Technical efficiency of goat farming in the Western Mediterranean Region of Turkey by Stochastic Frontier Analysis

Recebimento dos originais: 21/04/2020
Aceitação para publicação: 14/01/2021

Şerife Gülden Yilmaz
PhD in Agricultural Economics
Institution: Bati Akdeniz Agricultural Research Institute
Address: Bati Akdeniz Agricultural Research Institute, Department of Agricultural Economics, P.O. Box:35 07100, Antalya, Turkey.
E-mail: **sgylmz@gmail.com**

Mevlüt Gül
PhD in Agricultural Economics
Institution: Isparta University of Applied Sciences
Address: Faculty of Agriculture, Department of Agricultural Economics.
P O.Box:32260, Isparta, Turkey
E-mail: **mevlutgul@isparta.edu.tr**

Abstract

The purpose of this study was to determine the technical efficiency of goat farms in the Western Mediterranean Region of Turkey. The main material of the study constitutes primary data that were gathered in 2016 from 95 goat farms in the research area with face-to-face interview technique. Data were collected from 47 settlements for goat farmers using the stratified sampling method in the research area. In this study, Stochastic Frontier Analysis method were used for the data analysing. SFA TE Effects Model were used for the effects of socio-economic variables on technical efficiency. According to study results, the average technical efficiency score was found as 80%. Positive and significant correlation between meat production and the cost of veterinary, operating capital, the family labour, the marketing, concentrated feed per goat (TRY/goat) were found. The socio-economic variables of credit availability of small ruminant farms and education were found positive and significant. However, only grazing (grazing number/day) was found negative and significant. According to the research results, efficiency was found to be insufficient. It is possible that higher efficiency can be achieve the same amount of input.

Keywords: Goat farms, Technical efficiency, Stochastic Frontier Analysis, Western Mediterranean.

1. Introduction

Livestock, as in every country, is important for Turkey's economy in terms of to ensure animal protein need of the national population. In addition, livestock sector provides raw materials to the industrial sector, converts products and wastes of plant into useful food with the ability of animals and contributes to the country's employment. Especially small ruminant husbandry within this sector is important for the economy and continuity of small

family businesses (Dellal et al., 2002).

Turkey is among the leading countries in terms of possessing sheep and goats in the world. Sheep and goat breeding has an important share in domestic and foreign trade as well as meeting the meat and milk needs of people. However, there has been a rapid reduction in the presence of small ruminant in recent years, which has led to significant declines in the amount of products such as meat, milk and leather. Considering its share in employment, this situation has emerged as factor that is one of the important effectives affecting the further impoverishment of rural farmers (Anonymous, 2015).

Turkey which has a lot of small family business due to consumption habits of families in rural areas in terms of small ruminant farm, has quite an appropriate environment with its natural resources, grazing area for sheep and goats because of favorable pasture. Similarly, the Western Mediterranean Region that covers Isparta, Burdur and Antalya is an important region for with its natural resources, meadows and pastures. The Western Mediterranean Region which was designated as a research area, has approximately 5% of the small ruminant existence of the country. According to Turkish Statistical Institute data, there were approximately 2.2 million of 46.1 million small ruminant presence in this region in 2018. 1.22% ofaround 1.1 million tons of annual red meat production were provided from goat meat (13603 tonnes) in Turkey. Turkey meat production from sheep and goats has showed a decline as the ratio for the year. This ratio has declined from 20.9% to 10.2% in last 10 years. The amount of 10.2% meat production and 9.08% milk production of Turkey were obtained from goats and sheep (TUIK, 2015; TUIK, 2019). In this respect; Antalya, Isparta and Burdur is determined as the target area both in terms of the number of animals produced and the potential of animal product in Turkey which have animal food consumption is also very important.

Studies that were about efficiency of the goat farms in Turkey is limited. The possibilities of farmers who earn more products and/or income by spending their resources at a certain level are researched by efficiency. As one of the main objectives of the farmers is to improve the profit level, it is important to determine their efficiency.

Therefore, the main aim of this research was to determine the efficiency of the goat farms in the Western Mediterranean Region and to evaluate the factors affecting the efficiency.

2. Literature review

Efficiency analysis studies were carried out with different parametric methods for measuring the efficiency in agricultural businesses.

Data Envelopment Analysis (DEA) or Stochastic Frontier Analysis (SFA) methods were used to research the causes of inefficiency in dairy cattle (Dağıstan et al., 2009; Gul et al., 2018), crop production (Gul et al., 2009), fruit production (Gul, 2005; Gul, 2006; Örmeci Kart et al., 2018) and sheep-goat farms.

For example, Tauer and Belbase (1987) determined the technical efficiency of New York dairy farms with SFA and Cobb-Douglas production function. It found that 69% of the farms were working effectively on average.

Mao and Koo (1997) examined technological development in agriculture, growth in productivity and changing in efficiency between 1984 and 1993 in China using Data Envelopment Analysis. In a result of the research, it was stated that technical efficiency should be increased in the two regions examined. It was also been noted that the Chinese Government supposed to support rural development projects and helped farmers.

Günden (1999) used data envelopment method in his study which were researched efficiency of cotton producers in Menemen region. Technical efficiency value was calculated as 0.677 in the majority of the research area. It was stated that the current production could be increased by using 32.3% less input, or the production could be increased at the same level with the substantial inputs in the research area.

Jaforullah and Whiteman (1999) used the DEA method to study the relationship between technical efficiency and farm size in dairy industry in New Zealand. The technical efficiency that was found in the average of the farms was calculated as 89%.

Singh et al (2000) aimed to determine the effects of free market economy policies on milk cooperatives. They used Fisher index approach and Data Envelopment Analysis (DEA). According to the empirical results obtained, it was stated that the milk industry alone couldn't respond to price freedom and free market economy.

Koyubende and Candemir (2006) aimed to compare the production efficiencies of dairy cattle farms in Bayındır, Ödemiş, Torbalı and Tire districts located in Küçük Menderes Basin. This study was carried out by interviewing 80 farmers which was selected by proportional method. DEA was used to determine the technical efficiency of the enterprises. The average technical efficiency scores of the districts were respectively found as 0.939, 0.943, 0.984, 0.989. As a result of the research, it was stated that dairy cattle farms could not fully use their resources effectively in the research area, some resources were wasted in farms and the optimum production could not be realized.

Fogarasi and Latruffe (2007) used the Data Enveloping Method to determine the technical efficiency and efficiency changes of the agricultural enterprises that were dairy farmers in France and Hungary. As a result of the study, it was stated that the productivity increased in these years and French dairy cattle farmers produced more effectively.

Gündüz et al. (2011) used DEA to estimate the efficiency criteria of dried apricot farms and to determine cost efficiencies in Malatya province of Turkey. The data were obtained from 97 farms which were calculated by stratified random sampling method. The study was carried out on two groups. The results showed that their production costs could be reduce in farms by 30.3% and 44.2% respectively. It was stated that the main cause of technical inefficiency was pure technical inefficiency. It was also stated that it might be beneficial to reorganize the structure of the farms and control the marketing cost.

Parlakay (2011) aimed that technical, economic and allocative efficiencies of peanut farms were determined in Turkey. Data were obtained from 90 farms which produced peanuts in Adana and Osmaniye. DEA and SFA methods were used to calculate efficiency. As a result of the efficiency analysis, the technical effeciency ranged from 0.81 to 0.86. Economic and allocation efficiency values were estimated as 0.60 and 0.74. When the correlation between efficiency levels and variables was examined, a positive correlation was found between education level, peanut growing area and nitrogen usage. It was reported that the relationship between only education level, peanut growing area and family labor force was statistically significant.

Gül et al. (2016) estimated technical efficiency using DEA in goat breeding in Isparta province. In the research area, data were obtained by interviewing 92 goat farmers. The average efficiency was respectively found as 0.44 and 0.66. Constant and variable return were determined according to the scale assumptions. It was reported that the most important factors which affected the productivity of goat production were cooperative membership, farming experience, milk yield per goat, family and temporary labor. It was stated that technical efficiency could be increased by providing research and development programs on goat breeding and training-extension activities which was well organized for farmers. In addition, it was stated that inefficiency mostly resulted from wrong input usage.

Small ruminant farms are important in the Western Mediterranean Region. There was also no study to examine the efficiency levels of goat farms in the region. Therefore, it was aimed to mesure technical efficiency of goat farms, to determine inefficiency factors and to offer solutions based on those findings to increase the level of efficiency.

3. Material and Method

The main material of this research consisted of data which were obtained from goat farms by using the face to face interview method. In addition, the data of TURKSTAT and Sheep and Goat Breeders' Association regarding the presence of small ruminants in the Western Mediterranean Region were also used. The data included the 2016 production period. "Neyman Model" which is one of the strafied methods was applied on the population of the research area (Çiçek and Erkan, 1996) and the sample size was found to be 95 for goat farms.

The Western Mediterranean Region which was determined to be study area consist of Antalya, Isparta and Burdur provinces. 18 districts which constitute 70% of the goat and sheep assets in these provinces as the research region were selected by using the Purposeful Sampling Method. In this context, Manavgat, Korkuteli, Elmalı, Döşemealtı, Kaş, Gazipaşa, Kumluca, Finike, Demre, Alanya districts in Antalya province; Bucak, Merkez, Yeşilova, Ağlasun in Burdur province; Eğirdir, Sütçüler, Merkez and Keçiborlu districts in Isparta province constituted the main population for goat rearing.

The efficiency was measured by using deviations from the production boundary which formed with the data obtained from the enterprises in the research area. In this study, Stochastic Frontier Analysis which is one of the three parametric methods was used.

SFA establishes a relationship between inputs and outputs within the scope of the regression logic. It estimates the production function by using of these relationships. Not only there are errors in the model but also it allows the separation of these errors (İnan, 2000). The production function that is used in the SFA method is explained below in detail (Aigner et al., 1977; Meeusen and Van den Broeck, 1977):

$$Yi = Xi\,\beta + Vi - Ui \qquad (1)$$

In this equation (1), Yi represents the output of 'i'st decision unit, β symbolizes the parameters of the (Kx1) dimensional input vector, Xi represents the (K+1) dimensional input line vector. The first element of this vector becomes "1". There are two error terms in the equation: Vi: It represents measurement errors, random factors that are not under operational control and other inputs that are not involved in the production function. Ui: It is a random variable that is non-negative and represents inefficiency. K is the number of input, X and Y represent inputs and outputs that are stated in logarithmic method (Coelli, 1996; Parlakay and Alemdar, 2011; Parlakay et al., 2017).

The technical efficiency that indicated to be TEi is calculated as below:

$$TEi = \exp(-U_i) \qquad (2)$$

After the efficiency scores were calculated in the analysis, these scores were take to be dependent variable. Different socio-economic variables were taken to be independent variables, and the factors causing inefficiency were determined statistically with the help of regression equations. Vi that was added to the model is a variable that can take negative or positive values, which was brought independent of Ui to the model that have normal or symmetric distribution. In this sense, it corresponds to the error terms in classical regression analysis. The existence of V means that the boundary is stochastic due to the random disruption of V (Kök and Çoban, 2010).

U's which have semi-normal or exponential distribution can only get positive values and show that the deviation from the efficiency boundary is due to inefficiency, not random causes (Caudill, 2002). U's taking positive value means that production is below the boundary. The technical efficiency of the enterprise is obtained by dividing the actual production to the border production. In this case, technical efficiency; Equal to e-Ui expression (Aigner et al., 1977; Şahin, 2002).

Factors that cause inefficiency is identified in efficiency analysis. The effects of external factors are obtained by Inefficiency Factors Model on productivity. The equation (3) is The Inefficiency Factors Model. ‘δ’ is the variable coefficient in the vector, and ‘Z’ is the explanatory external variables vector (Parlakay et al., 2017).

$$Yi = \beta * Xi + Vi - (\delta i * Zi) \quad (3)$$

It is thought that it will be more appropriate using SFA method due to the high number of risks and uncertainties in agricultural production in the efficiency studies of agriculture in developing countries (Coelli et al., 2003). However, many researchers works on the same dataset using both methods that are parametric and nonparametric techniques. Because they have strengths and weaknesses side so these are used comparing (Chakraborty et al., 2002; Kwon and Lee, 2004; Ören and Alemdar, 2006; Kaçıra, 2007; Gözener, 2013).

Considering that the enterprises examined in the region produce under similar conditions in terms of geographical location, agricultural technique and natural factors, technical efficiency was analyzed and interpreted. Many computer software has been developed to analyse efficiency (Coelli 1996a; Coelli, 1996b). In this study; Frontier 4.1 software was used for SFA.

In the Stochastic Frontier Analysis which was used to measure the technical efficiency of small ruminant farms in the region, inputs which were used extensively in production and had the greatest impact on efficiency were included. In the efficiency analysis, the amount of meat per goat (kg/head) of the meat sold during the yearas output, concentrated feed cost

(TRY/goat), veterinary cost (TRY/goat), marketing cost (TRY/goat), family labor force (TRY/goat), operating capital (TRY/goat) as input were used.

The variables that caused technical inefficiency were the farmer age (years), the farmer education level (years), farmer experience with goats rearing (years), grazing (number/day), grazing duration (hours/grazing), getting credit for small ruminant (1-yes, 0-no), getting support for small ruminant (1-yes, 0-no).

In the research summary statistics about variables were presented in Table 1. The average meat yield per goat which were obtained from the number of goats remaining in the farms at the end of the year was found to be 21 kg. The average concentrate feed cost per goatwas 67.77 TRY, the average veterinary cost per goat was 16.72 TRY, the average marketing cost per goat was 5.47 TRY, the average family labor cost per goat was 280.73 TRY and the average operating capital per goat was 1575.26 TRY to be found.

Table 1: Variables used in efficiency analysis in goat farms

	Minimum	Maximum	Mean	Standard Deviation
Output				
Meat production (kg / head)	1.00	411.40	21.0091	49.57766
Inputs				
Concentrated feed cost (TRY/goat)	1.00	798.00	67.7743	110.85930
Veterinary cost (TRY/goat)	1.00	200.00	16.7183	26.63448
Marketing cost (TRY/goat)	1.00	300.00	5.4660	30.65606
Family labor force (TRY/goat)	28.99	5050.00	280.7249	580.10822
Operating capital (TRY/goat)	302.12	19896.50	1575.2643	2791.99725

1 US dollar = 3.03 TRY (Turkish Liras)

4. Results and Discussion

Stochastic Frontier Analysis is output oriented. The purpose of the output-oriented measurements is to determine how proportionally the quantity of output can be increased without changing the input quantities used. When this is considered for goat breeding; the purpose was a possible increasing in the amount of meat production without changing the concentrate feed, veterinary, marketing, family labor costs and operating capital.

Technical efficiency score of the enterprises was found as 0.80 on average. While the efficiency scores of 24.2% of the farms were between 0.91-0.99, the efficiency scores of 38.9% were between 0.81-0.90, the efficiency scores of 14.7% were between 0.71-0.80 and 11.6% of them were between 0.61-0.70. There are no enterprises that was operated fully effectively. Meat production can be increased by 15% (1-80 / 94) according to SFA method

without changing the amount of input in enterprises (Table 2).

Inefficiency may occur due to the inability applying the appropriate input composition in agricultural enterprises. Farmers consider that they obtain more output by increasing the used of the amount of input. They ignore the most appropriate production with the most suitable input composition. In a study on fertilizers, it was seen that the producer used his own choice in the selection of fertilizers and ignored other data. Therefore, both the production cost increased and the desired yield could not be obtained with the wrong fertilizer application (Önceler and Arıoğlu, 2005). The determination that was obtained in this study supports the said judgment.

Table 2: Technical efficiency of goat farms

Number of Enterprises (Frequency)		
Technical Efficiencies		
	Frequency	Ratio (%)
<=0.50	4	4.2
0.51- 0.60	6	6.3
0.61- 0.70	11	11.6
0.71- 0.80	14	14.7
0.81- 0.90	37	38.9
0.91-0.99	23	24.2
Total	95	100.0
Summary Statistics		
Minimum 0.14		
Maximum 0.94		
Mean 0.80		

Gujarati (2006) stated that one of the most important problems which is encountered in econometric studies is multiple correlations between independent variables, and this can be measured by calculating the correlation between independent variables. Therefore, the correlation between these variables was examined in the SFA model.

In this study, the correlation coefficients between the variables that was included in the model were examined in order to reveal whether there are multiple correlation problems. As a result of the examination, it was determined that the correlation between all variables was positive. There was a strong and significant correlation between all variables except for family labor force. In addition, the family labor force had strong and significant correlation with only operating capital (Table 3).

Table 3: Correlation between independent variables in goat farms

Variables	Concentrated feed cost	Veterinary cost	Marketing cost	Family labor force	Operating capital
Concentrated feed cost	1	0.835**	0.691**	0.368**	0.772**
Veterinary cost	0.835**	1	0.716**	0.296**	0.748**

Marketing cost	0.691**	0.716**	1	0.094	0.677**
Family labor force	0.368**	0.296**	0.094	1	0.710**
Operating capital	0.772**	0.748**	0.677**	0.710**	1

It is significant at a **0.01 significance level

The coefficients of the SFA model were given in Table 4. A positive and statistically significant relationship between the amount of meat production per goat and concentrate feed costs, veterinary costs, marketing costs, family labor costs, operating capital usage were determined. While concentrated feed costs were significant at 10% level, marketing and family labor costs were significant at 5% level, veterinary costs and operating capital were found to be significant at 1%. All variable coefficients were positive, which means that increasing the usage of all of these variables will increase the amount of product. It means that effects of costs of veterinary services and the usage of operating capital are high on increasing the total amount of products. The capital status, possibilities and opportunities of the enterprise, also the vaccination monitoring, disease control are important for the positive continuation of the goat breeding in the enterprise.

In the technical efficiency study of the goat breeding with DEA in Isparta province, it was determined that the technical efficiency ranged from 0.13 to 1.00. The average efficiency was determined respectively 0.44 and 0.66 for constant and variable returns. Farming experience, milk yield per goat, cooperative membership, family and temporary labor were identified as the most important factors that effect the efficiency of goat rearing in the region (Gül et al., 2016).

In research which was conducted to determine the technical efficiency level of milk production farms in Jordan, it was stated that the technical efficiency of milk production was low and the average technical efficiency was at 39.5% level. A positive relationship were found between efficiency and all the variables in the technical efficiency. While herd size (cow-head), feed (kg), labor force (male-day) were found statistically significant at 0.01 level, veterinary costs were did not find significant (Al-Sharafat, 2012). Binici et al. (2006) calculated the average efficiency of dairy cattle farms as 50% in Burdur province. They stated that herd size and the type of the feeding system used and were statistically significant two factors that affect production efficiency. Wubeneh and Ehui (2006) found that family and foreign labor force (hour) were not significant in the technical efficiency model. They calculated the average efficiency level of farmers as 79%. Feed at 1%, veterinary costs at 5%, hybrid cows and concentrate feed at 10% was found significant and the relationship was positive in technical efficiency.

Tauer and Belbase (1987) found the average efficiency of New York dairy farms to be

69%. The used foreign labor ($), livestock costs ($), family labor ($), machinery costs ($), feed cost ($), real estate costs ($) and various expenditures ($) were calculated statistically significant and positive at 0.01 level. Oğuz and Canan (2016) calculated the technical efficiency of the union member dairy farms in Konya as 0.83 and those of non-members as 0.86.

Furesi et al. (2013) calculated the technical efficiency as 90.5% in sheep farming. Cabrera et al. (2010) calculated the average technical efficiency to be 0.88 in dairy farms of Wisconsin and found other variables except for capital positive and statistically significant. Kompas and Che (2004) applied the SFA model in Australian dairy farms. They reported that efficiency scores of animal capital ($), labor force (week), land size (hectare), feed cost ($), material and service cost ($), plant and operating capital ($) were found statistically significant and positive at 0.01 level. Gündüz (2011) found the average technical efficiency as 89% in cattle farms in Samsun. He stated that they can obtain the same output by reducing the input usage of the enterprises by 9%.

It was determined that while farmer's experience and the number of grazing in a day affected the inefficiency negatively in inefficiency model of this study, the others affected the inefficiency positively (Table4).

Table 4: Most likelihood predictions of coefficients in technical inefficiency model

Variables	Parameter	Coefficient	Standard Deviation	t-ratio	
Stochastic Frontier Analysis					
Invariant	$\beta 0$	-2.557	0.726	-3.520	
Ln (Concentrated feed cost (TRY/goat))	$\beta 1$	0.114	0.069	1.663	*
Ln (Veterinary cost (TRY/goat))	$\beta 2$	0.200	0.072	2.791	***
Ln (Marketing cost (TRY/goat))	$\beta 3$	0.197	0.085	2.326	**
Ln (Family labor force (TRY/goat))	$\beta 4$	0.238	0.098	2.424	**
Ln (Operating capital (TRY/goat))	$\beta 5$	0.422	0.140	3.012	***
Technical Inefficiency Model					
Invariant	$\delta 0$	-4.950	1.947	-2.542	
Farmer age (years)	$\delta 1$	0.019	0.018	1.054	
Farmer education level (years)	$\delta 2$	0.479	0.163	2.936	***
Farmer experience with goats rearing (years)	$\delta 3$	-0.020	0.017	-1.158	
Grazing (number / day)	$\delta 4$	-1.796	0.653	-2.751	***
Grazing duration (hours / grazing)	$\delta 5$	0.083	0.068	1.217	
Getting credit for small ruminant	$\delta 6$	1.047	0.507	2.064	**
Getting support for small ruminant	$\delta 7$	0.731	0.682	1.071	
Variance Parameters					
	$\sigma 2$	0.686	0.234	2.927	
	γ	0.441	0.157	2.800	
Log. Likelihood function	-94.06				
LR test	14.31				
Average Technical EfficiencyScore	0.80				

It is significant at a *0.1; **0.05; ***0.01 significance level

The farmer education level and the number of grazing during a day were statistically significant at 1% level in enterprises. While farmer age, farmer experience, grazing duration, getting support for small ruminant were insignificant, relationship between getting credit for small ruminant and inefficiencies of enterprises were statistically significant at 5% level.

Wubeneh and Ehui (2006) researched to examine the effect of credit on adopting technology in Ethiopia. They found that literacy was significant at 5 % level, animal husbandry education at 10% level, and these variables with farmers' getting credit status was negatively in the inefficiency model.

In this study, it was seen that the number of grazing during the day affected the inefficiency significantly at 1% level and negatively while the duration of each grazing was statistically insignificant. This situation showed that the enterprises which increased the number of grazing during a day worked more effectively than the fewer grazing enterprises. This means that when the goat were grazed more numbers in terms of nutrition and increasing meat weight, enterprises worked more effectively. Gözener (2013) found that the relationship between feeding duration and inefficiency was negative in the efficiency research that was made on cattle breeding in the TR83 Region and she stated that the farms would work more effectively by extending the feeding period.

In this study on goat farms in the Western Mediterranean Region, it was seen that relationship between the educational level of the farmers and technical inefficiency was a statistically significant, but increasing of level of education affected the inefficiency positively. Kaliba and Engle (2004), Cinemre et al. (2006), Koç et al. (2011) and Parlakay et al. (2015) also found that relationship between education level and efficiency was negative in their studies.

While a positive relationship between education and efficiency have been found in some studies, a negative relationship have been found in some studies. A statistically significant relationship haven't been found in some studies, too. Gözener (2013) found that there was no statistically significant relationship between education and technical inefficiency in cattle farms; Bravo-Ureta and Rieger (1991) in their study of dairy farms and Bravo-Ureta and Evenson (1994) found that there was no significant relationship between education and efficiency.

Gül et al. (2016) stated that there was a positive relationship between the level of education and efficiency in their research on goat farms, but it was not found statistically significant. Huang and Kalirajan (1997) in corn and rice enterprises, on the other hand Kumbhakar et al. (1989) in dairy farming found that there was a positive relationship between

education level and efficiency. Similar researches in which it was found a positive relationship between education and efficiency; Alemdar and Işık (2008), Gul et al. (2009), Demircan et al. (2010), Parlakay et al. (2015) in Turkey, Battese et al. (1996) in Pakistan, Binam et al. (2004) in Cameroon and Idiong (2007) in Nigeria.

Al-Sharafat (2012) found a positive relationship between education (years) and farmers experience (years) in milk production farms in Jordan and statistically significant at 0.01 level. In the results, also dairy farms produced only 40% of their potential border production levels in Jordan, which was about 60% below of their production limit due to technical inefficiency.

In a study on cattle farms in Samsun province; while the education level, experience and milking techniques of the farm had a negative relationship with inefficiency, a positive and significant relationship had been determined between the family size and inefficiency. It was stated that increasing the education and vocational education level of the farmers were important in terms of increasing technical efficiency (Gündüz, 2011). Parlakay et al. (2015) stated that farmer's experience was positive in the technical efficiency model of dairy cattle farms in Hatay. It was reported that the most important factors affecting the productivity of goat rearing were farmer experience, cooperative membership, milk yield per goat, family and foreign labor force in Isparta province. In addition, it was stated that inefficiency could generally result from wrong input usage (Gül et al., 2016).

It was stated that the relationship between efficiency and cultivation area, family labor force, education was found statistically significant in peanut production (Parlakay, 2011). In an efficiency study on dried apricots, it was stated that the main reason of technical inefficiency was pure technical inefficiency (Gündüz et al., 2011).

Considering experience of the enterprises on goat rearing, it was determined that there was negative and no statistically significant relationship with inefficiency (Table 4). On the other hand, the experience of the farmer was found to be statistically significant and negative in the inefficiency model on cattle breeding (Gündüz, 2011).

5. Conclusions and Recommendations

Goat farming was mainly done by traditional methods in this research area and mainly based on grazing. It was observed that goat rearing were concentrated at small family enterprises in the Western Mediterranean Region, and the family is a shepherd. The production was made mostly for meat production, milk and milk products. According to the

results of the research, it was determined that the producers could not use their resources full effectively.

According to the average technical efficiency score, it could be said that goat farms in this region use their resources well but are not efficient enough. Farmers can increase their productivity and efficiency by making better use of their available resources.

It stated that the high input prices affected goat producers'profit margin and efficiency. Therefore, small ruminant support which was given to shepherd should be increased by the Republic of Turkey Ministry of Agriculture and Forestry for increasing productivity. Especially, feed costs and grazing affected the efficiency of farm positively. So, it will be beneficial to decrease the feed wages, to protect and to rehabilitate rangeland to increase the efficiency. In addition, regional training and information meetings on small ruminant rearing, new technologies, feeding, goat diseases and prevention should be organized and/or increased.

6. References

AIGNER, D., LOVELL, C.A.K., SCHMIDT, P. Formulation and estimation of stochastic frontier production function models. Journal of Econometrics, v. 6, p. 21-37, 1977.

ANONYMOUS. Agricultural Research Master Plan 2011-2015, p. 335, 2015.

ALEMDAR, T., IŞIK, H. Technical efficiency of peanut growing farms in Turkey. Acta Scientiarum Polonorum, Oeconomia 7, p. 5-15, 2008.

AL-SHARAFAT, A. Technical efficiency of dairy farms: A stochastic frontier application on dairy farms in Jordan. Journal of Agricultural Science, v. 5, n. 3, p. 45-53, 2012.

BATTESE, G.E., MALIK, S.J., GILL, M.A. An investigation of technical inefficiencies of production of wheat farmers in four districts of Pakistan. Journal of Agricultural Economics, v. 47, p. 37-49, 1996.

BINAM, J.N., TONYE, J., NYAMBI, G., AKOA, M. Factors affecting the technical efficiency among smallholder farmers in the slash and burn agriculture zone of Cameroon. Food Policy, v. 29, p. 531-545, 2004.

BINICI, T., DEMIRCAN, V., ZULAUF, C.R. Assessing production efficiency of dairy farms in Burdur province, Turkey. Journal of Agriculture and Rural Development in the Tropics and Subtropics, v. 107, n. 1, p. 1–10, 2006.

BRAVO-URETA, B.E., EVENSON, R.E. Efficiency in agricultural production: The case of peasant farmers in Eastern Paraguay. Agricultural Economics, v. 10, p. 27-37, 1994.

BRAVO-URETA, B.E., RIEGER, L. Dairy farm efficiency measurement using stochastic frontiers and neoclassical duality. American Journal of Agricultural Economics, 421-428, 1991.

CABRERA, V.E., SOLÍS, D., CORRAL, J.D. Determinants of technical efficiency among dairy farms in Wisconsin. American Dairy Science Association, v. 93, p. 387–393, 2010.

CAUDILL, S.B. SFA, TFA and A New Thick Frontier: graphical and analytical comparisons. Applied financial economics, v. 12, p. 309-317, 2002.

CHAKRABORTY, C., MISRA, S., JOHNSON, P. Cotton farmers' technical efficiency: stochastic and nonstochastic production. Agricultural and Resource Economics Review, v. 31, n. 2, p. 211-220, 2002.

ÇIÇEK, A., ERKAN, O. Research and Sampling Methods in Agricultural Economics. T.C. Gaziosmanpaşa University, Faculty of Agriculture Publications No: 12, Lecture Notes Series No: 6, Tokat, Turkey. 1996.

CINEMRE, H.A., CEYHAN, V., BOZOĞLU, M., DEMIRYÜREK, K., KILIÇ, O. The cost efficiency of trout farms in The Black Sea Region, Turkey. Aquaculture 251, p. 324-332, 2006.

COELLI, T.J. A Guide to Frontier Version 4.1: A computer program for stochastic frontier production and cost function estimation. CEPA Working Paper 96/07, Department of Econometrics, University of New England, Armidale, Australia, 1996a.

COELLI, T.J. A Guide to DEAP Version 2.1: A data envelopment analysis computer program. CEPA Working Paper 96/08, Department of Econometrics, University of New England, Armidale, Australia, 1996b.

COELLI, T.J., RAO, D.S.P., BATTESE, G.E. An introduction to efficiency and productivity analysis. Kluwer Academic Publishers, Boston, 2003.

DAĞISTAN, E., KOÇ, B., GÜL, M., PARLAKAY, O., AKPINAR, M.G., 2009. Identifying Technical Efficiency of Dairy Cattle Management in Rural Areas through a Non-Parametric Method: A Case Study for the East Mediterranean in Turkey. Journal of Animal and Veterinary Advances, v. 8, n. 5, p. 863-867, 2009.

DELLAL, İ., KESKIN, G., DELLAL, G. Economic analysis of small ruminant farms in the GAP region and supply of animal products to the market. TEAE, Publications No:83, Ankara, 2002.

DEMIRCAN, V., BINICI, T., ZULAUF, C. R. Assessing pure technical efficiency of dairy farms in Turkey. Agricultural Economics – Czech, v. 56, p. 141-148, 2010.

FOGARASI, J., LATRUFFE, L. Technical efficiency and productivity change of dairy farms: Acomparison of France and Hungary. Contributed Paper for the 103rd EAAE Seminar Adding Value to the Agro-Food Supply Chain in the Future Euro Mediterranean Space, Barcelona, Spain, 2007.

FURESI, R., MADAU, F.A., PULINA, P. Technical efficiency in the sheep dairy industry: An application on the Sardinian (Italy) sector. Agricultural and Food Economics, v. 1, n. 4, p. 1-11, 2013.

GÖZENER, B. Economic analysis and technical efficiency of cattle breeding farms in the TR 83 Regio (in Turkish). Thesis (PhD). Gaziosmanpaşa University, Tokat, Turkey, p. 175, 2013.

GUJARATI, N.D. Basic Econometrics Translated: Ümit and Gülay G. Şenesen. Literature Publications: 33, ISBN: 975-7860-99-9, 2006.

GÜL, M. Technical efficiency and productivity of apple farming in Antalya province of Turkey. Pakistan Journal of Biological Sciences, v. 8, n. 11, p. 1533-1540, 2005.

GÜL, M. Technical efficiency of apple farming in Turkey: A case study covering Isparta, Karaman and Nigde provinces. Pakistan Journal of Biological Sciences, v. 9, n. 4, p. 601-605, 2006.

GÜL, M., KOC, B., DAGISTAN, E., AKPINAR, M. G., PARLAKAY, O. Determination of technical efficiency in cotton growing farms in Turkey: A case study of Cukurova Region. African Journal of Agricultural Research, v. 4, n. 10, p. 944-949, 2009.

GÜL, M., DEMIRCAN, V., YILMAZ, H., YILMAZ, H. Technical efficiency of goat farming in Turkey: a case study of Isparta province. Revista Brasileira de Zootecnia, v. 45, n. 6, p. 328-335, 2016.

GÜL, M., YILMAZ, H., PARLAKAY, O., AKKOYUN, S., BILGILI, M.E., VURARAK, Y., HIZLI, H., KILIÇALP, N. Technical efficiency of dairy cattle farms in East Mediterranean region of Turkey. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, v. 18, n. 2, p. 213-225, 2018.

GÜNDEN, C. Determination of technical efficiency in cotton production by data envelopment analysis: The case of Menemen (in Turkish). Thesis (MSc). Ege University Izmir, Turkey, p. 140, 1999.

GÜNDÜZ, O. Technical efficiency of dairy farms: A stochastic efficiency approach. Journal of Harran University Faculty of Agricultural, v. 5, n. 1, p. 11-20, 2011.

GÜNDÜZ, O., CEYHAN V., ESENGÜN, K. Measuring the technical and economic efficiencies of the dry apricot farms in Turkey. Journal of Food Agriculture & Environment, v. 9, n. 1, p. 319-324, 2011.

HUANG, Y., KALIRAJAN, K.P. Potential of China's Grain production: Evidence from the household data. Agricultural Economics, v. 17, p. 191-199, 1997.

IDIONG, I.C. Estimation of farm level technical efficiency in small scale swamp rice production in cross river state of Nigeria: A stochastic frontier approach. World Journal of Agricultural Sciences, v. 3, p. 653-658, 2007.

İNAN, E.A. Measurement of efficiency of bank and efficiency in banking in low inflation process. Journal of Banker, v. 34, p. 84, 2000.

JAFORULLAH, M., WHITEMAN, J. Scale in the New Zealand dairy industry: A non-parametric approach. The Australian Journal of Agricultural and Resource Economics, v. 34, p. 523-541, 1999.

KAÇIRA, Ö.Ö. Efficiency analysis of corn production: case of Şanlıurfa province (in Turkish). Thesis (PhD).Çukurova University, Adana, Turkey, p. 123, 2007.

KALIBA, A.R., ENGLE, R.C. Cost efficiency of catfish farms in Chicot County, Arkansas: The impact of extension purposes. Selected paper prepared for presenting at the Southern Agricultural Economics Association Annual Meeting, Tulsa, p. 25, Oklahoma, 2004.

KOC, B., GUL, M., PARLAKAY, O. Determination of technical efficiency in second crop maize growing farms in Turkey: A case study for The East Mediterranean in Turkey. Asian Journal of Animal and Veterinary Advances, v. 6, p. 488-498, 2011.

KOMPAS, T., CHE, T.N. Production and technical efficiency on Australian dairy farms. Asia Pacific School of Economics and Government Working Papers, Australian National University International and Development Economics, v. 04, n. 1, p. 1-20, 2004.

KOYUBENDE, N., CANDEMIR, M. Comparison of the technical efficiencies of dairy farms in Ödemiş, Tire, Bayındır and Torbalı districts, the basin of Küçük Menderes. Journal of Animal Production, v. 47, n. 2, p. 9-20, 2006.

KÖK, R., ÇOBAN, O. Necessity of a regulation model for kits and efficiency of resource utilization: example of Nevşehir tekel raki factory. 6th METU International Conference in Economics, p. 11-14, 2010.

KUMBHAKAR, S.C., BISWAS, B., BAILEY, D. A Study of economic efficiency of Utah dairy farmers: a system approach. The Review of Economics and Statistics, v. 71, n. 4, p. 595-604, 1989.

KWON, O.S., LEE, H. Productivity improvement in Korean rice farming: Parametric and nonparametric analysis. The Australian Journal of Agricultural and Resource Economics, v. 48, n. 2, p. 23-346, 2004.

MAO, W., KOO, W.W. Productivity growth, technological progress, and efficiency change in Chinese agriculture after rural economic reforms: A DEA approach. China Economic Review, v. 8, n. 2, p. 157-174, 1997.

MEEUSEN, W., VAN DEN BROECK, J. Efficiency estimation from Cobb-Douglas production functions with composed error. International Economic Review, v. 18, p. 435-444, 1977.

OĞUZ, C., CANAN, S. Factors affecting milk production in dairy farming enterprises and effectiveness analysis: A case study in Konya province of Turkey. Custos e Agronegócio Online, v. 12, n. 3, p. 121-36, 2016.

ÖNCELER, H.İ., ARIOĞLU, H.H. The effects of fertilizers containing different mineral nutritions yield and some agricultural characteristics in main cropped peanut.Turkey VI. Field Crops Congress, 5-9 September, v. I, p. 569-574, Antalya, 2005.

ÖRMECI KART, M.Ç., GÜL, M., KARADAĞ GÜRSOY, A. Technical efficiency in grape production: A case study of Denizli, Turkey. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, v. 18, p. 211-217, 2018.

ÖREN, M.N., ALEMDAR, T. Technical efficiency analysis of tobacco farming in Southern Anatolia. Turkish Journal of Agriculture and Forestry, v. 30, p. 165-172, 2006.

PARLAKAY, O. Technical and economic efficiency of peanut production in Turkey (in Turkish). Thesis (PhD). Çukurova University, Adana, Turkey, p. 167, 2011.

PARLAKAY, O., ALEMDAR, T. Technical and economic efficiency of peanut production in Turkey. Turk. Agri. Econ. Asso, v. 17, n. 2, p. 47-53, 2011.

PARLAKAY, O., SEMERCI, A., CELIK, A.D. Estimating technical efficiency of dairy farms in Turkey: A case study of Hatay province. Custos e Agronegócio Online, v. 11, p. 106-115, 2015.

PARLAKAY, O., YILMAZ, H., GÜL, M., AKKOYUN, S., BILGILI, M.E., VURARAK, Y., HIZLI, H., KILIÇALP, N. Technical efficiency of dairy cattle farms in the Eastern. Mediterranean Region of Turkey by stochastic frontier analysis. The Journal of Animal & Plant Sciences, v. 27, n. 5, p. 1689-1694, 2017.

SINGH, S., FLEMING, E., COELLI, T. Efficiency and productivity analysis of cooperative dairy plants in Hayrana and Punjab States of India. University of New England, Working Paper Series in Agricultural and Resource Economics, ISSN 1442 1909, 2000.

ŞAHIN, H. Technical efficiency of telecommunications companies in Eurostat Countries: A stochastic frontier approach. Ankara University, Faculty of Political Sciences, Discussion Papers of Development and Society Research Center, N. 39, p. 6, Ocak 2002.

TAUER, L.W., BELBASE, K.P. Technical efficiency of New York dairy farms. Northeastern Journal of Agricultural and Resource Economics, v. 16, n. 1, p. 1-7, 1987.

TUIK. Turkish Statistical Institute. Animal Production Statistics. Date of access: 25.08.2015, http://www.tuik.gov.tr, 2015.

TUIK. Turkish Statistical Institute. Animal Production Statistics. Date of access: 15.05.2019. http://www.tuik.gov.tr, 2019.

WUBENEH, N., EHUI, S. Technical efficiency of smallholder dairy farmers in the Central Ethiopian Highlands. International Association of Agricultural Economists Conference, Gold Coast, 12-18 August, p. 16, Australia, 2006.

7. Acknowledgement

I would like to thank to Scientific Research Projects Management Unit of Süleyman Demirel University with BAP 4766-D1-16 project and to Republic of Turkey Ministry of Agriculture and Forestry General Directorate of Agricultural Research and Policies with TAGEM/ TEAD/ 17/ A08/ P01/ 001 Project for which supported my project financially.