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Kenan KESKİNKILIÇ^{1*}

Canan ABAY¹

Ege University, Faculty of Agriculture,
Department of Agricultural Economy, 35100,
İzmir, Türkiye

* Corresponding author (Sorumlu yazar):

kenankeskinlic@gmail.com

Sustainability of sheep farming: A case study of İzmir province*

Koyunculuk faaliyetinin sürdürülebilirliği: İzmir ili örneği

* This article is summarized from the corresponding author's doctoral thesis.

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ABSTRACT

Objective: The objective of this study was to measure sustainability level of sheep farming and to make suggestions on the policies that could be developed for improving the production, marketing and management of its processes by examining holistically the economic, social and environmental factors which are effective in sheep farming.

Material and Methods: The data set of the study obtained from surveys with 126 sheep enterprises in the year 2018 in İzmir. Sustainability has been measured with the aid of a composite index calculated using a series of hierarchical methods.

Results: The sustainability composite index was calculated as 28.30% (economic sustainability 14.13%, social sustainability 4.76% and environmental sustainability 9.42%). According to the sustainability level reference developed by FAO, the sustainability of sheep farming in Izmir is at the limit.

Conclusion: Economic factors are more effective than social and environmental factors in the sustainability of sheep farming activities. However, improvement of the system and sustainability depends on a holistic approach that considers the evaluation of economic, social and environmental factors.

ÖZ

Amaç: Bu araştırmanın amacı koyunculuk faaliyetinde etkili olan ekonomik, sosyal ve çevresel faktörleri bütüncül yaklaşımla inceleyerek sürdürülebilirlik düzeyini ölçmek ve faaliyetin üretim, pazarlama ve yönetim süreçlerini iyileştirmeye yönelik geliştirilebilecek politikalara önerilerde bulunmaktır.

Materyal ve Yöntem: Çalışmanın veri seti 126 koyunculuk işletmesi ile 2018 yılında yapılan anketlerden elde edilmiştir. Sürdürülebilirlik, bir dizi hiyerarşik yöntem kullanılarak hesaplanan kompozit endeks yardımıyla ölçülmüştür.

Araştırma Bulguları: Araştırmada sürdürülebilirlik kompozit endeksi %28.30 (ekonomik sürdürülebilirlik %14.13, sosyal sürdürülebilirlik %4.76 ve çevresel sürdürülebilirlik %9.42) olarak hesaplanmıştır. FAO'nun geliştirdiği sürdürülebilirlik düzeyi referansına göre İzmir ilinde koyunculuk faaliyetinin sürdürülebilirliği sınır seviyesindedir.

Sonuç: Koyunculuk faaliyetinin sürdürülebilirliğinde ekonomik faktörlerin sosyal ve çevresel faktörlere göre daha etkili olduğu anlaşılmaktadır. Ancak sistemin ve sürdürülebilirliğin iyileştirilmesi ekonomik, sosyal ve çevresel faktörlerin bir arada değerlendirildiği bütüncül yaklaşıma bağlıdır.

Keywords: Composite index, sheep farming, sustainability

Anahtar sözcükler: Kompozit endeks, koyunculuk faaliyeti, sürdürülebilirlik

INTRODUCTION

Sheep farming has an important place in animal production activities in the world. In various countries, pastures and grasslands which are not used for other purposes can be properly utilized through sheep farming. Sheep transform the natural vegetation in such areas into foods necessary for human nutrition, such as meat and milk; makes use of poor pastures better than other livestock species. Sheep also produce products such as fleece and leather used to make clothing necessary for human survival (Emsen et al., 2008). However the sector has been facing different problems and trying to cope with them.

Besides being an economic activity, sheep farming has also been the lifestyle of most rural households in terms of social and cultural aspects. However, the primary source of income of many households, especially in mountainous regions, where herbal production activities are carried out in limited areas and in low quantities, is sheep farming. In line with all these statements, it can be stated that sheep farming activity has a strategic importance for Turkey. For this reason, the sustainability of the sheep farming activity is of importance .

Due to its problems in recent years, sheep farming activity has begun to be abandoned. According to the Turkish Statistical Institute data, while the country population was 45 million in 1980 there were 50 million sheep, by 2018 the population of the country reached 81 million, but the number of sheep decreased to 33 million. In the sheep farming industry, Turkey is still the 10th largest country in the world, with 33 million sheep assets. But, with the effect of the increasing population in Turkey, the total demand for meat has become unattainable with domestic production and imports have begun in order to meet the domestic demand.

In addition, the decrease in pasture areas, the increase in production costs and the unwillingness of the young population to sheep farming have also contributed to the decrease in the number of sheep and the increase in the red meat deficit. Considering the existence of proper conditions, that constitute absolute superiority justifications for Turkey, such as Turkey's sheep farming past and experience, having necessary climate and geography for sheep farming, it is of great importance to increase the number of sheep by re-developing the sheep farming activity. This is also a requirement of the national economy understanding.

Farming systems have a complex nature. In understanding these systems and designing sustainable management strategies, it is necessary to perform a holistic approach while analyzing indicators that are based on multiple criteria (Masera & . Lopez-Ridaura, 2000). In this context, factors such as having a labor-intensive venture attribute, affected by natural conditions, intensive use of input etc. indicate that sheep farming is influenced by many variables.

In agricultural activities, production units are predominantly small-scale, the education and income level of the operators are low, self-sufficiency in production is at the forefront, supply and demand flexibility in terms of production and consumption is low and production is mostly under the influence of natural conditions. Although these variables cause many risks and uncertainties in the production-marketing-management triangle, they directly affect the sustainability of agricultural activities.

In recent years, sustainability of production in agricultural activities subject has become the focus of both scientists and authorities (developed countries, multinational agricultural enterprises, etc.) Measurability of sustainability is of great importance both for identifying errors and deficiencies experienced in production and hinder sustainability and also for offering solutions. The economic, social and environmental problems of the sector adversely affect the future and sustainability of the sheep farming.

The main purpose of this research is to measure sustainability by considering the economic, social and environmental factors that are effective in sheep farming and with scientific findings to shed light on the potential policies that can be developed to improve production, marketing and management processes of the sector. This research also includes findings and information that will contribute to future studies.

There are many scientific studies on sheep farming in different disciplines that have taken place in the literature in the national and international arena. Researchers have examined not only the economic dimension of sheep farming, but also its sociological and environmental dimensions. However, the number of studies dealing with these three dimensions as a whole is quite limited.

Sheep farming in Turkey cannot meet the demand of the market. The decrease in the total number of sheep in the last two decades has led to a decrease in the supply of products such as meat, milk and leather. The shrinkage of the sector also causes a decrease in employment and impoverishment of the rural (Kaymakçı et al., 2018). One of the most important environmental factors affecting the sustainability of sheep breeding activity is sufficient pasture availability and pasture quality in the region (Gezici, 2018). Problems such as market, cost of feed and insufficient government support negatively affect the sustainability of enterprises (Kılıç et al., 2013).

Sustainability is influenced by the history of society, cultural values and traditions. The agricultural system contains ecological, social, political and economic elements. For sustainable development, it is necessary to improve human and animal health and protect rural life (Madai et al., 2009).

The level of sustainability of agricultural systems should be considered not only from economic and environmental aspects, but also from social aspects (Ruiz et al. 2009). In the study of Hasanshahi et al., the economic, social and environmental sustainability of agricultural production was analyzed in Iran. By comparing the production pattern and examining the variables affecting production in the Marvdasht Plain, they uncovered the gaps that hinder sustainability. In order to achieve this goal, they benefited from the composite index used to determine sustainability and the economic, social and environmental sustainability indicators, which include three dimensions and consist of 11 indicators (Hasanshahi et al., 2015).

MATERIALS and METHODS

Material

Primary data, the main material of the study, were obtained through face-to-face interviews from 126 enterprises whose core business is sheep farming and resident in Bergama, Dikili, Ödemiş and Tire districts of İzmir, in 2018. Secondary sources were also used in this study. The data of the secondary sources consists of the resources such as the official statistical channels sources as Turkey Statistical Institute, the United Nations Food and Agriculture Organization (FAO), Organization for Economic Development and Co-operation (OECD) etc and, various national and international doctoral and master's theses, books, articles, papers, reports, etc.

Methods

Methods used to collect data

The main population that is the subject of the research findings of this study is the enterprises whose main activity is sheep farming in İzmir province. Primary data collected from enterprises and used in the sustainability analysis were obtained through face-to-face interview survey method. In order to determine main population, official records are taken into consideration. Number of sheep belonging to sheep farming enterprises, establishment campus and contact information are obtained from Republic of Turkey Ministry of Agriculture and Forestry Animal Information System and İzmir Province Sheep and Goat Farmers Association. By combining these sources containing common business information, the widest number of businesses has been reached. Then, basing on the number of sheep assets in their totally owned animal assets population (sheep, goats, cattle and buffalo), the main focus group enterprises of the study whose main activity is sheep farming was determined and formed. Hereunder; the number of enterprises engaged in sheep farming activities in Bergama, Ödemiş, Dikili, Tire, Menemen, Kiraz, Aliağa, Bayındır, Kınık, Menderes, Torbalı, Seferihisar, Kemalpaşa, Foça, Urla, Çiğli and Bornova districts of İzmir province is listed in descending order to reveal the main mass distribution. As a result, it was determined that the main population consists of 3094 sheep farms in 17 districts.

Since the sheep farming activities of the enterprises to be surveyed will be examined, each enterprise has been given an equal right to be selected. For this reason, simple random sampling method was decided to be the most appropriate one and the formula developed for finite main populations was taken as the basis for the sampling calculation.

$$n = \frac{NS^2}{(N-1)D^2+S^2} \quad \text{and} \quad D = \frac{d}{t} \quad (\text{Oğuz \& Karakayıcı, 2017}).$$

In the formula; n: Number of samples, S: Standard deviation, N: Number of enterprises in population, S2: Variance, t: t probability value at 95% confidence limit, D: Accepted error (5%), d: Margin of error for the mean.

$$n = \frac{3094 \times 74,7^2}{(3093 \times 42,32) + 74,7^2} = 126$$

According to the formula; the sample size was determined as 126 with 95% confidence interval and 5% accepted error. Time and economic constraints were also taken into consideration in the process of calculating the distribution of 126 producer surveys by district. Accordingly, 4 districts representing the main population at the level of 52% were determined, taking into account the number of enterprises, number of sheep and pasture area on district basis. As a result, considering the number of enterprises in these four districts, it is planned to conduct a total of 126 producer surveys with 48 samples in Bergama, 32 in Ödemiş, 25 in Dikili and 21 in Tire.

Methods used in data analysis

Recent literature on sustainability assessment of agricultural systems defends the adoption of integrated, flexible, participatory and multi-scale approaches to address complex issues involving various disciplines and stakeholders.

In this study, the sustainability was measured and obtained value was compared with the sustainability level reference values developed by FAO and accordingly the sustainability level of sheep farming activity in İzmir province was revealed. The main purpose of the method was to obtain an index score. The calculation process of this index, known as the composite sustainability index, consists of using a series of hierarchical methods (Figure 1). In the first stage of this hierarchical method, the set of indicators affecting the sustainability of the sheep farming was constituted.

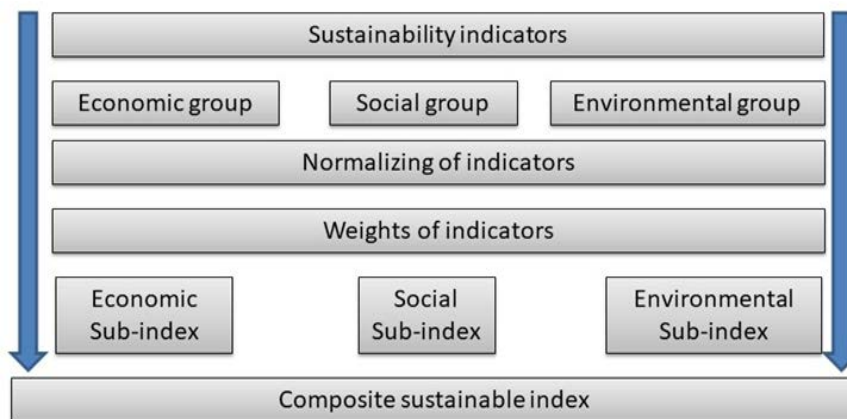


Figure 1. Composite sustainability index stages (OECD, 2008; Krajnc & Glavic, 2005; Hasanshahi et al., 2015).

Şekil 1: Komposit sürdürülebilirlik endeksi aşamaları (OECD, 2008; Krajnc & Glavic, 2005; Hasanshahi et al., 2015).

In the second stage, numerous and interrelated indicators were reduced to 3 dimensions (economic, social and environmental) using the principal component analysis (PCA) method. In the third stage of the analysis process, normalization was applied to the data with the min-max method to bring the indicator values of different measurement units to a common denominator. Thus, scale error has been eliminated. In the fourth step, the normalized indicator values are weighted by the analytical hierarchy process (AHP) method. Developed by Saaty, AHP is a method used for solving decision making problems. This method is a useful measurement model based on subjective management inputs based on multiple criteria. These inputs are converted into scores that are used to evaluate each of the possible alternatives. AHP is a powerful management science tool that has proven successful in creating complex multi-criteria decisions in business (Saaty, 1980).

Accordingly, the contribution of the indicators to the composite index was calculated as percentage, and in the fifth stage, by combining these values the percentage values (contribution to the index) of the basic (sub) components were obtained. In the last stage of the sustainability analysis, equal contribution was given to these three main component values. Thus, the composite sustainability index was calculated by summing the calculated new component values.

The indicators used in this study were formed by taking into consideration exemplary scientific studies conducted in the international field and also the opinions of experts such as producers, zoo technicians, veterinarians and agricultural engineers of the field. Thus, 8 sustainability indicators reflecting the economic, social and environmental dimensions were selected for the study. Sustainability indicators, measurement methods and units are specified in Table 1.

Table 1. Indicators of sustainable sheep farming

Çizelge 1. Koyunculuk faaliyeti sürdürülebilirlik göstergeleri

	Indicator	Measurement	Unit
1	Economic efficiency	Agricultural production value / Total cost	%
2	Labor profitability	Net profit / Labor	TL
3	Animal profitability	Net profit / Number of sheep	TL
4	Animal fertility	Animal production value / Total number of sheep	TL
5	Non-agricultural income	Non-agricultural income / Total income	%
6	Employment	Contracted employee / Total employee	%
7	Presence of pastureland	Pasture area / Total agricultural area	%
8	Animal density	Number of animals / pasture area	%

Source: Indicators 1-6 are compiled from Ripoll-Bosch et al., 2012, Ripoll-Bosch, & Bernués, 2014, and Vitunskiene & Dabkiene, 2016. Indicators 7 and 8 were determined by the author.

RESULTS and DISCUSSION

In this section, sustainability of sheep farming activities in the research area is analyzed. In analysis process, sustainability indicators were determined, economic, social and environmental indicator values were calculated with these indicators and a composite sustainability index was constituted as a result. Sustainability level of sheep farming was revealed according to the calculated index value, and obstacles to the sustainability were determined by interpreting the contribution of indicators to the index.

The sustainability indicators specified in Table 2 have been collected in three sub-components by PCA analysis. Accordingly, Labor Profitability, Animal Profitability, Economic Efficiency and Animal Productivity indicators formed 1st Main Component, Pasture Status and Animal Density indicators formed the 2nd Main Component, and Employment and Non-Farm Income indicators formed 3rd Main Component. Considering the common properties of indicators following definitions are made: 1. Main

Component: Economical Indicator, 2. Main Component Environmental Indicator, and 3. Main Component: Social Indicator. At this point, the group of economic indicators reflects the economic well-being, productivity, profitability, and financial condition of the farm; the group of social indicators reflects worker and animal welfare and the productivity of the enterprise; the environmental indicators group reflects the effects of the availability and use of natural resources on sustainability.

According to the results of the hierarchical analysis, the contribution of economic indicators to the sustainability index is 14.13%; the contribution of social indicators to the sustainability index is 4.76%; the contribution of environmental indicators to the sustainability index was calculated as 9.42%. As a result, by summing up sustainability index scores of the three main components the Composite Sustainability Index value obtained was calculated as 28.31% (Table 2).

Table 2. Sustainability index analysis results

Çizelge 2. Sürdürülebilirlik endeksi analiz sonuçları

Sustainability Indicators	Main Components	Contribution of Indicators to the Index (%)	Sustainability (%)
Economic efficiency			
Labor profitability	Economic	14.13	28.31
Animal profitability			
Animal fertility			
Non-agricultural income	Social	4.76	
Employment			
Presence of pastureland	Environmental	9.42	
Animal density			

It is possible to interpret the sustainability measurement results from two different perspectives. Firstly; the calculated composite sustainability index value of 28.31% has been compared with the sustainability level reference table developed by FAO (Table 3) and it has been determined that the result is in the second place in the reference table, that is, within the percentage range of 21-40%. Accordingly, it has been determined that the sustainability of sheep farming activity in the research region is at the limit.

Table 3. Level of sustainability reference table

Çizelge 3. Sürdürülebilirlik düzeyi referans çizelgesi

Performance	Score	Percentage Score
Best	5	81-100 percent
Good	4	61-80 percent
Moderate	3	41-60 percent
Limited	2	21-40 percent
Unacceptable	1	0-20 percent

Source: FAO, 2013.

From the second perspective, the impact levels of sub (economic, social and environmental) indicators on the sustainability index can be examined. According to Table 2, the contribution of economic indicators to the index is 14.13%, the contribution of social indicators to the index is 4.76% and the contribution of environmental indicators to the index is 9.42%. As it is understood from the index contribution values, the highest contribution to the sustainability of sheep farming activity comes from economic indicators, while the lowest contribution comes from social indicators. Accordingly, this adds up economic factors in the research region are more effective than social and environmental factors in terms of the sustainability of sheep farming activity. In other words, the level of economic sustainability level is higher than social and environmental sustainability.

The second highest contribution to composite sustainability index comes from the environmental indicator. At this point, it can be stated that the sustainability index, which is at the limit, is affected by two important factors namely the presence of sheep and the insufficiency of pasture areas. Although pasture areas seem to be relatively sufficient in terms of the presence of sheep in the region, pastures are insufficient in terms of grass quality. Overgrazing and neglected rangelands negatively affect sustainability in the research area.

The lowest contribution to the sustainability index came from social indicators. At this point, it was determined that employment and non-agricultural income indicators negatively affect the sustainability of sheep farming activity. Based on this, it can be stated that the biggest obstacle to sustainability which is at the limit is social indicators. As it can be recalled from the survey results of the study; while family labor force utilization percentage is 88.43, the use of outsider labor is 11.57%. The low level of outsider labor utilization can be considered as a significant threat to the future of the business, considering the aging population of sheep farming.

As stated in Madai's study (2009) in sheep sector there are a lot of lack of sectoral strategies. Some important of them are consumed forages, knowledge, low capacities, low interests and low social prestige, the lack of experts and producers, high forage prices and cost level. The problem tree of sheep farming shows that the resultant of problems is focused in a single great block of effects, which is entitled "a sector reacting to economic, social and environmental changes and challenges with difficulty". This is a relation of cause and effect which further weakens the competitiveness of Hungarian sheep farming, its added value and innovation are of low level, and thus it is not sustainable in the long run. For all these reasons the region cannot retain its population, enterprises are liquidated, landscape gets transformed; production and commerce become unviable. Social and societal problems are embodied in the fact that the sector loses its prestige, the production layer is ageing; however, provincial unemployment, which cannot be converted into other areas, soars. Economic-environmental problems are due to the fact that the capital attraction potentials of sectors are low and as a result of unexploited and neglected grasslands the costs of landscape maintenance and health care increase.

CONCLUSION

In Turkey, sheep farming is not only an economic activity, but also it is also an activity that has a long standing socio-cultural background and has become the lifestyle of many rural people. The number of sheep in Turkey is not increasing in parallel with population growth. Some years even decreased. This situation points out that there are some obstacles to sustainable production. These barriers are not only caused by economic factors such as price and cost, but also include many social and environmental factors such as employment, education and natural resources. It is seen that these problems negatively affect the future and sustainability of sheep farming activity.

According to the results of the sustainability analysis for the research area; the sustainability of sheep farming in Izmir province is at the limit. While the highest contribution to sustainability comes from economic indicators, economic sustainability is followed by environmental and social sustainability, respectively.

The fact of sustainability is at the limit in sheep farming activities indicates that the sector has some economic problems. Production costs are at the top of these problems. The cost of feed input is very important in terms of economic sustainability. Although the production process is predominantly based on pasture, especially the costs of scientific feed group such as milk feed and grower feed significantly affect the economic efficiency.

Labor expenses are another important factor affecting profitability. A significant part of the work force required by sheep farming, which is a labor-intensive activity, is met from the family work force. Although the operators want outsider employment assets, they are not at a level to afford labor wages, so

they must cover almost all the total job from the family workforce. It is understood that this situation is a mandatory option for the operators. In the interviews, it was understood that most important reasons why the operators wanted to stay away from the sheep farming activity were the lack of time for their private life due to workload, their distancing from social life and they could spend very little time with their families. It has been determined that this is the main reason that especially the young generation do not want to engage in sheep farming activities. At this point, the sustainability of the workforce is of great importance in terms of both economic and social sustainability.

Animal productivity is another factor affecting economic sustainability. In the study area, live weights of sheep are not at the desired levels due to reasons such as pasture-based feeding and using low amount of concentrated feed. This situation is reflected in the carcass meat yield and causes a decrease in the unit income.

Environmental factors contribute significantly to the sustainability of the sheep farming activity. In areas where pasture conditions and animal density are suitable, feed expenses decrease significantly, and sheep farming becomes a more profitable activity. Although the presence of pasture area in the research area is sufficient in terms of animal density, it is not at the desired levels in terms of grass diversity and grass quality. On the other hand, changing ecological balance and insufficient rainfall during the year reduce the beneficial period of rangelands. Lack of alternation in pasture use shortens the life of rangelands. As a result, overgrazing and neglected pastures negatively affect environmental sustainability.

Lack of financing is the main obstacle to social sustainability. Therefore, financing policies are needed for sheep farming activities especially for small scale farming. Due to its nature, sheep farming should be evaluated as a whole, not only just in the economic dimension, but social, cultural, environmental and even technological dimensions should also be considered. In order to meet the deficit in the red meat demand of the country, the number of animals should be increased. For sustainable sheep farming, small-scale family businesses should be considered as special status ones, supports for the projects on pasture improvement should be prioritized, misuse of pastures should be prevented by law.

Stock markets for livestock, red meat, milk, forage and fleece wool exchanges should be established and active operation of the market should be ensured. This will result in operational market and accordingly accurate and reliable price mechanism can be achieved.

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