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Economic Performance of Dairy Sheep Farms in Less-Favoured Areas of Greece: A Comparative Analysis Based on Flock Size and Farming System

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Abstract: Dairy sheep farming is a significant agricultural sector in Mediterranean countries, providing income and employment opportunities in less-favoured areas (LFAs). The economic performance of dairy sheep farms is of significant interest to LFAs. However, relevant literature is scarce. The objectives here were to evaluate the economic performance of dairy sheep farms in LFAs of Greece and perform a comparative analysis based on flock size and farming system. In total, 19 and 26 dairy sheep farms for two production periods were used. Farm technical (flock size, production, grazing and nutritional management) and economic (income and variable costs) data were collected. The economic performance of farms was estimated using Happy Goats, a decision support tool for small ruminant farming. Estimated economic parameters were analysed by flock size (≤150 ewes vs. >150 ewes) and farming system (intensive/semi-intensive vs. semi-extensive). Results showed that 37% and 31% of farms were operating with losses in each production period, respectively. Based on nutritional management, ewes produced about 50 kg less milk per milking period. Smaller and semi-extensive farms had significantly ($p < 0.05$) lower incomes and variable costs. A significantly ($p < 0.05$) lower average gross margin was reported for smaller compared to larger farms. Results suggest a better economic perspective for larger flock sizes.

Keywords: sheep; less-favoured areas; economic performance; flock size; farming system

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1. Introduction

Globally, the sheep population is approximately 1.2 billion, of which 60 million are reared in the European Union [1]. Dairy sheep farming is mainly centered in the Mediterranean region accounting for 45% of world ewe milk production [2]. In Greece, this sector plays an important role, accounting for almost 45% of the total value of livestock output [3]. According to the latest data, Greece holds 12% of the EU's sheep population. In particular, the Greek sheep population is the third largest in Europe after Spain and Romania (approximately 15 million and 10 million heads, respectively), with about 7.3 million animals spread over 83,000 holdings [4]. This population consists mainly of the indigenous Greek breeds Chios and Frizarta, and the foreign Lacaune and Assaf breeds with their crosses, mainly reared under semi-intensive conditions [5].

The Greek sheep farming sector is concentrated in less-favoured areas (LFAs), offering job opportunities and incomes for families where alternatives are limited. Moreover, it contributes to the development and growth of small local dairy industries and other facilities, enhancing life perspectives and promoting the economy in remote areas [2,6–8].

However, between 2010 and 2021, the sheep population in Greece decreased by 10% [4]. This was attributed to several challenges faced by the sector related to the economic and energy crisis [9]. Specifically, feedstuff and energy costs have continuously increased during the last decade. This adversely affected farms' profitability, although milk price increased from 0.97 EUR/kg in 2010 to 1.20 EUR/kg in 2022 [10]. On the other hand, global demand for dairy sheep and goat products is constantly growing due to population increase. Therefore, the dairy industry should apply appropriate management practices and new strategies to overcome these obstacles [2,11–13]. In this regard, economic performance and factors associated with the profitability of dairy sheep farms are of significant interest to LFAs. Several studies have been carried out on this topic [2,13–15]. In Greece, however, such studies are limited and, in all cases, farming system specific. Specifically, previous studies have focused on the technical efficiency of intensive farms and the economic analysis of organic and transhumant sheep and goat farms [3,8,16–18]. Moreover, comparative economic studies in relation to important farm parameters are scarce. Hence, the objective of the present study was two-fold: (i) to evaluate the economic performance of dairy sheep farms located in LFAs of North-Western Greece and (ii) to conduct a comparative economic analysis clustering the farms by flock size and farming system.

2. Materials and Methods

2.1. Farms and Study Area

A random sample of 19 dairy sheep farms was used for two consecutive production periods (2019–2020 and 2020–2021). During the second production period, seven other farms were willing to participate in this study, so the number of farms increased to 26. Studied farms followed the intensive, semi-intensive or semi-extensive farming system (first study period: 3, 5 and 11 farms, respectively; second study period: 4, 7 and 15 farms, respectively). The main difference between semi-intensive and semi-extensive farming systems is that in the latter, feeding mostly relies on grazing to meet nutritional requirements. Specifically, in these systems, the average daily grazing time was 4.2 h longer than in semi-intensive ones (Dataset S1 in Supplementary Materials). As asserted in the introduction, all farms were located in LFAs, specifically in mountainous and disadvantageous areas of North-Western Greece [7].

The average farm comprised 174 ± 64.0 and 189 ± 82.8 milked ewes with an average milk yield of 218 ± 88.7 and 239 ± 91.8 kg/milking period (8.7 ± 1.0 and 8.7 ± 1.5 months) for the two studied periods, respectively. Reared ewes were crossbreeds of Lacaune or Assaf with indigenous Greek sheep breeds. All farms were located in the region of Florina, North-Western Greece (Figure 1). Contrary to the Mediterranean climate that is predominant in Greece, this area has a continental climate characterized by warm to cool summers and cold winters with strong winds, snowstorms and low temperatures [19].

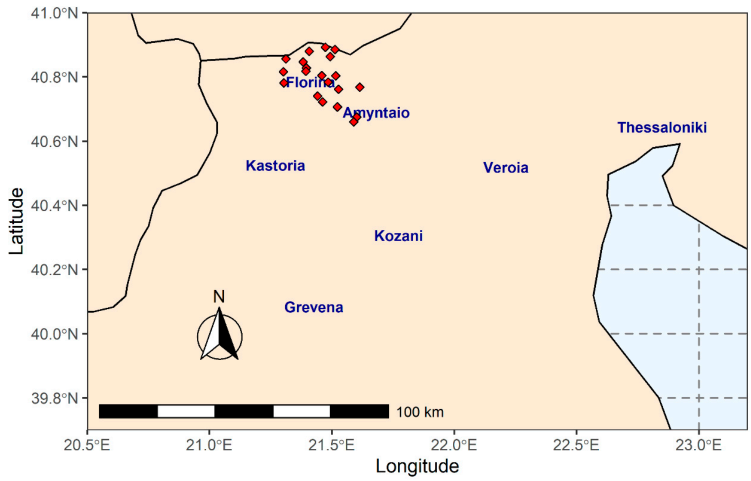

Figure 1. Map of North-Western Greece illustrating the regions in which the studied farms were located.

2.2. Datum Collection and Handling

Technical and economic data of the studied farms for each production period were collected by a group of veterinarians using a designated questionnaire which did not include questions about personal or sensitive data. Technical data included parameters for flock size, production (milk and meat), grazing (area, time and distance) and nutritional management (foraged and concentrated feedstuffs). Economic data included information on subsidy income, variable costs (feeding, labour, transportation, utility, renting, veterinary and grazing land costs) and prices for milk, meat and feedstuffs. Descriptive statistics of collected technical and economic data for each studied period are presented in Supplement S1; Tables S1 and S2, respectively.

Collected data from each farm (19 and 26 farms for the first and second studied period, respectively) were inputted into the web application Happy Goats (https://happygoats.eu/, accessed on 3 October 2022), a decision support tool for small ruminant farming [20], to estimate their economic performance and assess the impact of nutritional management on ewe productivity. Specifically, the farm income, variable costs, gross margin, the estimated difference in milk production based on nutritional management and the respective energy and protein balance were calculated. All input and output data are available in Dataset S1.

2.3. Statistical Analysis

Descriptive statistics for the economic performance data of studied farms were calculated for each period. To detect potential differences in economic performance parameters, selected farms were divided by flock size depending on the number of reared ewes and farming system into the following groups: (i) ≤150 ewes (n = 8 for 2019–2020, n = 9 for 2020–2021); (ii) >150 ewes (n = 11 for 2019–2020, n = 17 for 2020–2021); (iii) intensive/semi-intensive farms (n = 8 for 2019–2020, n = 9 for 2020–2021); (iv) semi-extensive farms (n = 11 for 2019–2020, n = 17 for 2020–2021), respectively. Data were analyzed for each studied period separately with one-way ANOVAs using the R statistical package "stats" [21].

3. Results

3.1. Economic Performance of Studied Dairy Sheep Farms

Descriptive statistics for the economic performance data of the studied dairy sheep farms per productive period are presented in Table 1. During the period 2019–2020, the average farm income, variable costs and the gross margin were EUR 53,286.3, EUR 46,374.6 and EUR 6911.7, respectively; the gross margin per ewe was EUR 24.3. However, results showed that 39% of farms were operating with losses of a negative average total gross margin and gross margin per ewe of EUR −5464.9 and EUR −34.2, respectively. Income was mostly based on milk production, followed by meat production and subsidies (58.3%, 22.5% and 19.2%, respectively). Feeding was the most important element of variable costs (83.6%), followed by transportation (5.6%), renting (3.0%), veterinary (2.6%), utility (2.3%), milking parlour (1.1%), grazing land (1.0%) and labour costs (0.9%). The greatest part of feeding and total variable costs was for milked ewes (EUR 183.3 and EUR 214.6, respectively). However, relevant costs for rams (EUR 99.4 and EUR 130.7, respectively) and non-milked ewes (EUR 75.8 and EUR 105.6, respectively) were also high (Table 2). According to nutritional management assessment, the average farm should have a higher milk production by 50.0 kg/ewe/milking period, which would result in a higher gross margin of 50.0% (Table 3).

Table 1. Descriptive statistics (mean and standard deviation) of economic performance data in the studied farms for the periods 2019–2020 and 2020–2021.

Trait	Period	N	Mean	SD [1]
Gross margin (EUR)	2019–2020	19	6911.7	15,460.85
	2020–2021	26	15,739.6	24,142.14
Gross margin per ewe (EUR)	2019–2020	19	24.2	61.43
	2020–2021	26	66.8	91.96

Table 1. *Cont.*

Trait	Period	N	Mean	SD [1]
Income (EUR)	2019–2020 2020–2021	19 26	53,286.3 66,291.9	32,671.10 41,238.48
Income from milk sales (%)	2019–2020 2020–2021	19 26	58.3 64.8	9.95 11.84
Income from meat sales (%)	2019–2020 2020–2021	19 26	22.5 17.1	10.35 7.63
Income from subsidies (%)	2019–2020 2020–2021	19 26	19.2 17.9	10.69 13.20
Income from animal sales (%)	2019–2020 2020–2021	19 26	0.1 0.2	0.44 1.00
Variable costs (EUR)	2019–2020 2020–2021	19 26	46,374.6 50,552.5	22,538.17 26,835.58
Feeding costs (%)	2019–2020 2020–2021	19 26	83.6 74.6	8.91 13.61
Labour costs (%)	2019–2020 2020–2021	19 26	0.9 2.4	2.73 5.75
Renting land costs (%)	2019–2020 2020–2021	19 26	3.0 4.7	3.15 7.48
Transport costs (%)	2019–2020 2020–2021	19 26	5.6 8.2	5.95 5.75
Utility bills costs (%)	2019–2020 2020–2021	19 26	2.3 3.4	2.42 3.06
Milking parlour (%)	2019–2020 2020–2021	19 26	1.1 1.9	1.32 2.01
Veterinary costs (%)	2019–2020 2020–2021	19 26	2.6 3.3	1.43 1.50
Grazing land costs (%)	2019–2020 2020–2021	19 26	1.0 0.9	1.37 1.70

[1] SD = standard deviation.

Table 2. Descriptive statistics (mean and standard deviation) of variable costs per animal category in the studied farms for the periods 2019–2020 and 2020–2021.

Trait	Period	N	Mean	SD [1]
Variable costs per milked ewe (EUR)	2019–2020 2020–2021	19 26	214.6 211.7	63.75 103.08
Variable costs per non—milked ewe (EUR)	2019–2020 2020–2021	19 26	105.6 147.4	57.79 95.00
Variable costs per ram (EUR)	2019–2020 2020–2021	19 26	130.7 176.6	44.4 116.52
Variable costs per lamb (EUR)	2019–2020 2020–2021	19 26	83.4 121.8	27.15 86.94
Feeding costs per milked ewe (EUR)	2019–2020 2020–2021	19 26	183.3 154.8	52.03 42.47
Feeding costs per non—milked ewe (EUR)	2019–2020 2020–2021	19 26	75.8 90.0	41.94 40.60

Table 2. *Cont.*

Trait	Period	N	Mean	SD [1]
Feeding costs per ram (EUR)	2019–2020 2020–2021	19 26	99.4 119.7	42.07 58.84
Feeding costs per lamb (EUR)	2019–2020 2020–2021	19 26	52.0 63.2	9.04 20.96

[1] SD = standard deviation.

Table 3. Descriptive statistics (mean and standard deviation) of estimated milk production change based on nutritional management (energy and protein balance) and respective economic performance data in the studied farms for the periods 2019–2020 and 2020–2021.

Trait	Period	N	Mean	SD [1]
Milk production change (kg/ewe/milking period)	2019–2020 2020–2021	19 26	50.0 50.8	17.81 21.16
Income (EUR)	2019–2020 2020–2021	19 26	60,444.3 76,057.9	36,308.72 47,740.55
Gross margin (EUR)	2019–2020 2020–2021	19 26	14,069.6 25,505.5	18,312.0 28,317.02
Gross margin per ewe (EUR) Milk production change	2019–2020 2020–2021	19 26	58.7 109.3	67.02 99.9
(kg/ewe/milking period)	2019–2020 2020–2021	19 26	50.0 50.8	17.81 21.16

[1] SD = standard deviation.

During 2020–2021, the average farm's gross margin increased by EUR 8827.9 (Table 1). The income was higher by 24.4% and primarily based on milk productivity, followed by subsidies and meat sales (64.9%, 17.9% and 17.1%, respectively). Variable costs increased by 9.0%. Nevertheless, 31% of farms remained not economically viable (the negative average farm's gross margin in total and per ewe were EUR −4087.6 and EUR −25.4, respectively). For all animal categories (Table 2), total variable and feed costs increased, except for milked ewes that decreased by 1.4% and 15.5%, respectively. Finally, according to nutritional management, the average farm's milk production and hence, gross margin should have been higher by 51 kg/ewe/milking period and EUR 25,505.5, respectively (Table 3).

3.2. Comparative Economic Analysis Based on Flock Size and Farming System

Significant differences ($p < 0.05$) in economic performance were reported in relation to flock size and farming system (Tables 4 and 5, respectively). For both studied periods (2019–2020, 2020–2021), smaller farms had significantly ($p < 0.05$) lower incomes (by EUR 41,982.4 and EUR 47,027.3, respectively), but also lower variable costs (by EUR 27,993.6 and EUR 33,005, respectively), compared to larger ones. However, only for the period 2019–2020, a significantly ($p < 0.05$) lower average total gross margin and gross margin per ewe (by EUR 13,988.8 and EUR 60.2, respectively) was obtained for smaller compared to larger farms. Furthermore, for both periods, in smaller farms, utility costs accounted for a significantly ($p < 0.05$) higher percentage of total costs compared to larger ones (by 2.6% and 2.4%, respectively).

Regarding farming systems, for both studied periods, significantly ($p < 0.05$) lower incomes (by EUR 42,618.6 and EUR 37,171, respectively) were reported in semi-extensive compared to intensive/semi-intensive farms. Variable costs were significantly ($p < 0.05$) lower for the former farms in the period 2019–2020 (by EUR 29,581.7). In these farms, feeding costs accounted for a significantly higher percentage of total costs for both periods (by 10.6% and 11.7%, respectively). In intensive/semi-intensive farms, a significantly ($p < 0.05$) higher percentage of total costs was attributed to milking parlour costs for both periods (by 1.4% and 2.1%, respectively) and to transportation costs (by 4.7%) for

2020–2021. In both periods, significantly higher costs per milked ewe (by 79.4% and 93.0%, respectively) and costs per lamb (by 28.8% and 79.0%, respectively) were found for intensive/semi-intensive farms; costs per milked ewe and costs per ram were significantly higher only in the period 2019–2020 (by EUR 83.8 and EUR 98.4, respectively). Feed costs per milked ewe were found to be significantly higher in these farms by EUR 47.9 for 2020–2021.

Table 4. Significant effects (mean and standard deviation, β-coefficient, standard error; $p < 0.05$) of flock size on economic performance traits for the periods 2019–2020 and 2020–2021.

	Period	Smaller Farms [3]	Larger Farms [4]	β-Coefficient	*p*-Value
Gross margin (EUR)	1 [1]	−1187.1 (4997.31)	12,801.7 (4261.72)	−13,988.8 (6567.76)	0.0481
Gross margin per ewe (EUR)	1	−10.6 (19.39)	49.6 (16.54)	−60.2 (25.49)	0.0304
Income (EUR)	1	28,980.7 (9013.86)	70,963.1 (7687.05)	−41,982.4 (11,846.54)	0.0025
	2 [2]	35,544.0 (11,687.0)	82,571.0 (8503.0)	−47,027.0 (14,453.0)	0.0034
Variable costs (EUR)	1	30,167.8 (6367.4)	58,161.4 (5430.14)	−27,993.6 (8368.41)	0.0038
	2	28,972.1 (7326.10)	61,977.1 (5331.10)	−33,005.0 (9060.0)	0.0013
Utility costs (%)	1	3.8 (0.71)	1.2 (0.63)	2.6 (0.97)	0.0157
Grazing land costs (%)	2	1.9 (0.53)	0.4 (0.39)	1.5 (0.65)	0.0387

[1] 1 = 2019–2020, [2] 2 = 2020–2021, [3] Smaller farms = ≤150 ewes, [4] Larger farms = >150 ewes.

Table 5. Significant effects (mean and standard deviation, β-coefficient and standard error; $p < 0.05$) of the farming system on economic performance traits for the periods 2019–2020 and 2020–2021.

	Period	Intensive/Semi—Intensive Farms	Semi—Extensive Farms	β-Coefficient	*p*-Value
Income (EUR)	1 [1]	77,960.2 (8911.60)	35,341.6 (7599.85)	42,618.6 (11,712.15)	0.002
	2 [2]	96,596.0 (12,617.10)	53,425.0 (9180.10)	37,171.0 (15,603.0)	0.025
Variable costs (EUR)	1	63,500.8 (6118.0)	39,919.2 (5217.45)	29,581.7 (8040.62)	0.002
Variable costs per milked ewe (EUR)	1	260.6 (17.98)	181.2 (15.33)	79.4 (23.63)	0.037
	2	273.0 (31.50)	180.0 (22.90)	93.0 (39.0)	0.025
Variable costs per not milked ewe (EUR)	2	207.0 (33.50)	123.0 (21.50)	83.8 (39.80)	0.047
Variable costs per ram (EUR)	2	241.0 (36.20)	143.0 (26.30)	98.4 (44.70)	0.004
Variable costs per lamb (EUR)	1	100.1 (8.32)	71.2 (7.10)	28.8 (10.94)	0.017
	2	175.5 (28.30)	96.5 (19.40)	79.0 (34.30)	0.031

Table 5. *Cont.*

	Period	Intensive/Semi—Intensive Farms	Semi—Extensive Farms	β-Coefficient	*p*-Value
Feeding costs (%)	1	77.5 (2.59)	88.1 (2.21)	−10.6 (3.40)	0.006
	2	67.0 (4.21)	78.7 (3.06)	−11.7 (5.21)	0.034
Feed costs per milked ewe (EUR)	1	211 (16.74)	163.1 (14.28)	47.9 (22.0)	0.044
Transportation costs (%)	2	11.3 (1.79)	6.6 (1.3)	4.7 (2.22)	0.039
Milking parlour costs (%)	1	1.9 (0.40)	0.5 (0.34)	1.4 (0.53)	0.015
	2	3.2 (0.59)	1.2 (0.43)	2.0 (0.73)	0.010

[1] 1 = 2019–2020, [2] 2 = 2020–2021.

4. Discussion

As asserted in the introduction, the aim here was to evaluate the economic performance of dairy sheep farms in LFAs of North-Western Greece and conduct a comparative economic analysis based on flock size and farming system. Such studies are of utmost interest, especially for LFAs, considering the economic challenges faced by the sector.

During the last decade, a trend towards farm intensification has emerged to accommodate the needs of higher-producing foreign breeds and increase animal productivity in Greek dairy sheep farms [4]. However, in the studied LFAs, the prevailing farming system is still the semi-extensive one. This was also depicted in our study, in which intensive and semi-intensive farms were fewer than semi-extensive ones. Therefore, for comparison purposes, the former two were grouped and considered representatives of a higher level of intensification. Regarding flock size, herein, a cut-off point was set to 150 ewes to distinguish smaller from larger flocks based on the respective median and according to previous literature [2].

Our study showed that for both studied production periods (2019–2020, 2020–2021), a high percentage (37% and 31%, respectively) of dairy sheep farms in LFAs were not economically viable, indicating an uncertain future for the sector. Similar economic losses were reported by Ragkos et al. [16] for transhumant sheep and goat farming in Greece. The reported negative economic performance of studied farms is primarily attributed to irrational nutritional management, considering animal productivity, along with high feeding costs. Specifically, milked ewes were fed with dry alfalfa hay, straw and concentrated feed; however, in most cases the ration provided was not balanced in terms of energy and protein. This is further supported by the fact that, milked ewes were found to produce less milk (about 50 kg/milking period for both periods) than expected based on nutritional management, reducing gross margins. Furthermore, reduced animal productivity could also be associated with animal health, welfare issues and a lack of genetic improvement. Additionally, feeding costs highly contributed to the total variable costs (about 75 to 84%), resulting in high expenses.

Moreover, studied farms were strongly dependent on subsidies; the gross margin excluding the income of subsidies was negative for about 65% of the studied farms. In our study, the involvement of subsidies in the total farm income was higher than the one reported (7–14%) for dairy sheep farms in Spain [13,22,23] and transhumant farms (11%) in Greece [16]. In contrast, our results were similar to those stated by Ruiz et al. [24] and Morin and Charroin [22] in dairy sheep farms from Northern Spain and France (17–20% and 14–21%, respectively). Several factors could explain such differences. Initially, schemes implemented by the Common Agricultural Policy (CAP) system for subsidies and compensations may differ among EU countries [25]. Furthermore, the incomes of dairy sheep farms are primarily based on milk sales and hence defined by milk price. This price fluctuates within the EU and over the years, modifies the input of other sources (subsidies, meat sales) in total income. To increase economic sustainability, farms should reduce their dependence on external resources and improve ewe productivity through appropriate feeding practices and genetic selection programs [13].

Several studies support that sheep and goat farming intensification and larger flock sizes could improve farm profitability and help achieve higher efficiency levels while also covering high consumer demands for small ruminants' dairy products [3,12,14,26–28]. Theodoridis et al. [3] and Ragkos et al. [16] reported that larger dairy sheep flocks in Greece were associated with higher technical efficiency levels. These findings are in general agreement with the present study, although the gross margin was significantly affected by flock size only in the first studied period. Moreover, in our study, intensive/semi-intensive farms were more profitable than semi-extensive ones, but no significant differences ($p > 0.05$) were reported for the gross margin. These results are in accordance with previous descriptive comparisons between intensive and semi-extensive transhumant farms in Greece [2].

In the present study, the income was significantly higher in larger and intensive/semi-intensive farms for both studied periods. This is mainly related to the higher milk production achieved by these farms, given that milk sales constituted the major component of total farm income (about 58–65%). This finding is in accordance with a study from Spain in which larger flocks reared under semi-intensive conditions had higher milk production than small- and medium-sized flocks under extensive management [23]. The importance of milk sales for dairy sheep farm profitability has also been indicated by previous studies with a contribution of 46.2–79.0% in the total farm income [3,13,16,22,23,29]. In our case, the total farm income increased by EUR 12,192.2 in 2020–2021 compared to 2019–2020, mainly attributed to the increase in milk price by 0.15 EUR/kg.

Variable costs of dairy sheep farms have been previously reported to be affected by flock size. Specifically, Ragkos et al. [16] suggested that in sheep and goat transhumance in Greece, larger farms managed their available inputs more efficiently, resulting in lower production costs. However, in the study of Theodoridis et al. [28], smaller dairy sheep farms in France were found to be more efficient with lower variable costs. The latter results are in accordance with those of this present study. Moreover, herein, variable costs (total and per animal category) were also significantly affected by the farming system; semi-intensive/intensive farms had higher variable costs, especially for feeding, transportation and the milking parlour, than semi-extensive ones. Such results are attributed to the principal characteristics of the studied farming systems. Specifically, intensive farms are characterized by higher levels of investment in infrastructure, equipment, technology and feeding costs to achieve higher milk yields.

On the other hand, in semi-extensive farms, traditional management is applied with lower investments and feeding relies mostly on grazing [2,5]. Dairy sheep nutritional management during the milking period is characterized by increased energy and protein demands. Therefore, feeding costs for lactating ewes constitute the main component of total feeding expenses. In our study, feed costs per milked ewe were higher than previously reported by two studies conducted in Greece (66–96.4 EUR/ewe and 90.3 EUR/ewe, respectively) [16,18]. (2014; 66–96.4 EUR/ewe),18 (2011; 90.3 EUR/ewe)]. However, similar findings were reported by Sanchez et al. [30] (160 EUR/ewe) and Mantecon et al. [31] (145 EUR/ewe) in dairy sheep farms in Spain. Reported differences could be related to variations in farm management (feeding practices, production systems, breed and feedstuff prices).

Overall, in the present study larger and intensive/semi-intensive farms had significantly higher incomes and variable costs than smaller and semi-extensive farms. In the case of farming systems, the gross margins were higher in intensive/semi-intensive farms, indicating a more sustainable future than in semi-extensive ones. However, the reported differences were not significant, suggesting that there is substantial room for improvement by further increasing the farm income and reducing production costs. It should be noted that larger farms were significantly more profitable than smaller ones due to their higher milk production levels. Therefore, results suggest that dairy sheep farms in the studied LFAs of Greece could economically benefit by increasing flock size. In all cases, results further indicate that adjusting nutritional management according to animal productivity could help to increase farm profitability. Based on previous research, the uptake of additional best practices and innovations with special emphasis on reproduction, genetic improvement and technology could further help to improve the economic performance of dairy sheep farms [8,32,33].

5. Conclusions

Results of the present study indicate that a high percentage of dairy sheep farms in LFAs of North-Western Greece cope with economic losses. Moreover, a dependence on EU agricultural subsidies was essential for farms' economic viability. The comparative economic analysis showed a better economic perspective for larger flock sizes, indicating that the sector could economically benefit by increasing the number of milked ewes. However, in all cases, milk production was lower than expected. Considering all the above and according to the continuously increasing prices in energy and feedstuff, measures for improving nutritional management, feed efficiency and ewe productivity by adopting plans of selection and genetic improvement are considered fundamental for the future sustainability of the sector.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su15021681/s1, Dataset S1: Total dataset of traits used for the analyses, Supplement S1: Table S1. Descriptive statistics (mean and standard deviation) of collected technical farm data for each studied period, Table S2. Descriptive statistics (mean and standard deviation) of collected economic farm data for each studied period, Table S3. Effects (mean and standard deviation, β-coefficient, standard error) of flock size on farm economic performance traits for each studied period, Table S4. Effects (mean and standard deviation, β-coefficient, standard error) of farming system on farm economic performance traits for each studied period.

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Data Availability Statement: Data presented in this study is contained within the article and Supplementary Material (Dataset S1, Supplement S1 and Figure S1).

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