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Economic and Financial Sustainability Dependency on Subsidies: The Case of Goat Farms in Greece

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Abstract: Goat farming is an important production sector not only for Greece, but also for other Mediterranean countries, as it contributes to the family economy in rural areas. Despite the importance of goat farming, this sector has experienced economic difficulties due to poor management and increased production costs. The aim of our research is to determine goat farm profitability by surveying goat farmers for revenues, variable costs, and fixed costs of their farms. With the use of Principal Component Analysis, all economic factors contributing to overall production costs are examined, as well as their specific impacts on cost formulation. According to our results, goat farms in Greece are not profitable and they cannot survive without government subsidies. Farm economics and agricultural policies could be leveraged to improve community and environmental outcomes in order for farms to be economically and financially sustainable.

Keywords: Principal Component Analysis; goat enterprises; sustainable development; financial indexes; subsidies



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1. Introduction

The goat farming industry is crucial to economic cohesion, especially for countries in the Mediterranean and Middle East regions, contributing to the family economy, to the social function of rural areas, to sustainable livelihoods and to the production of high-quality products, due to the high contents of poly unsaturated fat, cardioprotective omega-3 fatty acids and antioxidants in food products derived from goat [1–5]. Global goat milk production is 20 million (M) metric tons and goat meat production is 6.2 million (M) metric tons [6]. European Union countries contributed 15% to goat milk production (3 million metric tons) and 1.6% (96,310 metric tons) to goat meat production. Greece is the fourth largest producer of milk, with 355,760 metric tons, and the first producer of goat meat, with 26,480 metric tons [6]. In Greece, goat milk is mainly used in cheese production, since there are many products with a protected designation of origin (PDO), such as feta and other traditional types of cheese.

Despite the importance of the goat farming in Greece, nowadays the sector is experiencing economic and structural difficulties due to the decrease in livestock numbers and the policy changes in public funding. A typical example is the fact that farmers with land rights are receiving subsidies, whereas environmental measures are being considered [7]. By subsidizing the goat industry, the Greek government may be indirectly supporting an industry that has historically had negative environmental impacts. In many areas, especially in inland, low-accessibility mountainous districts, grazing has greatly increased with Common Agricultural Policy (CAP) subsidies. The low plant cover found in many grazing lands is considered to be a consequence of overgrazing [8]. Moreover, the availability of financial resources has enhanced the purchase of fodder to increase flock size, and this has resulted from the availability of subsidies [8]. Goat farming is under pressure to produce

higher levels of outputs whilst reducing the use of resources and the environmental impact, all at the lowest possible price.

The agricultural income support policy has contributed to these changes. The CAP has changed three times. In the first reform, the price support was changed to direct farm payments, based on the area farmed and livestock kept, and intervention prices were reduced [9,10]. The second reform expanded the shifts towards direct payments. The third reform decoupled the direct payments from production [11], and the last reform connected subsidies with the three pillars of sustainability. The new reform of the EU Common Agricultural Policy in Greece is not so clear, because, in some regions, subsidy schemes supported the abandonment of grazing through the conversion of extensive pastures into forests or crop production, while in other regions, grazing was intensified through direct payments that initiated higher animal stocking rates [12]. However, within the last year, there was an increase in the national flock at the same time there was a decrease in the number of farms that have not been associated with homogeneous grazing patterns of the available land [13]. Despite the most recent CAP reform, which takes into account agri-environmental issues, the majority of goat farms in Greece have intensified their farming practices [14]. The intensification of farm management in terms of animal feed inputs is reflected in the higher consumption of feedstuffs and the reduction in the use of grazing pastures [13]. A lack of feed provided from grazable land during the year and an increase in the use of supplementary feed caused by low feed prices [6] has led farmers to change their production methods and financial resources.

The majority of the existing goat farming systems are vulnerable to price variability, or economic capital [14,15]. The high production costs of farms have led to the low competitiveness of the sector compared to other countries with more developed goat sectors. A combination of inadequate farm prices and high production costs has led farms to operate with negative profits [16,17]. The measurement of farms' viability and sustainability in terms of achieving a specific income it is not a simple issue. Changes to goat farming, as well as the contribution of other income sources to farm household income, complicate the financial viability of the farms. Recent studies agree that economic sustainability is the long-term viability of the farm household, whereas economic viability measures farm-level capability to grow [18,19]. Economic viability is closely related to the economic sustainability and risk of business failure [18]. Farms that are neither viable nor sustainable are vulnerable to not being able to be transferred to future generations.

It is true that major expenses in goat farms occur from feeding expenses [20–22]. Moreover, last year, grazing was supplemented more with purchased forage and feed [23]. In Greece, goat farming is associated with investments in equipment and livestock, which increase production costs [24]. According to previous empirical findings, variable costs accounted for almost two-thirds of total expenses and fixed costs accounted for about 50% of capital expenses [25,26]. Another feature of the sector is the low prices paid for milk and meat [27]. Goat farming is labour intensive, as it requires high labour input [28]. The energy cost has tripled [29]. In addition, the abatement of liquidity resulted in late payments from farmers to banks and input suppliers.

For the economic viability and sustainability of farms, it is essential to elaborate the indexed production cost. As farmers cannot control the price of milk and meat, it is essential to manage the variables under their control, as the economic outcome depends on the management of production costs and economies of scale [30]. Moreover, farmers' financial sustainability has a direct and significant influence on the development and growth of the economy where they are located [31]. Farmers take social and environmental issues seriously when they are viable and economically sustainable [32].

The measurement of goat farming's economic profitability and sustainability has received limited interest among academics. It is necessary to analyze the factors affecting the economic structure and profitability of the sector and the variables that determine the total production cost. Last year, due to the economic crisis brought about by the COVID-19 pandemic, there was an important change not only to the productivity but also to the

economic profitability of the livestock sector [33]. Thus, the long-term viability of the goat industry is now questioned due to the effects these conditions have had on farm income.

Many tools have been proposed to measure the profitability and economic sustainability of farms. These tools vary greatly in terms of use and sustainability framing, i.e., in how sustainability is classified into themes and indicators [14]. In order to measure economic viability at the farm level, a number of indicators have been proposed. Some of these indexes include revenues and costs, income, and availability of cash [19]. Researchers correlate the insurance and the share of output under contract with fixed price delivery contracts and economic viability measurement [34]. The economic dimensions should include parameters such as employment rate, labour productivity, gross fixed capital formation, income per annual working unit (AWU), net investment per AWU, and farm net value added per animal [35]. In another study, researchers developed a model for the calculation and analysis of production costs and, from the model, elaborated a production cost index. The cost components were categorized as variable costs, fixed operating costs, and total cost [36]. The most commonly used economic indicators associated with farm's profitability are farm income, efficiency, and productivity [37]. Other researchers [38] use the income of producers, the contribution of agriculture to GDP, and the insured area, as economic indicators. Moreover, one means of measuring economic sustainability in agriculture is through calculating the operating expenses as a proportion of total production value [39].

As there are many indicators that can be used to measure economic sustainability, which are the appropriate indicators to be used? In order to answer this question, various papers describe and characterize economic indicators; nevertheless, few papers deal with indicator selection using a data-driven approach [37]. The appropriate choice of indicators is crucial, as it can influence the conclusions reached [37].

With this in mind, this study focuses on the financial viability of farms as an opportunity cost measure, as economic sustainability is long-term economic viability at the farm household level. The aim of this article was to express economic aspects of sustainable goat farming, in relation to its cost structure. We examine all economic factors that contribute to the overall production cost and how these factors affect the cost formulation. Despite there being references in the literature to sustainability assessment at the farm level, there is no systematic review of sustainability economic indicators. This is the first study that takes into account all economic categories that make up farm-level production costs for Greek goat production. Although prior literature has focused on sustainability assessments (e.g., overgrazing) for the goat industry in Greece, there has been no analyses on its economic sustainability nor how such farm economics could impact environmental and community sustainability. Our research seeks to fill this gap.

2. Materials and Methods

2.1. Area of the Study

The study area is the regional unit of Larissa, Prefecture of Thessaly, located in the center-east of mainland Greece and the regional unit of Thessaloniki, Prefecture of Central Macedonia (Figure 1, source: "Hellenic Military Geographical Service". In the region of Larisa, there are 1329 goat farms with 175,096 animals, which represents the 2.1% of farms and 5% of goats in Greece [40]. In regional unit of Thessaloniki, there are 600 farms with 110,216 goats, which represents the 1% of the farms and the 3.1% of the goats in Greece. The goat sector in the sample areas shows significant maturing, highlighting these regions as dynamic and of great economic importance. The results of this research can be generalized to other regions in Greece due to similar goat industry characteristics in these other areas [41].

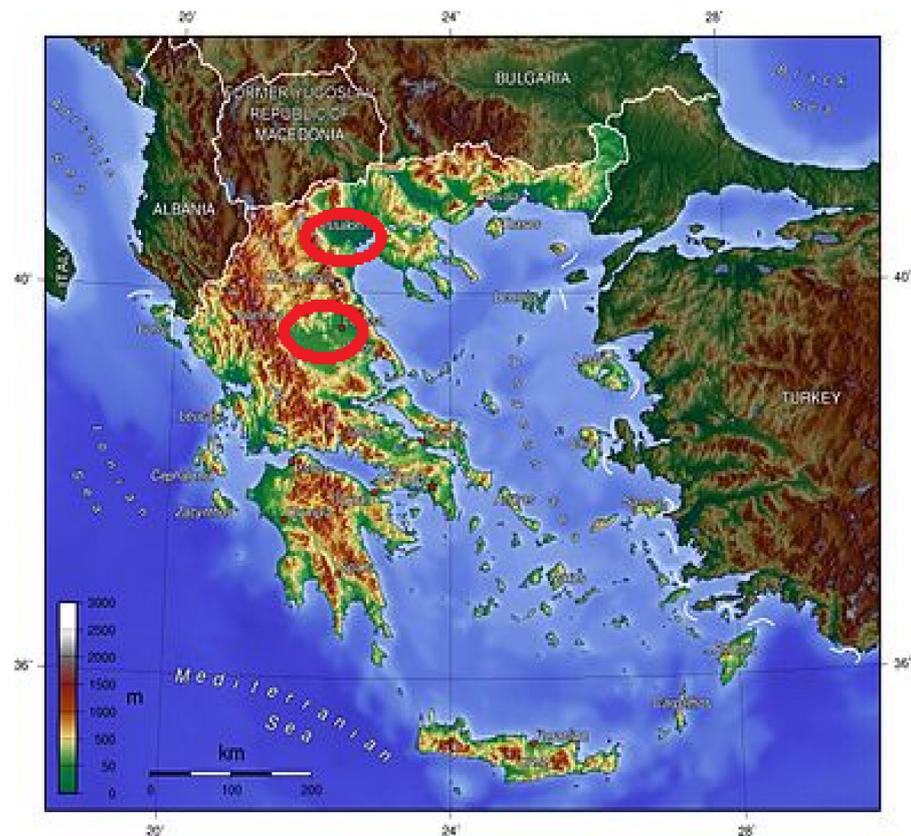


Figure 1. Map of Greece, where goat farmers were surveyed; Thessaloniki and Larisa are circled in red.

2.2. Data Collection

The data were obtained through a questionnaire survey asking each farm questions such as their total goat herd inventory during 2020. The sample consisted of 272 farms, a number that corresponds to 14.1% of the total number of goat farms in the selected regions. The average farm had 138 goats. Simple random sampling was employed as a sampling method. Data were collected from small to large farms, including variable cost parameters. The questionnaire included questions about the economic characteristics of the farms such as the farm size and structure, the facilities and equipment, feeding management, labour cost, fixed and variable capital expenses and data about the production of goats.

2.3. Selection and Calculation of Indicators

Greek's goat sector is characterized by inadequate farm-gate prices and increased production costs. In order to survive these challenges, goat farms receive public support from the EU through the Common Agricultural Policy [42]. However, such measures have not managed to improve productivity or competitiveness of the sector. Livestock producers cannot control external factors like disease that affect productivity and prices. Therefore, in order for the farms to be viable, farmers should control fixed and variable capital [43]. Farms that take into account the factors that affect production costs are more viable [44].

The total production cost for goat farms consists of the feed cost, the annual cost of livestock, the annual cost of fixed assets as well as labour expenses [44]. The efficiency of the units of the sector is also influenced by the perceptions from management about the economic environment, the competition in the sector, the markets for goat products, and decisions about the structure of the fixed and variable capital [45]. This study examined all potential determinants of fixed and variable capital. The financial indexes used were the imputed rent, hired land expenses, family labour expenses, hired labour expenses, foreign engineering labour expenses, feed cost, fuels/water/electricity, drugs/antibiotics,

fixed assets interest, circulating capital interest, depreciation, as well as maintenance and insurance premiums.

In this study, farm revenues were surveyed and particular costs were subtracted from revenues to calculate four different measures of profit. The first profit measure, farm income, was calculated, which involves general farm operations. The second profit measure calculated was family farm income, which included the fixed factors of production as well as remuneration for the entrepreneur's expenses during the accounting year. Finally, short-run and long-run profits were also calculated. Short-run Return Over Variable Costs (ROVC) was calculated as:

$$\text{ROVC} = \text{TR} - \text{VC} \quad (1)$$

where TR equals total revenue from annual production of goat products and VC are variable costs that change with the level of production in a year, such as labor and purchased feed. ROVC is a short-run measure of farm profitability since goat farms can tolerate not covering fixed costs (FC) in the short run and not theoretically go out of business. However, for time periods longer than one year, goat farms need to cover FC and, thus, have positive long-run profit or Net Farm Income (NFI), which was calculated as:

$$\text{NFI} = \text{TR} - \text{VC} - \text{FC} \quad (2)$$

FC do not change with goat product output in an annual budget year and include equipment depreciation, land rent, as well as taxes and insurance. Farms that have negative NFI risk going out of business in the long run, thus failing to be passed down intergenerationally.

2.4. Principal Component Analysis

In this study, PCA was used because it synthesizes data that can have dispersion and heterogeneity for some variables or factors, explaining most of the total variation in the sample [46,47]. The interpretation of the factors can be helped through the use of the rotated matrix, varimax. Moreover, with PCA, the variables can be normalized and weighted according to importance [48].

The PCA method is a dimensionality reduction method of the initial dataset, without losing much of the information. The PCA method assumes that initial vectors are n -dimensional and have the following format [49]:

$$x_1, \dots, x_n \quad (3)$$

The dimensionality reduction without information loss, is achieved by discarding the components with low information and considering the remaining components (principal components) as new variables (PC_{*i*}). Every principal component is defined as a linear combination of the variables (x_1, \dots, x_n) from the original vectors, and follows the following format [38]:

$$\text{PC}_i = a_1 x_1 + \dots + a_n x_n \quad (4)$$

In order to use the PCA method, the Kaiser–Meyer–Olkin (KMO) index and the Bartlett's test of Sphericity index must be tested. The KMO index compares the observed correlation coefficients with the partial correlation coefficients. Low KMO values (KMO < 0.30) indicate that the PCA method is not a suitable technique for the data under study [50]. Bartlett's test of Sphericity index should reject the null hypothesis that there are no significant correlations in the data, so that PCA can be properly applied to the data [50].

Finally, to testify the practical or clinical significance of the components formed, only variables with communalities higher than 0.30 are used for PCA analysis. Communalities are defined as the total amount of variance on original variable shares holding all other variables included in the analysis constant. Also, the number of components to be retained follows the Kaiser criterion (eigenvalue > 1) [49].

3. Results

Table 1 presents mean values of economic costs surveyed from goat farmers. The mean value of labour expenses is about EUR 6140.64 per farm. Additionally, the feed cost is also high and is calculated at EUR 9645.57 per farm. Finally, the fixed assets interest and depreciation play a crucial role in the total production cost. Table 2 compares mean economic results with and without subsidies. According to Table 2, the total revenue without subsidies is EUR 21,215.62 and with subsidies is EUR 57,158.99. Farm income and family farm income are EUR 8259.60 and EUR 6230.36, respectively, without government subsidies and EUR 41,572.93 and EUR 11,418.79, respectively, with such subsidies. The Return Over Variable Costs (ROVC) and Net Farm Income (NFI) with current government subsidies are both positive at EUR 44,598.07 and EUR 32,530.08, respectively. However, when subsidies are subtracted, ROVC is positive at EUR 11,284.74 but NFI is negative at EUR−783.24 per farm. Finally, the capital efficiency is 1.14% without subsidies and 17.06% with subsidies.

Table 1. Descriptive statistics of economic costs in Euros (€) used in farm budget and statistical analyses.

Production Expenses (€)	Mean	Standard Deviation	Percent of Total Production Expenses
Land expenses			
Imputed rent	243.90	263.04	1.11
Hired land expenses	126.61	215.49	0.57
Total Land expenses	370.50	373.17	1.68
Labour expenses			
Family labour expenses	4461.82	6682.09	20.36
Hired labour expenses	1678.82	2658.55	7.66
Total Labour expenses	6140.64	9039.72	28.02
Variable cost expenses			
Foreign engineering labour expenses	320.46	341.42	1.46
Feed cost	9645.57	17,634.46	44.01
Fuels/water/electricity	419.43	572.99	1.91
Drugs/antibiotics	373.81	540.37	1.70
Circulating capital interest	416.26	717.71	1.89
Total variable cost expenses	11,175.52	18,949.17	50.97
Fixed cost expenses			
Fixed assets interest	1118.07	1421.93	5.10
Depreciation	2751.15	3752.71	12.55
Maintenance	240.22	311.84	1.09
Insurance premiums	116.37	141.63	0.53
Total fixed cost expenses	4225.80	5565.37	19.27
Total production cost	21,912.48	32,385.89	100

Table 2. Economic results of the mean goat farm with and without subsidies.

Economic Indicators	Without Subsidies		With Subsidies	
	Mean	Standard Deviation	Mean	Standard Deviation
Total revenue	21,215.62	31,440.27	57,158.99	135,597.7
Family farm income	6230.36	11,418.79	39,543.69	143,232.5
Farm income	8259.60	13,150.79	41,572.93	163,352.8
Return over variable cost (ROVC)	11,284.74	16,471.98	44,598.07	133,623.6
Net Farm Income (NFI)	−783.24	8877.355	32,530.08	123,362.8
Capital efficiency	1.14	17.43	17.06	18.93

Before the PCA analysis, two basic conditions must be met. The first is the Kaiser–Meyer–Olkin Measure of Sampling Adequacy or simply KMO and Bartlett’s Test of Sphericity must be performed to understand if the variable count and sampling size allow the application of PCA or not. Our test results suggest that PCA can be properly used [51] (Table A1).

The KMO index is 0.918, indicating that PCA was appropriate (>0.500). Bartlett's test of sphericity was significant with p -value ≤ 0.001 assuming an a priori significance level (α) of 0.01. Therefore, it was concluded that the strength of the relationship among the variables was high (Table A1). Therefore, the PCA can be applied to the data as both basic PCA requirements are met.

The PCA performed on the dataset of indicators yielded three principal components. The three main components (factors), that are exported, explain 83.99% of the total variance. The first, second, and third major components explained 68%, 8.3%, and 7.69% of the total variance, respectively. Principal Component Analysis (PCA) is extracted after VARIMAX rotation of the axes, three components that account for 83.95% of total variance. Only the "loadings" that were at an absolute value ≥ 0.500 were taken into account. "Loadings" greater than or equal to 0.300 have general practical significance [48], but for the specific sample size ($N = 200$), "loadings" with an absolute value of ≥ 0.500 are also statistically significant at significance level $\alpha = 0.05$ with power level $\gamma = 0.80$ [48]. Regarding the suitability of the PCA model, Bartlett's test of sphericity showed that the correlation matrix differs significantly from the identity matrix ($X^2 = 5916.981$ degrees of freedom = 78, $p < 0.001$), and the index, or otherwise the sample adequacy measure of Kaiser, Meyer, and Olkin (KMO), relative to the appropriateness of the data for PCA (possibility to factorize the correlations matrix), was found to be equal to 0.918, much above the allowable limit of 0.50 to 0.60 according to other studies [48,52,53]. Since our KMO value was greater than 0.40, this indicated a satisfactory quality of data reconstitution from the model of the three components (Table A2) [48].

According to Table 3, the PCA highlighted three significant components. This first component has a significant correlation with all cost parameters, except for land costs and the circulating capital interest. The second component has a high correlation with two variables related to land expenses. The third component is mainly related to the circulating capital interest. Therefore the first, second, and third components can be characterized as general costs, land expenses, and a local cost dimension, respectively.

Table 3. Principal Component rotated loadings resulting from PCA and Communalities for the economic variables.

Variable Names	PC1	PC2	PC3	Communalities
Depreciation	0.97			0.97
Fixed assets interest	0.97			0.97
Insurance premiums	0.96			0.95
Fuels/water/electricity	0.94			0.91
Foreign engineering labour expenses	0.93			0.89
Hired labour expenses	0.92			0.87
Family labour expenses	0.91			0.85
Drugs/antibiotics	0.91			0.83
Feed cost	0.88			0.80
Maintenance	0.80			0.67
Hired land expenses		0.77		0.64
Imputed rent		0.75		0.62
Circulating capital interest			0.97	0.95

In the first component, the greatest impact on the determination of the general cost is linked to depreciation and fixed assets interest. This is followed in descending order by insurance premiums, other expenses such as fuels, water and electricity, foreign engineering labour expenses, hired labour expenses, family labour expenses, drugs and antibiotics, feed cost and maintenance. After VARIMAX rotation, the percentages of total variance explained by principal components were calculated. The first principal component explains 65.47% of total variance. The percentages of variance explained were lower for the second principal component including land cost (10.52%), and the third principal component, relating to circulating capital interest (7.95%).

Moreover, Table 3 shows the communality values for the cost production variables.

A communality explains the degree of the variance for the particular extraction that is being accounted for by the other variables. Small values indicate variables that do not fit well with the factor solution, and should possibly be dropped from the analysis. As can be seen, each variable separately explains more than 30% of the total variance in the factor, which shows not only the practicality but also the significance of these variables [42]. The communalities ranged from 0.62 to 0.97, implying that each variable's variance was well represented in the extracted components and hence PCA. As a rule of thumb, a value greater than 0.35 is acceptable for the PCA analysis in order to achieve a 0.05 significance level and 80% level of power [48]. However, some sources and papers raise this value up to 0.5 or 0.6 [54,55].

4. Discussion

4.1. Contrast to Prior Literature

Despite the significance of the Greek goat industry, limited in-depth economic research efforts have been made [56]. The sustainability of the small ruminant sector has been studied, and it was indicated that the economic challenges are among the most relevant for the future development of this sector. Low availability of perennial pastures results in high feeding costs and the insufficient structure of farms prevents the future sustainability of this sector. Other researchers [57] measured farm sustainability with the use of financial indexes and concluded that the balance sheet should be taken into consideration. Several authors [17,58,59] proposed different strategies to improve the economic sustainability in Greece's goat sector such as increasing farm size, promoting feed self-sufficiency, promoting cooperatives and relationships between farmers. Using grass as a grazed food source for goats results in less reliance on external feed and, therefore, reduced farm costs [60]. Moreover, the optimization of labour management during intensive times of the year should improve sustainability. It could be possible to improve the economic performance of livestock farms by modifying the conditions and criteria for obtaining European Common Agricultural Policy (CAP) subsidies in favor of environmental conservation, which could enhance the sustainability of livestock farms [61].

4.2. Making Subsidies Contingent on Environmental Outcomes

Goat farms are not viable without subsidies. For the viability and sustainability of the farms, it is essential to take into consideration how subsidies could be tied to agro-environmental outcomes. The economic aspect of the development should perceive society and the natural environment not as its inhibitors but rather as catalysts [62]. The sustainability of livestock farms involves the planning of farming production in a way that is environmentally and resource-friendly [63]. Researchers [64] argue that livestock production is affected by intensive production systems, which involve environmental and animal welfare concerns. Future production systems will be influenced by the competition for natural resources such as land and water [65]. The research community has long recognized the negative economic and environmental effects of subsidies on industrial development. There is no doubt that subsidies have served their short-term objectives, but in the long run, they have adverse impacts on the environment and economic efficiency, such as grazing lands and water [65].

The increase in capital expenditure is conducive to high economic efficiency in Europe. On the other hand, there is a concern that stimulating capital endowment under the CAP could encourage industrial livestock farming and lead to excessive investments [66]. Moreover, the effective use of resources is not only referring to the economic productivity growth at the farm level, but also refers to the ecological and economic dimensions of sustainable agriculture [67]. If goat farms want to be viable and sustainable, they should reduce their cost factors, through changes in land and input use [68]. Subsidies can only continue if environmental standards are implemented and enforced regardless of the number of animals. Farmers who apply environmentally friendly management practices should receive more economic support. The new European CAP regulations should point

out the importance of preserving long-term sustainable practices on Mediterranean pastoral landscapes [8].

The management of grasslands largely depends on ensuring that the forage supply that they depend upon is resilient in order to maximize the returns of livestock operations in the long term. For economically viable stocking rates, it is essential to utilize grazing practices that contribute to forage productivity and combat invasive species of woody plants and grasses [69]. By moving livestock herds through several paddocks, with only one paddock grazed at a time, rotational grazing allows plants in the other paddocks time to recover from herbivory effects [70]. Rotational grazing is an effective way to improve the profitability of goat operations while benefiting overall ecosystem health [71]. Rotational grazing systems require more labour due to more fencing repairs being needed and more frequent movement of animals taking place. In addition, potential barriers to the adoption of rotational grazing include the perceived high initial investment cost for fencing and water points that should be located no further than about 250 m from the farm [72]. The high installation cost and the labour requirements are barriers to the adoption of rotational grazing. Thus, the support from government subsidy programs can enhance the adoption of beneficial rotational grazing practices and reduce overgrazing.

4.3. General Discussion

4.3.1. The Role of Subsidies in Sustainability

Goat farming is an important production sector not only for Greece but also for other Mediterranean countries, as it contributes to the family business in rural areas. Over the last year, the sector experienced economic difficulties due to poor management and increased production costs, which were intensified due to the COVID-19 pandemic. Business, managerial, and economic factors can determine the sustainability of a sector [65]. The improvement of the cost structure can improve economic sustainability. The reduction in veterinary costs linked to animal health and the increase in biological efficiency in terms of quantity and quality of milk and meat production can lead to increased profit [73]. A reduction in infections can also improve the quality of products. Moreover, a change in the husbandry systems can improve small ruminant welfare. The improvement of building conditions can avoid crowding and poor animal health. The appropriate machinery can prevent chemical contamination of milk [73].

According to our results, goat farms in Greece are not profitable and they cannot survive without government subsidies. Return Over Variable Costs (ROVC) is positive, while Net Farm Income (NFI) is negative without subsidies. Positive ROVC and negative NFI suggest short-run profitability where variable costs are covered but revenues are not high enough to cover long-run fixed costs. This could compromise the successful transfer of the farm from one generation to the next. In addition, capital efficiency is very low, suggesting that the goat farms we studied do not use their assets satisfactorily. The farm and the family farm income are positive, but not satisfactory for the long-run continuation of goat farming.

In many European farms, production costs are higher than total revenues (up to 52% for dairy goats) [74], which necessitates a high dependence on EU Common Agricultural Policy (CAP) subsidies [17]. With this in mind, any strategic effort to reduce the production costs in goat farms in order to improve their economic sustainability should begin from the reduction in fixed assets' interest and depreciations. It is true that fixed assets' interest and depreciations increase if investments are made. As part of the Rural Development Program (2014–2020), funded by the European Union, a number of subsidies have been given to the agricultural sector during the past year to encourage sustainable development and to promote agri-food firms' competitiveness, also encouraging innovation through the use of technologies. In the food industry, technology has a strategic role in supporting innovation by facilitating production and opening up better access to information about production processes for customers [75]. In the goat sector, during the last few decades, the production system has undergone significant changes, and new technologies have been introduced.

The strategic link between innovation, novel technologies, and business performance has been highlighted [76].

In many countries, the capacity for innovation and adaptation has been held back by the same EU policy that has created a sector dependent on subsidies [56]. In Greece, and with specific reference to the government subsidies addressed to the upgrading of mechanical equipment and buildings, these measures were not properly designed in order to meet the real needs of goat farmers. It is, therefore, proposed that the policy makers and the government provide grants under the guidance of agricultural and livestock consultants and subsidize necessary mechanical equipment such as feed, milking machines and ice buckets, as well as the improvement of the buildings with autonomous systems.

4.3.2. Recommendations for Improving Sustainability

In Greece, the agricultural insurance system is supported by the government and is mandatory. The government insurance covers the losses in case of livestock death or slaughter due to epidemic diseases. Moreover, it provides assistance in case of disasters. The government insurance is an expensive risk mitigation tool. Without subsidies, livestock farmers would not be able to afford the high premium rates of livestock insurance policies [77]. Therefore, it is recommended for private insurers to enter the market in order to offer different insurance products and meet farmers' demand in terms of risk mitigation. Furthermore, in Greece, agricultural insurance is available only for yield loss and not for other forms of risk such as output price volatility. Price insurance that provides coverage against fluctuations in the product prices, and revenue insurance that provides coverage against changes in farm revenues, should be offered in the insurance marketplace. The volatility and uncertainty of prices is one of the greatest challenges in the livestock sector, which exerts a significant influence on its sustainability [56]. Other production costs need to be reduced for Greek goat farmers in order to improve financial viability. Fuels, water, and electricity can be reduced through the programs established by the Greek Ministry of Environment and Energy that concern subsidies for the purchase or lease of commercial electric vehicles. Moreover, there are other programs that subsidize the installation of autonomous photovoltaic systems in remote mountainous areas, which solve the problem of farmers' energy autonomy, enabling them to power their feed and milking machines, and ice buckets.

The foreign engineering labour expenses mainly concerns the cultivation works or the removal of manure from the farms. In order to reduce this cost, it is recommended that farmers hire contractors. Moreover, the use of workers and machines that belong to contractors may bring new ideas and technologies, thereby increasing productivity [78].

Labour costs also can impact cost determination. This cost consists of hired and family labour. The goat farming industry provides families with income and uses excessive farm family labour rather than hired labour [79]. Family farming is competitive because of the lower transaction costs within families compared with those associated with external labour [80–82]. For this reason, when labour needs to be decreased, hired labour can be reduced first, as it is more expensive [83]. It is suggested that hired labour be used in peak periods that arise from seasonal fluctuations. On the other hand, family labour cannot be reduced but it could become more productive and efficient with lower monitoring costs since farm family members are residual claimants on farm profits [80,84]. Participation in seminars that are related to farm management and access to new technology will lead to the improvement of farm management, as emphasized in the livestock and in other strategic sectors [3,85].

The participation in health programs will prevent the animal's diseases and reduce the cost of drugs. A possible preventive treatment could be based on alternative drugs, which may improve animal health and welfare conditions on farms [86]. Moreover, the improvement of livestock management, such as nutritional and hygienic practices, will reduce the need for antibiotics and drugs.

The rational use and the quality improvement of the feed, as well as the use of a well-balanced and economic rations, will lead to more efficient use of feed. The participation in forage programs, in which goats graze for more days per year, will reduce the feed cost. For example, goat grazing can be restricted for a limited time each day with goats moved at the end of the day to another pasture to avoid overgrazing [87]. Moreover, due to grazing, farmers can design alternative feeding plans according to the availability of resources and by adjusting the feeding costs [87].

In order to reduce the cost of maintenance, it is recommended that farmers participate in technical and management training, as well as technical support and monitoring provided by direct technical assistance in the field [88]. The use of land both for grazing and for crop production can reduce land costs since the fixed cost of the same land base is distributed across two enterprises instead of only one. To minimize erosion, farmers can cultivate lower-sloped grazing land with crops. These crops can be grown not only for human consumption, but post-harvest crop residues could also be fed to livestock such as goats. The circulating capital interest will be reduced if there is a rational valorization of labor, combined with mechanization of production, and facilities modernization for ergonomic purposes. In addition, a well-balanced feed and the participation in health and energy programs will optimize the circulating capital interest factor.

5. Conclusions

In Greece, goat farming is a very special activity because is adaptable to nature, it provides high quality products and is a vital component of social cohesion in less-favored areas where other sources of income are absent. Moreover, it contributes significantly to the country's gross agricultural production value. Last year, during the COVID-19 pandemic, goat farming was challenging. The majority of the farms are not sustainable in the long run and the future is uncertain due to the risk of further marginalization. The study of the economic structure of the farms is an important attribute for farmers to understand so they can face future changes. Many researchers study and measure farms' economic sustainability in order to mitigate current challenges faced by farmers. These studies can provide details of the farm households' income levels, which could then be analyzed in relation to other productive sectors. It is essential that the study of sustainability in the livestock sector focuses on specific indicators that can be applied more generally to other agricultural industries, countries, and regions. The selection of economic indicators should follow two basic criteria. First, the indicators should address important issues for policy makers in order to infer when action is needed [38,89,90]. Second, farmers should understand the value of indicators to optimize their use [91]. Moreover, the appropriate economic indicators should be calculated based on a 3-year average to minimize outliers [92,93]. Future research should focus on replicating our analyses for goat industries in other countries to see if their farm economics and agricultural policies could be leveraged for improving community and/or environmental outcomes.

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Appendix A

Table A1. KMO and Bartlett's Test.

Kaiser–Meyer–Olkin Measure of Sampling Adequacy.		0.918
Bartlett's Test of Sphericity	Approx. Chi-Square	5916.981
	Df	78
	Sig.	0.000

Table A2. Matrix of the explained total variance and eigenvalues.

Component	Initial Eigenvalues			Extraction SS Loadings			Rotation SS Loadings		
	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %
1	8.85	68.00	68.00	8.85	68.00	68.00	8.51	65.47	65.47
2	1.08	8.30	76.30	1.08	8.30	76.30	1.37	10.52	76.00
3	1.00	7.69	83.99	1.00	7.69	83.99	1.03	7.95	83.95
4	0.79	6.08	90.70						
5	0.53	4.08	94.15						
6	0.21	1.61	95.76						
7	0.18	1.38	97.14						
8	0.15	1.15	98.29						
9	0.10	0.77	99.06						
10	0.07	0.54	99.60						
11	0.04	0.30	99.90						
12	0.01	0.08	99.98						
13	0.00	0.02	100.00						

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