Economics of goat farming in Greece

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Abstract

This paper presents a technical and economic analysis of four goat breeds (Zaanen, Alpin, Skopelos, Indigenous to Macedonia), based on average milk and kid production per goat per year. The comparative economic analysis of the four goat breeds, without subsidies, shows that the Zaanen goats (625 Kg of milk production and 1.72 kids weaned per goat per year) and the Alpin goats (580 Kg of milk production and 1.74 kids weaned per goat per year) generate a high profit and a high farm income, followed by the Skopelos goats which yield a good profit and a good farm income. On the other hand, the result of rearing the Indigenous goats of Macedonia (134 Kg of milk production and 1.14 kids weaned per goat per year) is negative or very poor. The comparative analysis of the four goat breeds, including subsidies, highlights an increase in the farm income of about 16.8% for the Zaanen, Alpin and Skopelos goats, and of 50.8% for the Indigenous goats of Macedonia. Finally, the productivity analysis of the farm resources used in goat farming indicates the need for a more appropriate organization of labour, the use of more concentrates instead of forages and a better exploitation of the pasture available. In the light of these results, it may be concluded that the viability and the competitiveness of the Zaanen and Alpin goats is ensured. The same holds true for the Skopelos goats. Conversely, the viability of the indigenous goats of Macedonia, which are reared in the mountainous and less developed regions, is mainly achieved through subsidies and the use of low-cost pasture.

Résumé

Ce travail présente une analyse technique et économique de quatre races de chèvres (Zaanen, Alpin, Skopelos, Indigène de Macédoine), axée sur la production moyenne de lait et de chevreaux par chèvre par an. L'analyse économique comparative des quatre races de chèvres, en l'absence de subventions, a fait ressortir que les chèvres Zaanen (625 Kg de production de lait et 1,72 chevreaux sevrés par chèvre par an) et les chèvres Alpin (580 Kg de production de lait et 1,74 chevreaux sevrés par chèvre par an) réalisent un profit et un revenu d'exploitation élevés, suivies par les chèvres Skopelos qui elles assurent un profit et un revenu d'exploitation moyens. En contrepartie, l'élevage des chèvres indigènes de Macédoine (134 Kg de production de lait et 1,14 chevreaux sevrés par chèvre par an) a donné des résultats négatifs ou très peu satisfaisants. L'analyse comparative des quatre races de chèvres, incluant les subventions, montre une augmentation du revenu de l'exploitation d'environ 16,8% pour les chèvres Zaanen, Alpin and Skopelos, et de 50,8% pour les chèvres indigènes de Macédoine. Enfin, l'analyse de la productivité des ressources de l'exploitation utilisées dans l'élevage des chèvres met en évidence la nécessité de mieux organiser le travail, d'employer plus de concentrés au lieu du fourrage et d'exploiter plus correctement le pâturage disponible. A la lumière de ces résultats, on en conclut que les chèvres Zaanen et Alpin sont rentables et compétitives. Il en va de même pour les chèvres Skopelos. En revanche, les chèvres indigènes de Macédoine, qui se trouvent dans les régions montagneuses et moins développées, ne sont viables que grâce aux subventions et à l'utilisation du pâturage à faible coût.

1. Introduction

There is no doubt that goat farming is a basic branch of our livestock production because it contributes by about 17% to the total gross return of our livestock economy and occupies the first position (45.7%) in the European Union as regards the total goat population. Although goat farming does not face, at least directly, strong competition from other countries of the European Union, its viability and even more its competitiveness are not ensured, as demonstrated by the following comparative economic analysis of four goat breeds reared in Greece.

The physical and economic data used in this analysis are provided by two Centers of Genetic Improvement of Animals and by 35 goat farms located in Central and Northern Greece. Milk production and kids weaned represent an average of a five-year period (1996-2000), while the rest of the physical and all economic data refer to the period 1999-2000. Indeed, the milk production and the kids weaned per goat per year derive from the aforementioned Centers, whereas the physical and economic data of the 35 goat farms for the four goat breeds have been collected by using records and accounts. Considering these goat breeds in the production systems, it can roughly be said that the Zaanen and Alpin goats represent the intensive production system, the Skopelos goats the semi-intensive production system and the Indigenous goats of Macedonia the extensive production system. This comparative technical and economic analysis is intended to identify the strong and weak points of each goat breed and to illustrate the appropriate decisions which should be made by goat farms to become not simply viable but also competitive.

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2. Physical and economic data of the four goat breeds

2.1. Physical and economic data referring to livestock, buildings and equipment concerning four goat breeds

Table 1 reports the data which have to be taken into account before starting the analysis of each goat breed. These data refer to the value of buildings and equipment, the value of goats and bucks as productive animals and as slaughtered animals, their productive life and the number of goats per buck. All these physical and economic data make up the basis to estimate the annual expenses (depreciation, mortality, maintenance, insurance, interest) of livestock, buildings and equipment. The data show that there is a great difference between the most productive and the least productive goat breeds. An exception is the value of goats and bucks of the Skopelos breed, since this breed is the most productive domestic one and this explains the great demand for these animals.

Table 1. *Physical and economic data referring to livestock, buildings and equipment of goat farms*

Physical and economic data	Goat breeds			
	Zaanen	Alpin	Skopelos	Indigenous
1. Value of buildings and equipment (drs goat)	144,000	137,000	40,000	24,000
2. Value of a goat as a productive animal (drs)	60,000	60,000	60,000	30,000
3. Value of a goat as slaughtered animal (")	20,000	20,000	20,000	14,000
4. Value of a buck as a productive animal (")	80,000	80,000	80,000	45,000
5. Value of a buck as slaughtered animal (")	30,000	30,000	30,000	25,000
6. Productive life of a goat in years	6	6	8	8
7. Productive life of a buck in years	4	4	4	5
8. Goats per buck (number)	13	13	14	14

340.75 drs= 1€

Table 2. *Physical and economic data of reproduction and production of goats*

Reproduction and production data	Goat breeds			
	Zaanen	Alpin	Skopelos	Indigenous
1. Milk production (Kg/goat/year)	625	580	292	134
2. Milk price (drs/Kg)	140	150	200	170
3. Kids weaned per goat per year (no)	1.72	1.74	1.37	1.14
4. Value of a kid at weaning (drs)	15,000	15,000	15,000	15,000
5. Labour required (hours/goat/year)	20	18	15	13
6. Labour wages (drs/hour)	750	750	750	750
7. Concentrates mixture (Kg/goat/year)	433	436	345	201
8. Alfalfa (Kg/goat/year)	271	211	90	43
9. Straw (Kg/goat/year)	121	97	5	-
10. Price of concentrates (drs/Kg)	63.0	65.5	75.6	68.0
11. Price of alfalfa (drs/Kg)	57.0	55.3	66.2	58.0
12. Price of straw (drs/Kg)	15.0	15.0	20.0	-
13. Value of meadow, pasture, etc. (drs/goat)	4,227	4,308	1,390	830

2.2 Physical and economic data referring to reproduction and production of each of the four goat breeds

Table 2 illustrates the physical and economic data which can be considered the technical and economic coefficients upon which the analysis of the goat farm relies. Some of these data are related to the estimation of gross return, some others to the corresponding production costs. The first set of data include the milk yield in Kg, the number of kids weaned and their prices. Indeed, the Zaanen goats produce up to 625 Kg of marketable milk and 1.72 kids, followed by the Alpin goats (580 Kg of marketable milk and 1.74 kids), the Skopelos goats (292 Kg of marketable milk and 1.37 kids) and the Indigenous goats of Macedonia (134 Kg of marketable milk and 1.14 kids). The price of milk produced by the Skopelos and Indigenous goats is higher than that of the milk produced by the Zaanen and Alpin goats because the milk of the two first goat breeds is rich in total solids and particularly, in fats, compared with the two other goat breeds. As a matter of fact, it has been demonstrated that the higher the level of milk production the lower the proportion of total solids, especially fats. Conversely, the total value of each kid weaned is about the same in all goat breeds. The second set of data comprise the labour needed (from 13 to 20 hours/goat), the labour wages (750 drs/hour), the feed required (from 201 to 436 Kg concentrates and from 43 to 271 Kg alfalfa) and the feed price (from 63.0 to 75.6 drs/kg for concentrates and from 55.3 to 66.2 drs/Kg for alfalfa). The difference in the price of concentrates and alfalfa among the four goat breeds is due to the distance of the farms, of each goat breed, from the factories producing concentrates and the regions producing alfalfa. On the other hand, the difference in the cost of meadow and pasture (from 830 to 4,308 drs/goat) is based on the requirements of goats for each breed.

3. Economic analysis of the four goat breeds

3.1. Returns, costs, profits and incomes per goat without subsidies

The contribution of the milk value to the gross return of a goat increases, according to milk yield, from 57.1 to 77.2%, whereas the value of kids decreases from 42.9 to 22.8% because the milk yield increases more rapidly than the body weight of the kids weaned (table 3). Among all various kinds of expenses, the most important one is feed (from 41.5 to 51.1%), followed by annual expenses for livestock, buildings, equipment, etc. (from 29.7 to 36.3%) and labour (from 13.8 to 23.9%). Of utmost importance is the high contribution of the total interest (from 14.3 to

Table 3. *Returns, costs, profits and incomes per goat without subsidies*

Returns, costs, profits and incomes	Goat breeds			
	Zaanen	Alpin	Skopelos	Indigenous
I. Gross return per goat per year				
1. Value of milk production (%)	77.2	76.9	74.0	57.1
2. Value of kids at weaning (")	22.8	23.1	26.0	42.9
Total (drs/goat)	113,300	113,100	78,950	39,880
II. Production costs per goat per year				
1. Labour wages (%)	13.8	14.7	15.4	23.9
2. Feed (")	51.1	43.7	45.9	41.5
3. Depreciation, mortality, repairs, insurance of livestock, buildings, equipment etc. (")	15.5	18.8	18.1	15.4
4. Total interest of livestock, buildings, equipment and variable capital (")	15.3	17.5	14.6	14.3
5. Veterinary, fuel, water, etc. (")	4.3	5.3	6.0	4.9
Total (drs/goat)	106,193	101,306	72,970	40,837
III. Kinds of production costs				
1. Fixed costs (%)	70.6	69.6	74.9	74.1
2. Variable costs (")	29.4	30.4	25.1	25.9
IV. Profit or loss (drs/goat)	7,107	11,794	5,980	-957
V. Farm income (")	38,352	42,983	27,875	14,648
VI. Return on capital and interest rate				
1. Return on capital (%)	16.1	19.9	19.7	10.4
2. Average interest rate (")	11.2	11.9	12.6	12.4
3. Ratio of 1 to 2	1.44	1.67	1.56	0.84

17.5%) to the production costs, due to the high interest rate of long- (11%) and short- term (12%) loans in Greece. On the other hand, the high contribution to the total costs of the fixed costs (69.6-74.9%, average 72.3%) in relation to variable costs (25.1-30.4%, average 27.7%) shows the need for a more intensive exploitation of this livestock production. The profit increases from 5,980 to 11,794 drs/goat/year by increasing milk production from 300 to 600 Kg/goat/year. However, the profit is negative (-957 drs/goat/year) when the milk production per goat per year is under 150 Kg (in this case, 134 Kg). The profit or loss has a positive or negative effect on the farm income (from 14648 to 42983 drs/goat/year) as well as on the return on capital (from 10.4 to 19.9%). This one compared with the average interest rate shows that the capital invested in goat farming yields a good return when the milk production per goat is over 250 Kg (1.44, 1.56 and 1.67 for the first three goat breeds) and a low return when the milk production per goat is below 150 Kg (0.84 for the fourth goat breed).

3.2. Returns, costs, profits and incomes per goat including subsidies

Table 3 shows that the gross return of a goat covers its production costs and generates profit in all goat breeds except for the fourth breed. In table 4, the gross return of a goat includes subsidies which contribute to its total amount from 4.6 to 15.7%, as the milk production decreases. This may be attributed to the great difference of the gross return with and without subsidies, rather than to the subsidies farmers are granted for each goat breed. The subsidies prove to be of great significance for all goat breeds, but even more for the fourth goat breed since the loss (957 drs/goat) turns into profit (6,486 drs/goat).

Table 4. *Returns, costs, profits and incomes per goat including subsidies*

Returns, costs, profits, incomes	Goat breeds			
	Zaanen	Alpin	Skopelos	Indigenous
I. Gross return per goat per year				
1. Value of milk and kid production (%)	95.4	95.4	91.4	84.3
2. Subsidies (")	4.6	4.6	8.6	15.7
Total (drs/goat/year)	118,756	118,556	86,393	47,323
II. Production costs (")	106,193	101,306	72,970	40,837
III. Profits (")	12,563	17,250	13,423	6,486
IV. Farm income (")	43,808	48,439	35,318	22,091

Based on the farm income as reported in tables 4 and 3, it appears that subsidies have a significant effect not only on the viability but also on the competitiveness of goat farming in Greece, regardless of the goat breed. Indeed, the farm income increases from 12.7 to 50.8% accor-

ding to the goat breed. The improvement of the farm income for the third goat breed, and even more for the fourth goat breed, which are reared in the mountainous and less developed areas, is particularly important in order to maintain this production system of goat farms.

Table 5. *Milk yield, milk price and gross value per goat with and without probability of achieving them and decision-making*

Average milk yield in kg per goat per class of milk production	Number of goats and % per class of milk production	Milk price (drs/kg)	Probability of achieving each milk price per class of milk production	Gross value from each class of milk production and the corresponding prices without probabilities (drs/goat)	Probability of achieving gross value of each class of milk production and the corresponding prices per goat	Contribution of gross value of each class of milk production and the corresponding price to total gross value
<150	2970	155	37.4	20,770	17.6	3,656
(134)	(47.0)	180	62.6	24,120	29.4	7,091
150-500	2410	200	75.7	58,400	28.9	16,878
(292)	(38.2)	250	24.3	73,000	9.3	6,789
>500	935	140	57.2	84,840	8.5	7,211
(606)	(14.8)	150	42.8	90,900	6.3	5,727
Number of goats 6,315				58,672	100.0	47,352

3.3. Probabilities of achieving gross value of milk estimated and decision-making

Of the total number of 6,315 goats studied, 47.0% achieve milk yield under 150 Kg, 38.2% between 150 and 500 Kg and 14.8% over 500 Kg (table 5). Table 5 also outlines the fluctuations of milk price in each class of milk production, the probability of reaching this price, the gross value corresponding to this yield and price, and the contribution of each class of milk production to the gross value achieved in actual practice. By applying the decision tree analysis to average goat farming, it may be inferred that the gross value achieved in actual practice is 19.3% lower than that estimated by multiplying milk production by milk price, without taking into account the fluctuations of the milk yield and its price. Consequently, through the decision tree analysis, we can estimate the probability of achieving each amount of gross value and make the appropriate decision.

4. Productivity analysis of goat farms

The productivity of the factors used in milk and kid production and that of the two main kinds of feed (concentrates and forages) are of special importance from an economic point of view, because they may help solving some problems in goat farming. These problems refer: a) to the contribution of each production factor to the gross return achieved, b) to the marginal productivity of the resources used in relation to their opportunity costs, and c) to the marginal rate of substitution of concentrates by forages and vice-versa, to obtain the same milk and kid production at the lowest feeding costs.

The data used were analysed by applying the well-known Cobb-Douglas production function whose general equation is the following:

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} \ldots X_v^{b_v}$$

4.1. Marginal value products of resources used and their opportunity costs

The three farm resources included in the above production function are: a) Goats (depreciation and mortality of goats and bucks in drs/goat), b) Labour wages in drs/hour and c) Feed in drs/drs. The gross return generated is also expressed in drs/goat. The data were analysed as a whole and not per goat breed because, in actual practice, the analysis of a small number of goat farms, using this production function, is unfavourably affected, and it usually leads to unrealistic solutions. The sum of production elasticities (1.019) shows that there is a quite constant ratio of input to output, that is to say when the former doubles the latter doubles as well. On the other hand, the coefficient of multiple determination (0.921) indicates that the variation in the gross return achieved depends, by 92.1%, on the variation of the three farm resources used (table 6).

The marginal value product of goats is higher (17,341 drs/goat) than their opportunity costs (10,166 drs/goat), as demonstrated by comparing marginal return to opportunity cost ratio (1.706). This means that it is profitable to keep goats of high potential milk and kid production because their productivity covers their opportunity costs.

The marginal value product of labour, amounting to 408 drs per hour, is lower than labour wages (750 drs/hour), as it is shown by its ratio to opportunity costs (0.544). The low marginal productivity of labour is due to the slightly efficient organization of labour in goat farming and to the intensive employment of labour compared with the two other resources. In Greece, the labour employed in goat farming and generally, in livestock farming, is mainly based on foreign workers whose productivity is low.

The marginal value product of feed, amounting to 1.827 drs/drs, is higher than its opportunity costs, estimated at 1.06 drs/drs. This is confirmed by comparing marginal return to opportunity costs ratio (1.724). This means that

goats, yielding 283.2 Kg of milk and 1.315 kids per goat per year, can profitably utilize feed in larger amounts or at a higher cost than that used. However, the feed needed to generate the maximum total profit depends on the capacity of each goat breed, on the price or costs to produce feedingstuffs and on the milk and kid price.

Table 6. *Marginal productivity analysis of resources used in goat farming*

Number of goat farms		35
Period in years 1999-2000		1
Y= Gross return		
X_1= Goats	b_1=	0.240[b]
X_2= Labour	b_2=	0.083[c]
X_3= Feed	b_3=	0.696[a]
	Sum of b's	1.019
R^2		0.921
Marginal value products		
Goats (drs/goat including value of buck)		17,341
Labour (drs/hour)		408
Feed (drs/drs)		1.827
Opportunity costs		
Goats (drs/goat including value of buck)		10,166
Labour (drs/hour)		750
Feed (drs/drs)		1.06
Marginal return on opportunity cost ratio		
Goats		1.706
Labour		0.544
Feed		1.724

Probability level for t's
a) 0.001>P>0.000- b) 0.056>P>0.001 - c) 0.561>P>0.100

On these grounds, the maximum total profits may be yielded by increasing feed up to the level at which the cost of the last unit of feed supplied (marginal cost) is equal to the value of the additional amount of milk produced (marginal value product), with the same level of labour, buildings and equipment used.

The reliability of marginal productivity of farm resources is confirmed by the fact that most production elasticities were found statistically significant at 0.001 and 0.5 percent level of probability.

4.2. Marginal value products of concentrates and forages and marginal rate of substitution between them to achieve the least-cost ration

The feed supplied is divided into two main kinds, i.e. concentrates and forages. Both kinds of feed are given in Kg by converting meadow and pasture into physical units and dividing their total value in drs by the average price per Kg of alfalfa. The marginal value product of concentrates, amounting to 173.9 drs/Kg or to 2.32 drs/drs, is higher than that of forages, equalling 70.2 drs./Kg or 1.12 drs/drs. This explains why the former increases while the latter decreases to achieve a more economical ration. Indeed, the existing combination of these two kinds of feed in the actual ration is not the most profitable one, since it does not lead to a least-cost ration to produce the same amount of milk and number of kids. This is achieved by estimating the marginal rate of substitution of forages by concentrates. The general equation of the marginal rate of substitution is the following:

$$dX_2 / dX_1 = b_1 X_2 / b_2 X_1$$

which shows the amount of feed X_2 (forages) saved by supplying one additional unit of feed X_1 (concentrates) to produce the same amount of milk and number of kids. The marginal rate of substitution leads to a decrease in the total feeding costs per goat. However, the least-cost ration is achieved when this rate of substitution is equal to 1 drs/drs. As a matter of fact, the marginal rate of substitution decreases progressively when feed X_1 increases and X_2 decreases. The total amount of X_2, which corresponds to a certain amount of feed X_1, is estimated by the following equation:

$$X_2 = [\frac{Y}{aX_1^{b_1}}]^{1/b_2}$$

The marginal rate of substitution becomes 1 drs/drs when 310.5 Kg of concentrates and 60.0 Kg of forages are the total amount of feed for a goat producing 283.2 Kg milk and 1.315 kids.

At this level of milk and kid production and feedingstuffs, the lowest possible feeding cost is achieved, namely 25,485 drs/goat instead of 27,483 drs./goat, or 7.27% lower (table 7).

The reliability of the marginal productivity of concentrates and forages is confirmed by the fact that production elasticities were found statistically significant at 0.001 and 0.002 percent level of probability. These results highlight the need for decreasing the amount of forages, the production costs or the purchase price. This holds true especially for meadow and pasture insofar as the former is related to goat breeds of high milk and kid production, while the latter to goat breeds reared in the mountainous and less developed areas.

Table 7. *Marginal rate of substitution between concentrates and forages to produce the same quantity of milk (283,2 Kg/goat) and the same numbers of kids weaned (1.315/goat)*

Concentrates in Kg per goat including buck	Forages in Kg per goat including buck	Average marginal rate of substitution forages by concentrates		Total cost of feeding in drs per goat
		in Kg	in drs.	
290.0	118.0	2.480	2.086	27,483
295.0	81.6	1.686	1.419	25,674
300.0	74.2	1.507	1.268	25,588
305.0	67.1	1.341	1.128	25,519
310.0	60.7	1.193	1.004	25,492
310.5	60.0	1.188	1.000	25,485
311.0	59.6	1.168	0.983	25,497

5. Conclusions

This paper presents a technical and economic analysis of four goat breeds based on average milk and kid production per each goat per year. The analysis, without subsidies, shows that the Zaanen and Alpin goats generate high profits, (7,107 and 11,704 drs/goat, respectively) and a high farm income (38,352 and 42,983 drs/goat, respectively), followed by the Skopelos goats which yield a good profit (5,980 drs/goat) and a good farm income (27,875 drs/goat). Conversely, the result of rearing the indigenous goats of Macedonia is negative (loss 957 drs/goat) or very poor (farm income 14,648 drs/goat). The profit or loss affects positively or negatively the return on the capital invested in goat farming in relation to interest (1.44, 1.67, 1.56 and 0.84 for the above-mentioned four goat breeds, respectively). The fact that 69.6 -74.9% of the total production cost of a goat is fixed makes it necessary to intensify this livestock production. The analysis of the four goat breeds, including subsidies, highlights the increase in the farm income of 14.3, 12.7, 26.7 and 50.8% for the four goat breeds, respectively. The decision tree analysis demonstrates that the gross value of milk achieved in actual practice is 19.3% lower than that estimated by multiplying milk production and its price without probability. Finally, the productivity analysis of the farm resources used in goat farming indicates the need for a more appropriate organization of the labour, the use of larger amounts of concentrates instead of forages and a sounder exploitation of the meadow and pasture available.

Therefore, it may be concluded that the viability, without subsidies, and the competitiveness, with subsidies, for the Zaanen, Alpin and Skopelos goats are ensured, whilst the viability of the Indigenous goats of Macedonia is achieved mainly through subsidies and the use of low-cost pasture.

References

Centers of Genetic Improvement of Animals (1996-2000) "Data of milk and kid production of four goat breeds".

Kitsopanidis, G., et al. (1986 and 1990) "Economics and Productivity of various branches of livestock production in the most important farming regions in Greece". Department of Agricultural Economics, University of Thessaloniki, Greece.

Kitsopanidis, G. (1988) "Factors affecting the production of abundant and low-cost milk from sheep and goat farms", Animal Science Review, Special Edition No. 5 p.41-50.

Heady, E. and J. Dillon (1961) "Agricultural Production Functions", Iowa State University Press.

Hold, J. and K. Anderson (1978) "Teaching Decision-Making under risk and uncertainty to farmers", American Journal of Agricultural Economics, Vol. 60 No. 2 p. 249.

Papanagiotou, E., (1987) "Economics and Productivity of Goat Farming", Department of Agricultural Economics, University of Thessaloniki.

Rogdakis, E. et al. (1996) "Skopelos milk goat: Morphological characteristics and productivity", Animal Science Review, Issue 220, p. 26-35.

Zygoyiannis, D. and N. Katsaounis (1986) "Milk yield and milk composition of indigenous goats in Greece", Animal Production, vol. 42, p. 365-374.