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Comparative technical and economic analysis of a local sheep breed in Greece and North Macedonia

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Abstract. The development of the sheep sector resulted in the transition from traditional extensive systems to intensive, where local breeds have been gradually replaced by imported improved ones or extensive crossbreeding has taken place. This has been the case in Greece as well as North Macedonia, where cross-breeding between local breeds has also been extensive. This study examines the economic performance of the production systems of the local "Pelagonia" sheep breed - which can be found in the cross-border area of the two countries but is actually witnessing declining populations. The results of a descriptive technical and economic analysis demonstrated that the extensive Pelagonia production systems are more profitable than the intensive - despite lower milk yields– mainly due to significant savings in feeding costs. In addition, it showed that the economic results of the Greek extensive group were better than those of the average Pelagonia farm in North Macedonia. However, a different outcome is yielded when subsidies are not taken into account, as the economic results of the average Pelagonia farm in North Macedonia were more satisfactory than those of the Greek extensive group, indicating that the Greek Pelagonia farms highly rely on income support. The results of the technical and economic analysis are an essential step toward the definition of the framework within which Pelagonia sheep farms will be incorporated towards the emergence of sustainable production systems in both countries.

Keywords. Pelagonia sheep breed - Pasture - Technical and economic indicators - Livestock production systems.

Analyse technico-économique comparative d'une race ovine locale en Grèce et en Macédoine du Nord

Résumé. *Le développement de la production ovine a entraîné le passage des systèmes extensifs traditionnels vers des formes intensives, où les races locales ont été progressivement remplacées par des races importées ou des croisements ont eu lieu. Cela a été le cas en Grèce ainsi qu'en Macédoine du Nord, où les croisements entre races locales ont également été étendus. Cette étude examine les performances économiques des systèmes de production de la race ovine locale « Pelagonia » - qui se trouve dans la zone transfrontalière des deux pays mais connaît en réalité un déclin des populations. Les résultats d'une analyse technico-économique descriptive ont démontré que les systèmes de production extensifs de Pelagonia sont plus rentables que les systèmes intensifs - malgré la production de lait soit plus faible - principalement en raison d'importantes économies sur les coûts d'alimentation. En outre, il a montré que les résultats économiques du groupe extensif grec étaient meilleurs que ceux de la ferme Pelagonia moyenne en Macédoine du Nord. Cependant, un résultat différent est conclu quand les subventions ne sont pas prises en compte, car les résultats économiques de la Macédoine du Nord étaient plus satisfaisants que ceux du groupe extensif grec, indiquant que les fermes Pelagonia grecques dépendent fortement des subventions. Les résultats de l'analyse technico-économique sont une étape essentielle vers la définition du cadre dans lequel les élevages ovins Pelagonia seront intégrés vers des systèmes de production durables dans les deux pays.*

Mots-clés. *Race ovine Pelagonia - Pâturage - Indicateurs techniques et économiques - Systèmes de production animale.*

I - Introduction

In recent years, the development of the Greek sheep sector has been based on a transition from traditional extensive systems to intensive ones (Ragkos *et al.*, 2017). Most of the farms adopted a new capital-intensive business model (e.g. novel technologies in farm management, larger buildings), which also brought the introduction of imported sheep breeds (e.g. Lacaune, Friesland, Assaf, Awassi etc.) with high milk production capacity (Ragkos *et al.*, 2015). This trend combined with the absence of integrated breeding programs and the unplanned crossbreeding resulted in the gradual replacement of Local Sheep Breeds (LSB) by imported ones (Ragkos *et al.*, 2017). Their low milk yields - compared to the imported improved ones - constitute the main reason that led to the reduction of their populations and to the underestimation of their Total Economic Value. In particular, apart from their important functional traits (e.g. resistance to diseases and adaptability to specific local conditions), LSB are able to formulate multifunctional production systems in marginal areas, as they produce a wide range of services (e.g. climate change mitigation, protection of cultural heritage, maintenance of rural livelihoods) jointly with the provision of food (milk, meat, dairy products etc.) (Ragkos *et al.*, 2017).

According to the Ministry of Rural Development and Food (2018), there are 18 recognized LSB in Greece, many of which are nowadays threatened with extinction - to a greater or lower extent – or are already extinct. Among the breeds that are vulnerable to extinction is also the “Pelagonia” sheep breed, known also in Greece as Florina-Pelagonia or Florina breed. The current population of this breed in Greece is estimated at 1,800 heads, which are reared in ten farms, two of which are experimental farms (University of Western Macedonia and Research Institute of Animal Science in Giannitsa - Zaralis & Theodoridis, 2021). Pelagonia sheep have been reared for centuries in the area of Western Macedonia. On the other hand, in the Pelagonia region of North Macedonia, there are currently reared 5,409 sheep of the autochthonous Pramenka breed - a sheep very similar to Florina breed - most of which (4,547) are reared in the Municipality of Resen (Dodovski & Sdraveski, 2021).

Based on its productive characteristics, “Pelagonia” is a "dual-purpose" breed due to carcass quality and fattening ability of lambs (Christodoulou *et al.*, 2007; Papas 1996), as well as the milk quality and the ability to increase milk production under certain conditions (Alexandridis *et al.*, 1987). Furthermore, its adaptability to grazing along with its capability of long-distance walking render it suitable for extensive grazing (Triantafillidis *et al.*, 1998). Nevertheless, it has been observed that this breed is reared also in semi- intensive conditions (less grazing and more provision of forage and concentrates). The objective of this study is to analyze the economic performance of the Pelagonia sheep production systems in Greece and North Macedonia. The analysis is based on technical and economic data from a sample of fifteen sheep farms from Greece and North Macedonia, which were classified according to the level of intensification.

II - Materials and methods

The farm accounting data for the analysis were collected from farmers of the study area (Pelagonia area in North Macedonia and Western Macedonia in Greece), through a farm management survey using a carefully designed questionnaire. Data included a description of the flock; cropland (cultivated crops, total cultivated area, land market value, etc.) and pasture area used (natural or artificial – total acreage and rent); product yields and prices; subsidies/compensations; description of labour (family and hired); variable capital for purchased feedstuff, crop production and other supplies; fixed capital (buildings, machinery, etc.). Moreover, in order to highlight potential differences due to intensification, Greek farms were categorized as semi-extensive (SEG) and semi-intensive (SIG) according to grazing. Farms in

North Macedonia were not grouped, as all of them implemented a similar pasture-based system.

After the collection of the data, a comparative descriptive technical-economic analysis was employed to investigate the economic performance and profitability of the three groups. This analysis included the calculation of technical and economic indicators, the presentation of the structure of farm expenses per production factor (land, labour, and capital) as well as the calculation of the following basic financial results.

- Gross revenue = (Milk production * Milk price) + (Meat production * Meat price) + (Other products * Price) + Income support
- Net profit/Loss = Gross revenue—Production expenses
- Gross margin = Gross revenue—Variable expenses
- Return to labor = (Labor wage + Net profit/Loss)/Total labor (hours)
- Farm income = Land rent + Labor wage + Interest + Net profit/Loss

III - Results and discussion

Table 1 presents basic technical and economic indicators for the 'average' representative farm of each group. The average size of SEG and SIG was 270 and 350 lactating ewes respectively, while the size of the average Macedonian farm (aMF) was higher (598 lactating ewes). Note that the large size of aMF in this study constitutes an exception and not the rule, as according to Dodovski & Sdraveski (2021) the size of the sheep farms in North Macedonia - especially in Pelagonia region – ranged between 20 to 200 heads, and rarely exceeded 300.

The sampled farms in both countries exhibited similar characteristics in terms of production orientation (dairy farms) and cultivated land, however, grazing differed between these three groups. Milk yield decreased as grazing increased. Indeed, the average milk yield per ewe was higher for SIG by 55.9 kg and 7.6kg compared to SEG and aMF respectively. Regarding lamb meat production, also the SIG achieved a higher yield per ewe (2.4 kg higher) compared to SEG, but a lower yield by 2.2 kg per ewe in comparison with aMF. However, in terms of ewe/ram meat the SIG achieved a lower yield from both SEG and aMF.

Besides, Table 1 illustrates that the aggregate prices of milk were considerably higher in the SEG and SIG compared to those in aMF by 0.17€/kg and 0.19€/kg. However, it was interesting to note that farmers in North Macedonia received direct payments coupled to milk production of 0.073€ per kg. Therefore, by including coupled payments, milk price in North Macedonia was 0.65€ per kg, which was still lower compared to the Greek. Contrary to milk price, the lamb meat price (live weight) was higher in aMF compared to SEG and SIG by 0.24€ and 0.14€ per kg.

Moreover, even though aMF implemented a pasture-based production system similar to SEG, labor requirements were lower for the former, and almost equal to those of SIG, which may indicate more efficient farm management. However, when it comes to the structure of labor, both SEG and aMF relied on family and hired labor in contrast with the SIG that relied only upon family members.

The cost structure of the sample farms per group, reported in Table 2, indicates that SIG operated under higher costs per ewe compared to SEG and aMF. This was due to capital cost savings of 90.4€ /ewe for SEG and of 75.9€ /ewe for aMF mainly due to less purchased feedstuff. For SIG, as expected, capital expenses accounted for 71.1% of the total production costs, while for SEG labor was the most important cost driver (47.0% of total costs). However, it was notable that despite the grazing of animals the percentage of capital expenses in aMF were

high (75.8% of the total), while the labour costs were low (23.1% of the total), approaching those of SIG. As for the implicit (unpaid) expenses for family labor, they were calculated for an implicit hourly wage of 3.5€ /h in the case of the Greek groups and of 3.0€/h implicit hourly wage for aMF.

Table 1. Technical and economic indicators of the sampled "Pelagonia" farms: average

	Greek farms		Macedonian farms
	Semi-extensive (SEG)	**Semi-intensive (SIG)**	**(aMF)**
Average size	270	350	598
Crop production (ha/ewe)	0.007	0.006	0.010
Pasture area (ha/ewe)	0.020	0*	communal pasture areas
Milk yield (kg/ewe)	74.1	130.0	122.4
Lamb meat yield (live weight - kg/ewe)	15.2	17.6	19.8
Ewe/ram meat yield (live weight - kg/ewe)	6.7	3.1	6.7
Mean milk price (€/kg)	0.75	0.77	0.58
Mean lamb meat price (live weight - €/kg)	2.00	2.10	2.24
Labour requirements (h/ewe)	20.7	15.0	15.5
Family (h/ewe)	13.0	15.0	6.3
Hired (h/ewe)	7.8	0.0	9.2

*Sheep do not graze but spend a part of the day in common lands outside the barn.

Table 2. Production costs of the sampled "Pelagonia" farms

	Greek farms				Macedonian farms	
	Semi-extensive (SEG)		**Semi-intensive (SIG)**		**(aMF)**	
	€/ewe	%	€/ewe	%	€/ewe	%
Land	20.7	13.9%	15.4	7.4%	1.1	1.1%
Own	7.8		15.4		0.1	
Rented	13.0		0.0		0.9	
Labour	70.0	47.0%	45.0	21.5%	22.2	23.1%
Family	38.9		45.0		19.0	
Hired	31.1		0.0		3.2	
Capital	58.3	39.1%	148.7	71.1%	72.8	75.8%
Variable	43.2	29.0%	119.3	57.0%	47.4	49.3%
Purchased feedstuff	12.5		91.3		28.0	
Other	3.0		8.0		11.8	
Crop production	27.8		20.0		7.6	
Fixed	15.1	10.1%	29.4	14.1%	25.4	26.5%
Total	149.0	100.0%	209.1	100.0%	96.1	100.0%

As can be seen in Table 3, milk was the main product for all groups, accounting for 27.8%,

54.4% and 43.7% of total gross output, for SEG, SIG and aMF respectively, followed by meat. Moreover, SEG and SIG seemed to rely to a large extent on subsidies, which accounted for 55.3% and 23.8% of the total farm revenues, while in the case of aMF this percentage stood only for 5.8%. The lower milk price in North Macedonia along with the reduced subsidies were the main reasons for the reduced gross output compared to SEG and SIG. Note that the Single Farm Payment was not included in subsidies.

Table 4 summarizes two sets of financial results of farms across the groups — the first set including income support, while the second excluding them. Greek farms relied highly on subsidies, as when income support was not included, both Greek groups operated with net losses, while aMF operated with net profit. Indeed, when income support was not included in the analysis, aMF was by far more profitable than the Greek groups – despite the fact that its total gross output is lower than the latter (51.1€ and 35.5€ less gross output per ewe than SEG and SIG, respectively) – due to lower total expenses. In particular, the expenses of aMF were lower by 52.9€ and 113.0€ per ewe compared to SEG and SIG, mainly due to the low land and labour costs. However, the outcome was different when income support was taken into consideration. In that case, aMF still performed better than SIG, but the same conclusion could not be drawn in comparison with SEG, as the latter was more profitable according to the gross margin (€/ewe), farm income (€/ewe) and return to labor (€/h) indicators, while the aMF operated with higher net profit.

Furthermore, another important finding was that grazing contributed toward a more sustainable production system, increasing the competitiveness and the viability of the farms, due to significant cost savings. Indeed, in the case of the aMF, all financial results were positive while in SEG, only Net profit was negative (net loss) when income support was excluded, but even in this case the loss was lower compared to SIG. This coincides with Ragkos *et al*. (2016) who pointed out that sheep farmers in Greece shifted to grazing and became more extensive in order to mitigate the negative effects of the financial crisis and to reduce their production costs. However, Papadopoulou *et al.* (2021) reported that grazing in the feeding strategy of a farm does not always lead to higher financial results. On the contrary, unbalanced feeding patterns could lead to excessive expenses and higher labour requirements for flock supervision. This observation highlights the importance of a rationally designed feeding plan for all farms, regardless of their level of intensification.

Table 3. Gross output of the sampled Greek Pelagonia farms: average

	Greek farms				**Macedonian farms (aMF)**	
	Semi-extensive (SEG)		**Semi-intensive (SIG)**			
	€/ewe	%	€/ewe	%	€/ewe	%
Milk	55.6	27.8	100.1	54.4	64.9	43.7%
Meat	33.6	16.9	40.0	21.8	60.7	40.9%
Cheese/Wool	0.0	0.0	0.0	0.0	14.2	9.6%
Subsidies (without single farm payment)	110.3	55.3	43.8	23.8	8.6	5.8%
TOTAL	199.5	100.0	183.9	100.0	148.4	100.0%

Table 4. Financial results of the sampled Greek Pelagonia farms: average

	Greek farms				Macedonian farms (aMF)	
	Semi-extensive (SEG)		Semi-intensive (SIG)			
	With Subsidies	Without Subsidies	With Subsidies	Without Subsidies	With Subsidies	Without Subsidies
Total expenses (€/ewe)	149.0	149.0	209.1	209.1	96.1	96.1
Net profit/loss (€/ewe)	50.5	-59.8	-25.2	-69.0	52.3	43.7
Return to labor (€/h)	5.8	0.5	1.3	-1.6	4.8	4.2
Gross margin (€/ewe)	156.2	45.9	64.7	20.9	101.0	92.4
Farm income (€/ewe)	147.4	37.1	43.5	-0.3	84.9	76.3

IV - Conclusions

This study presented a technical-economic analysis of the Pelagonia sheep breed production systems based in Greece and North Macedonia. The findings of this study may help Pelagonia farmers - existing or future - to organize their farms more rationally and make the correct decisions towards the choice of a production system that not only will facilitate the conservation of the breed but will ensure or increase economic returns, thereby encouraging farm entrepreneurship in marginal areas of Greece and North Macedonia. However, the basic limitation of this study is the fact that information about the quantity and quality characteristics of the pastures that each farm grazes has not been considered. Therefore, in order to secure an in-depth analysis, it would be interesting to get insight into this issue in the future combined with more information of the effects of land access patterns. Apart from that, it would also be interesting to shed light on the ways that farm products (milk and meat) are valorized (e.g. in the production of local dairy products), that would increase financial performance.

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