Suggestions for reformation in sheep farms based on production cost

ARTICLE · JANUARY 2009

5 AUTHORS, INCLUDING:

Stamatis Aggelopoulos
Alexander Technological Educational Instit…
19 PUBLICATIONS **115** CITATIONS
SEE PROFILE

K. Soutsas
Democritus University of Thrace
11 PUBLICATIONS **23** CITATIONS
SEE PROFILE

WFL Publisher
Science and Technology
Meri-Rastilantie 3 B, FI-00980
Helsinki, Finland
e-mail: info@world-food.net

Journal of Food, Agriculture & Environment Vol.7 (3&4) : 561-566. 2009 *www.world-food.net*

Suggestions for reformation in sheep farms based on production cost

S. Aggelopoulos [1]*, K. Soutsas [1], A. Pavloudi [1], E. Sinapis [2] and D. Petkou [3]

[1] Department of Farm Management, Technological Educational Institute of Thessaloniki, Sindos, Thessaloniki, Greece.
*[2] Department of Animal Production, Faculty of Agriculture, Aristotle University of Thessaloniki, Greece.[3] School of Health and Medical Care, Technological Educational Institute of Thessaloniki, Sindos, Thessaloniki, Greece. * e-mail: stamagg@farm.teithe.gr*

Received 20 June 2009, accepted 30 September 2009.

Abstract

Sheep farming is considered to be one of the most dynamic sectors of the rural economy. Nevertheless, the operation of sheep farms presents several weaknesses, which are probably due to the relatively short period during which the sector has become systematised and has developed on a business basis. One of the most important problems facing this sector is the high production costs, which affect its competitive profile. This paper studies the potential of restructuring and promoting the business growth of sheep farms, by reducing their production costs. As an application of the proposed methodology, we used economic data from 110 Greek sheep farms. More specifically, through the application of principal component analysis, the present study examines the "internal cohesion" of the factors that shape the overall production costs, while analysing the structural relations between their primary parameters. Through the application of hierarchical cluster analysis, the farms in question are grouped into two clusters, based on the scores per cost component and the discriminating capacity of these components is highlighted. It is concluded that all efforts to reduce production costs should aim at: a) a productive use and rational utilisation of the fixed capital, b) a reduction of production costs for animal food, c) a productive valorisation of family labour. The latter (as a cost component) presents a discriminating capacity for all sheep farms. It is therefore obvious that a reduction in wages is a necessity for all such farms. A full valorisation of family labour, and an increased level of mechanisation per employee, is expected to lead to a reduction in the former's cost of use.

Key words: Sheep farming, production costs, restructuring, financing, principal component analysis, cluster analysis.

Introduction

Sheep farming is one of the most important sectors of primary animal production. On a global level, the main productive focus of sheep farms is meat production. Worldwide, the dominant country in sheep's meat production is China, followed by the EU [1], where approximately 100.5 million sheep and goats are bred. More specifically, as regards sheep farming, Great Britain is in top position with 23.7 million, followed by Spain with 22.1 million, Greece with 8.9 million, Romania with 8.4 million animals, Italy with 8.2 million and France with 8.1 million [2]. Sheep farming for meat production is of particular interest for the northern countries of the EU, while milk production is the predominant activity of countries in the southern parts of the EU. The main countries involved in sheep milk production in the EU are Greece, Italy, Portugal, Spain and France [2].

Greece is a country with a long tradition in animal breeding, particularly involving small ruminants. Sheep farming is a primarily traditional sector of animal breeding in Greece, with a very satisfactory adjustment to the Greek natural environment. Its share in the gross value of the total animal production is 36.2%, and approximately 13% in the overall agricultural production [3]. The total number of animals is 9,066,366, belonging to a total group of 127,937 farms, which are distributed in the regions of Greece as follows: Western Greece 24,999, Crete 17,515, Epirus 15,254, Thessaly 12,978, Peloponnese 12,949, Central Macedonia 6449, Eastern Macedonia & Thrace 4499, Northern Aegean 5512, Southern Aegean 4811, Attica 1436, Ionian islands 3603, Western Macedonia 3612, Sterea Ellada 14,319 [4]. More specifically, this sector accounts for 34.7% of the total amount of milk and 16.6% of the total meat production of Greece. Sheep farming has a major financial impact, due to: a) the production of large product quantities of a high biological and dietary value, b) the fact that it provides employment and an adequate stable income to a large number of animal breeders, and c) the creation of added value through the processing and trading of sheep's meat and milk.

Sheep farming also has an additional significance for Greece, given the fact that it is practised in mountainous and disadvantaged regions that cannot be otherwise valorised. Sheep farming is an expansive activity as a whole, and in recent years a large number of stabled-intensive farms have been developed [3]. The majority of sheep farms in Greece mainly focus on the production of milk, which originates from genetically non-homogeneous flocks, consisting of animals of different breeds, that are mainly cross-bred and of an unknown genotype mix; thus the farms' morphological, physiological and production characteristics present a great degree of variability [5].

Sheep farms in Greece primarily consist of small family-run holdings of an expansive form, with notable differences as regards their size, stabling facilities, production, etc. In recent years, a reduction in the number of small, nomadic holdings has been observed, along with an increase in the number of large, organized,

"closed"-type holdings, that show a clear focus on business structures [6-8].

The sector's high level of productivity in combination with its adaptability to the natural conditions of Greece, the provision of employment to a large number of employees, the attainment of a satisfactory agricultural income, along with the capacity to produce products of a high added value, jointly create the potential for an even greater development of this sector [9, 10].

About 1/3 of the sheep holdings in Greece are considered to be non-viable within the new environment created by the common agricultural policy, as formulated after the decoupling of subsidies from production [11].The size of the holdings is one of the two factors that have a major impact on the profitability of sheep and goat farms. The majority of Greek sheep farms function under increasing performances of scale, which means that an increase in their size is required in order for them to be able to achieve lower production costs and boost profitability [12].

During the last few years, there has been a trend of installing new, modern, intensive farms in lowland areas; these farms have a larger invested capital and produce animal food in order to cover all or part of the requirements of the bred animals [3]. However, despite the improvements of recent years, all sheep farms still present substantial organisational weaknesses, which are clearly linked to the low level of business growth in the sector [10]. These weaknesses result in a reduced level of competitiveness and a notable loss of income, as regards the comparative advantage of the sector (P.D.O. establishment of feta products). An improved level of competitiveness in Greek sheep farming can be achieved either through a further increase in productivity, either through a reduction of the overall production costs [9,10,13].

Due to the great significance of the sheep farming sector for the rural economy of Greece and EU, several research efforts have been carried out on this topic. Numerous researchers have studied the economics and viability of the sector, and its potential for further improving its competitiveness [8,14,15]. In a relevant paper, Apostolopoulos and Gidarakou [6] focused on examining the socio-economic factors that affect the structure of the sheep farming sector in Greece, by using multivariate data analysis methods. Zioganas *et al.*[16] examined the structure of sheep farms and studied the technical and financial efficiency of the operating system of such farms in the Epirus region. They also conducted a study of the socio-economic effects of sheep farming on the local area. These researchers used Cobb-Douglas type production functions to explore the optimum combination of the sector's available resources. Tzouvelekas *et al.* [17] estimated the relative efficiency of sheep farms in Greece, both in relation to size and geographical region. Furthermore, Hadjigeorgiou *et al.* [7] recorded the applied production systems and the livestock being used, and calculated livestock efficiency; they also studied some specialised trade issues affecting the sector. In addition, the progress of the sector in Greece was analysed through a study of various scenarios for the application of common agricultural policy measures. The effect of the qualitative characteristics of milk on the technical efficiency of sheep farms was examined by Karagianis and Galanopoulos [18]. Zioganas *et al.* [9] presented a technical-economic analysis of sheep and goat farming. They calculated the revenue, the cost details, the profit and the achieved income (with and without subsidies) and also determined their distribution per geographical region. Fousekis *et al.* [19] used a DEA model to determine the overall efficiency of sheep farms, mainly those located in the mountainous regions of Greece. The empirical results suggest: a) the average overall efficiency ratio in the sample is 80%. The pure technical and the scale efficiency are of almost equal importance in the determination of the overall efficiency. There are differences in the overall efficiency ratios across the three regions stemming mainly from differences in pure technical efficiency. Vlontzos and Soutsas[20] studied the sector of sheep/goat farming through the new regulatory framework that resulted from the new common agricultural policy and its recent review. After recording the current situation in the sector and carrying out a SWOT analysis, it emerged that one of its main weaknesses is its low competitiveness, due to the high production costs in Greece compared to other countries in the EU. Milán *et al.* [21] studied the economic results of Ripollesa breed sheep farms in Spain to establish a typology which would clarify the characteristics of the different types of existing farms. Rezitis *et al.* [22] examined the effect of investment plans both on the efficiency and productivity of a livestock farm. Theoharopoulos *et al.* [12] estimated the cost of use of the production coefficients and determined the technical efficiency of sheep farms. They arrived at the conclusion that technical efficiency and herd size are important factors affecting the Greek sheep farming sector. If technical inefficiencies are eliminated and farm size adjustments occur, there will be benefits for overall agricultural development. Furthermore, the same writers estimated the possibilities of reducing production costs by improving the technical efficiency of holdings, in order to withstand the elimination of subsidies

The above-mentioned studies highlight the fact that the high production costs in Greek sheep farms constitute one of the main, long-term problems affecting the sector, which lead to a reduced technical efficiency and low competitiveness, in relation to other EU countries. We can therefore come to the conclusion that any efforts aiming at the sector's business growth must be combined with a reduction in production costs.

The aim of the present paper was to examine the restructuring and business growth potential of sheep farms in relation to a reduction in their production costs. More specifically, it examines the "internal cohesion" of the factors that put together the overall production costs and how these factors affect cost formulation. In addition, the paper studies the structural relations between the nine basic production cost parameters (depreciation, insurance premiums, maintenance and fixed capital interest, expendable capital expenses, animal food expenses, other expenses, circulating capital interest and family labour). The objective of the paper was to present the discrimination capacity of the cost components.

Materials and Methods

The research data was collected using questionnaires and through personal interviews with the "heads" of the sheep farms during the years 2006-2007. Stratified random sampling was used to determine the sample [23], with the regions of Greece representing the strata being studied. The selected research area was the geographical regions of Thessaly and Central Macedonia (including the Prefectures of Larisa, Trikala, Thessaloniki, Kilkis, Pella and Imathia), regions where a large number of sheep farms are concentrated. The variety of breeding conditions in these regions allows for a generalisation of the research output for the whole country, with no major deviation from reality. The technical-

economic data of this research refer to the period 2007 and were collected using specially structured questionnaires.

The analysis included small, medium and large holdings, in order to have a greater variation of the cost parameters under examination. This is important to note because the cost components refer to a broad and general range of farms belonging to this sector. Therefore, the conclusions will pertain to the sheep farming sector as a whole and not to particular farm size categories. The size of the sample was set at 110 sheep farms.

According to the literature [10, 24-26], the basic factors that shape overall production costs at animal breeding holdings are labour, diet, annual livestock expenses, annual fixed asset expenses (buildings and machinery) and expenses for veterinary medication-vaccinations.

Through the application of principal component analysis, we examined the structural cohesion of the variables that compose the overall production cost, and their importance in its final formulation [27-31]. These variables are represented using non-observable variables-factors, according to the following mathematical formula:

$$F_i = \sum_{j=1}^{p} w_{ij} Z_j = w_{i1} Z_1 + w_{i2} Z_2 + \mathrm{K} + w_{ip} Z_p, \quad (i = 1, ..., m \le p \text{ and } j = 1, ..., p)$$

where w_{ij}'s are the coefficients (or loadings) for factor or component i (F_i) multiplied by the measured value for variable j (Z_j). So, each principal axis is a linear combination of the original measured variables.

Then, using PCA, a score per cost component was calculated for each sheep farm using the regression method [27]. Based on these scores, the sheep farms were grouped into two large clusters by using hierarchical cluster analysis [27-28]. Ward's criterion and the Euclidean distance square were used to form the clusters [27, 28, 32]. The analysis was carried out with the SPSS V. 15.

The MANOVA test was then applied [33, 34], the three cost components were considered to be the dependent variables and cluster membership was the independent variable (2 levels).

Results and Discussion

The goal of this paper was to examine the structural relations between the nine production cost variables. In other words, we are studying the probability of grouping the nine cost variables into cost components, in order to a) present the relative significance of the cost variables for each cost component and b) present the relative significance of the cost components, with the limitation that the cost variables in each component must have a high correlation between them, while the discriminant components must be unrelated, to the best extent possible. For this purpose, principal component analysis (PCA) was applied to the available data, with Varimax axis rotation (rectangular maximum variance rotation), while the significant components were those with an eigenvalue above or equal to 1. The PCA highlighted 3 significant components which explained 79.4% of the total variance. The first component with an eigenvalue of 4.90 explained 54.1% of the total variance. The second component with an eigenvalue of 1.30 explained 14% of the total variance and the third with an eigenvalue of 1.02 explained 11.3% of the total variance. All three components in total explained 79.4% of the total variance.

Based on the figures in Table 2, we observe that the first component is significantly correlated to all the cost parameters, with the exception of family labour expenses. The relative significance of the cost parameters for this component is expressed through the value of the factorial loads presented in Table 2. Furthermore, due to the fact that the first component explains a very high percentage of the total variance (54.1%), it can be characterised as the general cost component. The greatest impact on the determination of the general cost is linked to maintenance and fixed capital depreciation expenses, while the lowest impact is related to circulating capital interest. This is due to the existence of a surplus fixed capital and the fact that the latter is used erroneously [10]. Thus, if, through a better organisation and management of the fixed capital, we manage to limit or reduce the maintenance and depreciation expenses that emerge as the main production cost formulation factors, we will arrive at a reduction of this specific cost. The second and third components appear to be local dimensions of cost, with a high importance, however. More specifically, the second component is mainly structured by the parameters "circulating capital interest" and "animal food expenses". The coefficient with the greatest impact on the determination of this cost component is animal food expenses. This is due to the high cost of cereals, vitamin preparations, the production cost of animal food, and the commitment of a large percentage of the farms' available capital for animal food supplies. Choosing the most suitable and efficient method of food preparation, putting together a well-balanced and economical ration, being aware of the content of animal food as regards nutritious ingredients and their suitability, along with the existence of the appropriate animal food mixing, supply and storage facilities, are all factors that lead to a better valorisation of this component and a reduction of its cost of use [12, 35].

The third component is mainly related to family labour expenses. Family labour is in itself a cost parameter with a significant relative gravity, which changes independently of the cost parameters that shape the other two components. This fact serves to underline the great importance of the production coefficient "labour", particularly in the case of intensive-type farms [9, 16]. A rational valorisation of the "labour" coefficient is expected to lead to a limitation of this cost component and a reduction of the overall production costs.

It should be noted that the parameter "circulating capital interest", that appears both in the composition of the first and second component, has the smallest share in the formulation of the first component (factorial load = 0.51), and the highest in the case of the second component (factorial load = 0.96).

Based on the values of Cronbach's α reliability coefficient, we observe that both the first and second component present a high internal cohesion score. For the first component, the α coefficient is 0.91, and for the second it is 0.85. Both coefficients are above the acceptable limit of 0.70. If we examine the suitability of principal component analysis, the KMO (Kaiser-Meyer-Olkin) measure that is equal to 0.7 (above the acceptable limit of 0.60) and the Bartlett sphericity test, we will observe that Pearson's correlation table between the nine cost parameters, presents a statistically significant difference in relation to the identity matrix (χ^2=1142.74, d.f.=36, p<0.001). Finally, the common factorial variance indicators (communalities) show that the three-component model explains the structure of the nine cost variables to a very satisfactory degree. All the values of the communalities, as quality indicators of the three-component solution, are above 0.60.

Table 1. Production expenses of sheep farms.

Production cost categories (€)	Mean±Std. deviation (€)	Participation rate (%)
Depreciation	3449.2±1207.2	19.45
Insurance premiums	100.1±32.2	0.57
Maintenance	185.1±46.5	1.04
Interest	942.1±329.7	5.31
Expenses for expendable items*	1067.9±309.4	6.03
Animal food	3500.3±876.3	19.74
Other expenses	1623.0±503.1	9.15
Circulating capital interest	131.3±43.2	0.75
Family labour wages	6730.3±2220.9	37.96
Total	17729.3±5496.1	100.00

*including fuel, lubricants, medication, disinfectants etc.

Table 2. Cost production components.

Cost parameter	Cost component			
	C_1	C_2	C_3	Communalities
Maintenance	0.867			0.79
Depreciation	0.814			0.68
Other expenses	0.792			0.75
Interest	0.767			0.78
Expendable capital expenses	0.766			0.75
Animal food		0.962		0.93
Insurance premiums	0.632			
Circulating capital interest	0.510	0.767		0.89
Family labour			0.947	0.90
	α Cronbach = 0.91	α Cronbach = 0.85	*	

* No application.

Table 3. Scores per cost component.

Factor score	C_1	C_2
F_1	-0.141	0.167
F_2	-0.325	0.385
F_3	0.637	-0.756

The values are expressed in z-scores (MO = 0, Std = 1).

Table 2 presents the factorial loads with absolute values above 0.50. For this specific sample size (N = 164), loads that are above or equal to 0.50 are statistically significant at a significance level $\alpha = 0.05$ and a level of strength $\gamma = 0.80$.

Following the application of hierarchical cluster analysis and based on the scores per cost component achieved by the sheep farms in the sample, their grouping into two large clusters was carried out. Sixty farms were placed in the first cluster C_1 and the remaining 50 sheep farms in the sample were placed in the second cluster C_2. The first cluster C_1 includes farms with a composite cost (first component) and a second component a little below the general average, while presenting relatively high scores (above the general average) in the third component. The second cluster C_2 includes farms that present scores a little above the general average on the first two components, but relatively low scores in relation to the third cost component.

The MANOVA test indicated that all three components present a statistically significant difference at a significance level $\alpha = 0.05$ in both farm clusters (Pillais Trace = 0.616, F(3.106)=56.678, p<0.001).

More specifically, the two clusters present a statistically significant difference as regards the first cost component (p = 0.048, R^2 = 0.024), and similarly with the second component (p<0.001, R^2 = 0.0126) and the third component (p<0.001, R^2 = 0.485). The values of the coefficients of determination R^2 express the relative contribution of the corresponding cost components in the formation of the two sheep farm clusters. From the R^2 values, it emerges that the cost component with the greatest contribution is the third one (family labour) (R^2 = 0.485). The differences between the two clusters explain 48.5% of the total variance of the third component.

These results show that the first component, that expresses the general cost, has a non-significant discriminating capacity (R^2 = 0.048) and constitutes a structural tool in the operation of sheep farms, that is most probably a common element for the whole sector and seems to affect all sheep farms to the same extent, regardless of size. The second cost component has the second highest contribution (R^2 = 0.126). The third component is that with a discriminating capacity mainly associated with the wages of the "labour" coefficient. The overall efforts to improve the competitiveness of sheep farming through a reduction of production costs, should aim at a better valorisation of family labour.

Conclusions and Proposals

Sheep farming is one of the most important primary production sectors in Greece and the EU. It provides an income to thousands of agricultural families and also constitutes a major factor for rural development, particularly in mountainous and disadvantaged regions. Despite the improvements noted in recent years, sheep farming in Greece presents major organisational weaknesses, which are undoubtedly linked to the low level of business growth in the sector. These weaknesses result in a reduced competitiveness and a major loss of revenue, in relation to the comparative

advantage of this sector (e.g. establishment of feta as a P.D.O. product). Furthermore, several sheep farms in Greece are considered to be non-viable in the new environment created by the common agricultural policy, as shaped following the decoupling of subsidies from production.

The competitiveness of sheep farming in Greece can be improved either through a further increase in productivity, or by lowering the overall production costs. The present paper examines the potential for restructuring Greek sheep farms, based on a reduction of their production costs. Any efforts regarding the business growth of the sector must be combined with the possibility of reducing production costs. Following the application of principal component analysis (PCA), 3 major production cost components were highlighted, that explain 79.4% of its total variance. If we study the structural relations between the production cost parameters, we can observe both their relative significance and the discriminating capacity of the latter's components. The greatest effect on the formulation of the first cost component (general cost) comes from the maintenance and depreciation expenses for the fixed capital, while the lowest impact is related to the circulating capital interest. Thus, a productive use and rational utilisation of the fixed capital will lead to a reduction of this particular cost component. The second cost component is mainly dependent on the parameters "circulating capital interest" and "animal food expenses". The greatest effect on the formulation of this cost component is owed to animal food expenses. In this way, limiting the amount or reducing the cost of animal food, which is viewed as the major factor affecting this specific cost component, will lead to a reduction of the latter. What is recommended is a rational use and quality improvement of the animal food being used. Selecting the most suitable and most efficient method of animal food preparation, the elaboration of a well-balanced and economic ration, knowledge of the content of animal food as regards nutritious ingredients and their suitability, along with the existence of satisfactory animal food mixing, supply and storage facilities, are expected to lead to a better valorisation of this component, that will result in a reduction to its cost of use.

Family labour is a cost factor in itself, with a significant relative gravity, which changes independently of the cost parameters that affect the other two components. A rational valorisation of family labour, mechanising production (e.g. installation of milking systems), a modernisation of the facilities for ergonomic purposes, are some of the measures that are expected to lead to a reduction of this cost component.

Following the application of hierarchical cluster analysis and based on the scores per cost component, the sheep farms in the sample can be grouped into two clusters. According to the values of the coefficients of determination R^2, we found the relative contribution of the cost components to the formation of the two clusters. It is obvious that the third component (family labour) is the one with a discriminating capacity for all farms and a reduction of labour wages is a necessity in every case. Improving the effectiveness of labour is expected to lead to a better valorisation of the latter, and consequently to a reduction in the cost of its use. This can be achieved by a) a full and not only partial valorisation of family labour and b) by increasing the mechanisation rate per employee.

Specifically, an increase in nutrition factor relates to the rational use and quality improvement of used animal feed, as animal feed constitutes the most important factor in the formulation of the production cost. Selecting the most appropriate and effective way of producing feed, enforcing a well-balanced and inexpensive feeding ratio, knowledge of animal feed contents in nutritious ingredients and their suitability as well as efficient mixing, feeding and storage facilities of animal feed lead to the optimum exploitation of this factor.

Building facilities, machinery, especially for producing animal feed, are considered to be old-fashioned in contemporary Greek sheep farms. Hence, modernization of sheep farms is imperative, a modernization which will lead to productivity increase, and consequently to cost decrease of this factor. So, it is essential to absorb EU allocations granted for this cause, as well as financing the relocation and modernization of sheep farms using national financial resources.

References

[1]EU 2008. Statistical Report EU Cattle, Pigs, Sheep and Goats: Monthly Slaughter Statistics to March 2008. Issue No. 28/2008.

[2]EUROSTAT 2007. Agricultural Statistics - Main results: 2006-2007, in http://epp.eurostat.ec.europa.eu/portal.

[3]Ministry of Rural Development and Food 2006. Report on Sheep Farming. Athens.

[4]NSSG 2007. Agricultural Statistics of Greece, 2000-08.

[5]Chatziminaoglou, I. 2001. Sheeps and Goats in Greece and the World. Gahoudi-Giapouli, Greece.

[6]Apostolopoulos, K. and Gidarakou, I. 1991. A study of the structural and economic characteristics of sheep farms through the application of statistical methods of multivariate data analysis. Spoudai **41**(3): 327-368.

[7]Hadjigeorgiou, I., Vallerand, F., Tsimpoukas, K. and Zervas, G. 1999. The socio-economics of sheep and goat farming in Greece, and the implications for future rural development. Proceedings of the 2nd International Conference "Livestock Production in the European LFA's", December 1998, Bray, Ireland.

[8]Karagiannis, G. and Tzouvelekas, V. 2005. Explaining output growth with a heteroscedastic non-neutral production frontier: The case of sheep farms in Greece European Review of Agricultural Economics **32**(1):51-74.

[9]Zioganas, C., Kitsopanidis, G., Papanagiotou, E. and Kanteres, N 2001 Comparative technical-economic analysis of sheep and goat farming per geographical region of Greece. Aristotle University of Thessaloniki.

[10]Kitsopanidis, G. 2006. Animal Production Economics. Principles-Applications-Technical-Economic Analysis. Zitis Publications, Thessaloniki.

[11]Theocharopoulos, A., Papanagiotou, E. and Melfou, K. 2006. Impacts of decoupling on sheep/goat sector in Greece. Proceedings of 93rd EAAE seminar: Impacts of Decoupling and Cross Compliance on Agriculture in the Enlarged EU. Prague, 22-23, 9, 2006. Czech University of Agriculture.

[12]Theocharopoulos, A., Melfou, K. and Papanagiotou, E. 2007. A microeconomic approach for agricultural development: A DEA application to Greek sheep farms. New Medit - Mediterranean Journal of Economics, Agriculture and Environment **6**(4):48-54.

[13]Theocharopoulos, A., Melfou, K. and Papanagiotou, A. 2007. CAP financial support and efficiency driving economic development. Proceedings of the 3rd International Conference of Rural Development, Section: Agricultural Business Management. 8-10 November, Lithuania, pp. 293-299.

[14]Rosati, A. and Aumaitre, A. 2004. Organic dairy farming in Europe Livestock Production Science **90**(1):41-51.

[15]Rancourt, M., Fois, N., Lavín, M.P., Tchakérian, E. and Vallerand, F. 2006. Mediterranean sheep and goats production: An uncertain future. Small Ruminant Research **62**(3):167-179.

[16]Zioganas, Ch., Kazakopoulos, L. and Koutsotolis, K. 1994. Structure and viability of sheep farming in relation to socioeconomic stability in Pogoni area of Epirus, Greece. Proceedings of an International Symposium organized by HSAP and EAAP, June 18-20, Thessaloniki, Greece. EAAP Publication **83**:33-46.
[17]Tzouvelekas, E., Andreakos, I., Mattas, K., Fotopoulos, X. and Papanagiotou, E. 1996. Relative efficiency of sheep farms in Greece. Proceeding of 3rd Greek Congress of Agricultural Economy, Papazisi Publishers, Athens, pp. 244-254.
[18]Karagianis, G. and Galanopoulos, K. 2000. Analysis of the impacts of milk qualitative features on the technical efficiency of sheep farms in the region of Epirus. Proceedings of 6th Greek Congress of Agricultural Economy, Thessaloniki, pp. 563-574.
[19]Fousekis, P., Spathis, P. and Tsimboukas, K.2001. Assessing the efficiency of sheep farming in mountainous areas of Greece. A non parametric approach. Agricultural Economic Review **2**(2):5-14.
[20]Vlontzos, G. and Soutsas, K. 2004. The strategic development framework in goat and sheep farming. Series of Research Papers, University of Thessaly **10**(14):359-374.
[21]Milán, M., Arnalte, E. and Caja, G. 2003. Economic profitability and typology of Ripollesa breed sheep farms in Spain. Small Ruminant Research **49**(1):97-105.
[22]Rezitis, A., Tsimboukas, K. and Tsoukalas S. 2005. Efficiency and productivity of livestock farms after the implementation of improvement projects. Proceedings of 8th Greek Congress of Agricultural Economics, Agrotypos Publishers, Thessaloniki, pp. 90-102.
[23]Siardos, G. 2005. Methodology of Sociological Research. Zitis Publications.
[24]Doll, J. and Oragen, F. 1984. Production Economic. John Wiley and Sons, New York.
[25]Damianos, D. and Skuras, D. 1996. Farm business and the development of alternative farm enterprises: An empirical analysis in Greece.Journal of Rural Studies **12**(3):273-283.
[26]Aggelopoulos, S. 2007. Productive cost analysis and evaluation of cost return models of pig farms in Greece. New Medit. **3**:54-59.
[27]Hair, J., Anderson, R., Tatham, R. and Black, W. 1995. Multivariate Data Analysis with Readings. 4th edn. Prentice-Hall International, Inc., USA.
[28]Sharma, S. 1996. Applied Multivariate Techniques. John Wiley and Sons, Inc. Publications, New York, Thessaloniki.
[29]Cattell, R.B. 1978. Factor Analysis: An Introduction and Manual for the Psychologist and Social Scientist. Greenwood Press, Westrop, Connecticut.
[30]Dunteman, G.H.1989. Principal Components Analysis. In Quantitative Applications in the Social Sciences. Sage University Papers, London.
[31]Tabakis, N. 2001. Investigating the occupational adjustment determinants: A factor analysis approach. Scientific Applied Research Annual **VI**(1):139-152.
[32]Ward, J. 1963. Hierarchical grouping to optimize an objective function. Journal of the American Statistical Association **58**(301):236-244.
[33]Tsantas, N., Moysiadis, H., Bagiatis, N. and Hatzipantelis, Th. 1999. Data Analysis using Statistical Packages. Zitis Publications, Thessaloniki.
[34]Huberty, C. and Olejnik, S. 2006. Applied MANOVA and Discriminant Analysis. 2nd edn. Wiley Publication.
[35]Aggelopoulos, S., Pauloudi, A., Karipidis, P. and Mitsopoulos, I. 2006. Suggestions for reformation and financing programs in pig holdings based on the type of nutrition. Journal of Food, Agriculture & Environment **5**(2):355-358.