size, with a total 191.87 head of cattle. Two of them stand out with regard to the rent of uncultivated land and scrub, which, on average, accounts for 106,67 hectares for the whole of the group. Renting this surface has the purpose of completing the surface area of fodder necessary to apply for subsidies for cattle premium. On all the farms, the own machinery is valued at over 80,000 € On two of the farms, this machinery is used exclusively for use in stock farming.

On all three farms, milk output has a value of over 140,000€ However, there are big differences between them with regard to the absolute value, in fact, between the maximum and minimum limit for this value there is a difference of over 100%.

All the farms are run by farmers, whose main activity is farm management and who have an average age of 45; two of these businessmen could be called young farmers. All the work relies on family workers. The proportion of paid labour in relation to the potential labour necessary has a value of 17%.

This group stands out from the rest with regard to the value of its buildings and installations on the total fixed assets, accounting for 31% of them. However, the relative importance of machinery (17%) is lower than for groups 2, 3 and 4, due to the smaller participation of agriculture in the farms' business. The same happens with regard to the share of own land capital.

One of the biggest differences of this group compared to the rest is the amount of intermediate consumptions, which account for almost 80% of the total production. This fact clearly destabilizes the economic results and is shown in the farms' net operating surplus and the respective net entrepreneurial income.

5.- Conclusions

Five groups are clearly differentiated with regard to their productive structure and economic variables.

Practically all the farms combine agricultural and livestock activity, with this combination being a way to increase the added value by means of the intra-consumption of part of the crops output.

The relative importance of the buildings on the fixed capital as a whole can be highlighted on the farms in group 5 and the one of machinery in group 3.

The contribution of crop subsidies to the total agricultural production can be highlighted in group 3 (the group in which agricultural activity predominates), whereas the group in which these subsidies

have the least importance on the output as a whole is group 5 (the group in which the activity is almost exclusively livestock)

All the farms use family labour, whereas paid employment is not a common practice.

A certain decrease in the age of the farmers can be noticed. The average age of all the groups, except in group 1, is under 45. Group 4 can be highlighted as the one with the youngest businessmen in the sector.

All the businessmen who doesn't manage their farms as their main professional occupation have been clustered into group 1, which represents the smallest farms.

The presence of loaned capital can be highlighted in group 5 (larger-sized stock farms), resulting from the higher degree of investment due to the introduction of improvements and to the processes of modernization which are being carried out on the farms.

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