Economic analysis of sheep farms: a case study from eastern part of Turkey

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Abstract

Gross profit and profitability rates of 72 sheep farms in Center town of Hakkari was calculated and the relationship between milk production quantity per farm during lactation period and major production factors were determined using Coob-Douglas production function. Daily milk yield per sheep production unit and daily milk yield per sheep production unit per lactation was 0.28 g. and 47.59 kg, respectively. More than half (53 %) of gross production value ($ 8,435) was obtained from the selling values of lamb and goat followed by production values of milk with 25.7 %. Daily feed intake per sheep production unit was 1.87 kg, which roughage feed made up 97.64 % of total feed intake. On the other hand, feed costs per sheep production unit made up nearly two- third (74.68 %) of total variable costs. Gross profit per sheep production unit was $ 71. Coob-Douglas production function showed that a positive and strong relationship (R2 = 0.963) existed between total milk quantity per farm during lactation period and the major production factors. The total production elasticities was 1.71, which means increasing return to scale.

Keywords: Sheep Farms. Gross Production Value. Variable Costs. Gross Profit.

1. Introduction

Sheep production is regarded as an animal activity where it is not possible to promote other activities of diverse livestock farming systems due to marginal areas with harsh climatic

conditions (Milan et al., 2003; Ripoll-Bosch et al., 2012; Toro-Mujica et al., 2012; Toro-Mujica et al., 2015a; Zekeri, 2015). It also allows protection of natural resources, preservation of life styles and prevention of rural exodus (Milan et al., 2003; Toro-Mujica et al., 2015a; Yıldırım and Şahin, 2006). Furthermore, raising sheep is relatively easy with minimal inputs and low maintenance costs (Kumar et al., 2013; Nix, 1988; Zekeri, 2015) and employs low levels of family resources (Selvakkumar, 2017; Zekeri, 2015).

Sheep farming contributes a lot to a balanced nutrition (Kaymakçı et al., 2007; Kumar et al., 2013; Toro-Mujica et al., 2015a) while provides an immediate income for families, specially living in rural areas (Ibidhi et al., 2018; Kumar et al., 2013; Tsega et al., 2014).

A sustainable profitability rate is regarded an essential for continuity of sheep farming (Gugic et.al.2012). Research fingdings indicate that many factors have effect on the profitability, namely, sheep breeds (Kırk, 2007; Krupová et al., 2014; Lavvaf et al., 2014; Toro-Mujica et al., 2012; Tsega et al., 2014), pasture areas (Bohan et al., 2018; Kumar et al., 2013; Morantes et al., 2017; Toro-Mujica et al., 2012), efficiency and productivity (Krupová et al., 2014; Toro-Mujica et al., 2011; Toro-Mujica et al., 2015b), production costs, specially feed costs (Coldow et al., 2005; Hilali et al., 2011; Lavvaf et al., 2014; Milan et al., 2014; Pamukova and Momchilov, 2017; Sirohi and Rawat, 2000; Toro-Mujica et al., 2012; Tsega et al., 2014; Zekeri, 2015), farm size (Dağıstan et al., 2008; Dellal et al., 2002; Kaymak and Sarıözkan, 2016; Kumm, 2009; Milan et al., 2014; Pamukova and Momchilov, 2017; Popescu, 2012; Tamer and Sarıözkan, 2017; Toro-Mujica et al., 2011; Toro-Mujica et al., 2015a; Toro-Mujica et al., 2015b), efficient management, (Krupova et al., 2014; Lavvaf et al., 2014; Morantes et al., 2017; Selvakkumar, 2017; Toro-Mujica et al., 2012), market prices (Ayvazoğlu et al., 2015; Hilali et al., 2011; Kumar et al., 2013; Tsega et al., 2014), capital and labor (Ayvazoğlu et al., 2015; Tsega et al., 2014; Zekeri, 2015) and disease (Tsega et al., 2014; Zekeri, 2015).

The major hypothesises of this study was sheep farms would have a positive gross profit, and large-scale farms would have higher gross profit in comparison to small-scale farms. Furthermore, it was hypothesied that milk production per lactation could be raised by increasing the sheep numbers, lactation period, feed intake, labor demand and capacity of sheep barn, which means increasing return to scale would be the case.

2. Literature Review

There exist many research conducted in the field of sheep economics and production scale in various countries including Turkey. The relevant literature has already been given in

Introduction and Discussion section of this study. However, for convenient, some of research findings of previous studies is included in this section.

Dalgıç ve Demircan (2019), who analysed the data of 80 sheep farms in Isparta Province, Turkey, reported that the production costs per animal unit decreased and net profit increased in parallel with farm size and concluded that the large-scale farms had advantage over the medium and small-scale farms.

Stankov (2019) reported that the milk yield per sheep per lactaction and fertility rate in Shoumen District was 92 liter and 1.3 lambs, respectively. The meat and milk production value in the gross production value was reported as 79, 86 and 38, 5, respectively while the variable and fixed cost constituted 55,9 and 44,1 of total production costs. On the other hand, the reported feed costs in the variable and total costs were 78,72 and 44,00 %, respectively. The author concluded that it was not sustainable for black-headed Pleven sheep farming without government subsidies.

Dalgıç et. al. (2018) calculated the average productivity of sheep farms in terms of returns for fixed and variable variable to scale as 0,41 and 0,48 in Isparta Province, Turkey, and classified the major factors effective on the productivity as education level, the combination of family and hired labor, milk yield, lambs per sheep and age of leaving the herd.

Karadaş (2018) reported the number of sheep, lamb and ram as 96, 86 and 6 in Hakkari Province, Turkey and pointed to that the milk is transformed into fat, yogurt, cheese and ayran and these products are marketed.

Popoviç (2018) pointed to that the main income of 30 sheep farms in the Hilly-Mountain regions of Serbia was obtanined from lamb meat and sheep cheese.

Şahinli ve Özçelik (2013) reported that the feed costs constituted 63,47 % of variable costs followed by labor costs with 24, 24 % for 104 sheep farms in Isparta province, Turkey.

3. Material and Methods

The main material of this research paper was 150 sheep farms in Center town of Hakkari Province, Turkey, which has borders to Iran and Iraq Countries. The farms located at 8 villages, namely, Dağsu, Umutlu, Çaylıca, Durankaya, Biçenek, Derebaşı, and Bay, where an extensive sheep production was available. The data belonged to 2008 production period. Out of total population (150 sheep farms), 72 farms was determined as a sample size with help of following stratified random sampling method with 10 error percentage and 90 %

reliability range (Erkuş et al.,1996). The data was collected from farm managers interviewing face to face.

Where;

n= Sampling size

N= the number of farms in population

Nh= the number of farms in h th strata

S2h=the variance at h th strata

D2=d2/Z2 value

d= Error amount permitted from the population average

Z= Z value in standard normal distribution according to error amount

The farms were classified into three size groups taking into consideration the percentage distribution of each group in the total farms. Thus, the small-scale farms (farms with 1-50 sheep), medium-scale farms (farms with 51-99 sheep) and large-scale farms (farms with 100 and more sheep) constituted of 38.9 % (28 farms), 40.3 % (29 farms) and 20.8 % (15 farms) of the investigated farms, respectively.

Extreme values were controlled by means of outlier test before the data was analysed. Variance analysis was applied to see whether there was statistically significant differences among some means of physical variables size groups. The relationships of milk production quantity per farm during a lactation period and used inputs were determined using Coob-Douglas Production Function. Thus the production elasticities of inputs was calculated directly.

The productivity, costs, income and profits were calculated based on sheep production unit (Açıl and Demirci, 1977; Oktay, 1981; Yıldırım, 1993) due to difficulties of discriminating of feed intake, and labor and barn demand for different types of animals. In calculation of sheep production unit one sheep, one goat, lamb number per sheep and yearlings per goat, 0.04 ram, and 0.20 amortization of herd was taken into consideration as a technical coefficients.

4. Results and Discussion

4.1. General demographic information on farms

The population per farm was 9.9 person and increased in line with farm size being 7.85 person for small-scale and 12.60 person for large-scale farms. The experience of the

manager increased in proportion to farm size being 13.75, 21.41 and 25.60 years for small, medium and large-scale farms, respectively. The age of farm managers also increased in parallel with farm size being the lowest with 37.30 years for small-scale and the highest with 48.87 years for large-scale farms, respectively. Nearly two third of farm managers (66.7 %) completed the elementary school. The family labor potential was 1,686 man-days for total farms. However, this figure was 2,185 man-days for large-scale farms while it remained at 1,247 man-days for small-scale farms. The idle labor potential was 45.1, 50.0 and 48.9 % for small, medium and large-scale farms, respectively.

4.2. Sheep number, lactation period and milk yields

The average sheep numbers for small, medium and large-scale farms were 29.96, 59.17 and 99.33 head, respectively. The lactation period was 175, 170 and 170 for small, medium and large-scale farms, respectively. Daily milk yield per sheep production unit was 0.28 kg., 0.27 kg., and 0.29 kg. for small, medium and large-scale farms, respectively. Daily milk yield per sheep production unit per lactation was 48.39, 46.09 and 49.02 kg for small, medium and large-scale farms, respectively (Table 1). It seems that the lactation period and the daily milk yield per sheep production unit and milk yield per sheep production unit per lactation is similar for each of farm-size. On the other hand, milk yield per farm differed significantly among the farm sizes being 1,424 kg, 2,700 kg and 4,885 kg for small, medium and large-scale farms, respectively due to variation of sheep numbers (Table 1). The milk yield per farm of small-scale and medium scale farms amounted to nearly one third (29.15 %), and little more than half (55.27 %) of the large-scale farms' milk production quantity during the production period, respectively. The variance analysis showed that there existed a significant difference among the farm sizes in terms of milk production quantity per production period at the level of 0.01.

Milk yield per sheep per lactation in different part of Turkey was 21 kg in Korkut town of Muş Province (Kaymak and Sarıözkan, 2016), between 40-56 for various sized sheep farms in Van Province (Kırk, 2007), 98.25 kg in Ahlat town of Bitlis Province (Koca, 2000), 58.79 kg in Çatak town of Van Province (Yıldırım, 1993), and 118 kg in Ardahan Province (Ayvazoğlu et al., 2015).

Popescu (2012) reported that the milk yield per ewes per year as 146 and 297 liters for sheep groups including 62 and 255 ewes in Romania, respectively. Milk yield per ewe per

year for 30 sheep farms in Spanish region of Castilla-La Mancha was reported as 97.3 liters (Morantes, et al., 2017)

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Table 1: Some physical aggregates related to output and inputs

				Total
Sheep Number (Head)	29.96	59.17	99.33	56.18
Lactation Period (Days)	175	170	170	172
Daily Milk Yield Per Sheep Production Unit (kg)	0.28	0.27	0.29	0.28
Milk Production Per Sheep Per Lactation (kg)	48.39	46.09	49.02	47.59
Milk Yield per Farm (Kg) ***	1424	2700	4885	2659
Daily labour demand per sheep production unit(h)	0.52	0.32	0.26	0.34
Daily feed intake per sheep production unit (kg)	1.89	1.82	1.86	1.87
Daily Forage feed intake per Sheep production unit (kg)	1.88	1.78	1.80	1.83
Daily Concentrates feed intake per Sheep production unit (kg)	0.01	0.04	0.06	0.04

*** P<0.01

4.3. Labour demand

The daily labour demand per sheep production unit decreased in proportion to farm size being 0.52 h. for small-scale farms and 0.26 h. for large-scale farms (Table 1). The daily labour demand per sheep production unit was twice that large-scale farms while the medium scale-farms had 1.63 times more labour demand in comparison of large-scale farms.

4.4. Feed Intake and its Compositions

Daily feed intake per sheep production unit was 1.89, 1.82 and 1.86 kg for small, medium and large-scale farms, respectively. Daily forage feed intake per sheep production unit was 1.88, 1.78 and 1.80 kg for small, medium and large-scale farms, respectively. It seem small-scale farms had a little more feed intake compared to medium and large-scale farms. Daily concentrates feed intake per sheep production unit increased in line with farm size being the lowest for small-scale farms with 0.01 kg and the highest for large-scale farm with 0.06 kg (Table 1). These figures revealed that feed intake is mostly related to forage.

4.5. Gross Production Value

Gross production value per farm increased according to farm size being the lowest for small-scale farms with $ 4,467 and the highest for large-scale farms with $ 15,656 (Table 2). The gross production value per farm of the large-scale farms was 1.84 times, and 3.50 times higher than that of medium and small-scale farms, respectively. On the other hand, gross production value per sheep production unit was $ 149, $ 144 and $ 158 for small, medium and large-scale farms, respectively.

More than half of gross production value were obtained from lamb and goat selling value (53 %) followed by milk production value and culling sales with 25.7 and 17.3 %, respectively.

Lamb selling value consisted 63.5 % of total gross production value for 62 sheep farms in Korkut town of Muş Province, (Kaymak and Sarıözkan, 2016). Lamb selling value accounted for nearly three quarter of gross production value (67.8 %) followed by 15.4 and 14.4 % income obtained from sale of culling and milk production values, respectively for 63 sheep farms in Van Province (Şahin, 2001). Yıldırım (1993), who made a survey on 120 sheep farms reported that nearly half of gross production value (49.47 %) came from lamb production value followed by milk production value and sale of culling value with 24.61 and 13.39 %, respectively in Çatak town of Van Province.

Economic results of 52 Ripollesa breed sheep farms in Spain showed that public subsidies made up an average of 27 % of total income and 52 % of net agricultural value (NAVfc) (Milán et al., 2003). More than half of gross production value (54 %) of 30 sheep farms in the Spanish region of Castilla-La Mancha came from sale of milk followed by sale of lambs, and subsidies by 26 and 14 %, respectively (Toro-Mujica et al., 2012). Milan et al. (2014) reported that the income from milk accounted for more than three quarter of gross production value (78.6 %) for twenty dairy sheep farms of Assaf breed, located in the Spanish autonomous community of Castilla y Leon followed by lamb income (13.2 %) and European Union sheep subsidy (6.9 %), respectively.

Table 2: Production costs and profits per farm and per cow

				Total
Gross Production Value per Farm ($)	4.467	8.526	15.656	8.435
Gross Production Value per Sheep Production Unit ($)	149	144	158	150
Variable Costs per Farm($)	2.260	4.685	8.069	4.445
Variable Costs per Sheep Production Unit ($)	76	79	81	79
Feed Costs per Farm ($)	1.717	3.487	5.973	3.308
Feed Costs per Sheep Production Unit ($)	57	59	60	59
Gross Profit per Farm ($)	2.206	3.841	7.586	3.990
Gross Profit per Sheep Production Unit ($)	73	65	77	71

Economical Profitability rate in terms of gross profit (%)	34.1	30.3	33.1	32.2

4.6. Variable Costs

Variable cost per farm increased in line with farm size being the lowest for small-scale farms with $ 2,260 and the highest for large-scale farms with $ 8,069. The variable costs of large-scale farms was 3.57 and 1.72 times higher than that of small and medium-scale farms respectively (Table 2). Variable costs per sheep production unit increased in parallel with farm size being $ 76, $ 79 and $ 81 for small, medium and large-scale farms, respectively. Feed costs per farm was $ 1,717, $ 3,487 and $ 5,973 for small, medium and large-scale farms, respectively. Feed costs per sheep production unit increased in line with farm size being $ 57, $ 59 and $ 60 for small, medium and large-scale farms, respectively. Feed costs per sheep production unit made up three third of total variable costs with 0.750, 0.746 and 0.740 % for small, medium and large-scale farms, respectively.

Şahin (2001) indicated that nearly three quarters of variable costs (68.3) consisted of feed costs for 63 sheep farms in Van Province, Turkey. This proportion was reported as 47.13 % for 120 sheep farm in Çatak town of Van Province (Yıldırım and Oktay 1995), 54.30 % in Southeastern Anatolia region of Turkey (Dellal et al., 2002), 61.9 % in Toros Mountain Ereas in Southeastern part of Turkey (Erkan et al., 1993). On the other hand, the rate of feed costs in total production cost were reported as 59.5 % for 52 sheep farms in Yozgat Province (Tamer and Sarıözkan, 2017), 61.9 % for 62 sheep farms in Korkut town of Muş Province (Kaymak and Sarıözkan, 2016) and 47-53 % for 66 sheep farms in Ardahan Province (Ayvazoğlu et al., 2015).

Costs account results of twenty dairy sheep farms of Assaf breed, located in the Spanish autonomous community of Castilla y Leon showed that feding costs made up 61.6 % of total production costs. (Milan et al., 2014). Krupová et al. (2014) pointed out that feed costs accounted for 38 % of total cost for 41 dairy sheep farms in Slovakia.

High feed costs were reported as major obstacles for resource-poor dairy sheep farmers in West Asia, along with large fluctuation in grain and straw prices. Low-cost diets using locally available feeds were suggested to provide sufficient milk of good quality. (Hilali et al., 2011).

4.7. Gross Profit, and Profitability Rates

Gross profit per farm ranged between $ 2,206 for small-scale farms and $ 7,586 for large-scale farms. The large-scale farms had 3.43 and 1.98 times higher gross profit than that of small-scale and medium-scale farms, respectively.

Gross profit per sheep production unit ranged between $ 65 for medium-scale and $ 77 for large-scale farms. The economical profitability rate was 34.1, 30.3 and 33.1 % for small, medium and large-scale farms, respectively.

The reported profitability rate of sheep farms in different part of Turkey were reported as 31.14 % for 63 sheep farms in Van Province (Şahin and Yıldırım, 2002), 2.67 % in Southeastern Anatolia Region (Dellal et al., 2002), 12.83 % in Şanlıurfa Province (Kaya, 1997), and 27.84 % for 120 sheep farms in Çatak town of Van Province (Yıldırım and Oktay, 1995).

As many as three quarters of respondents of 58 sheep farm managers on the island of Pag indicated the profitability as the main motivation to engage in sheep production (Gugic et al., 2012). Krupová et al. (2014) suggested a rational utilisation of inputs and improved animal performance as an important factor to improve economic efficiency of sheep farming which is essential for a sustainable profitability. A suitable breeding system was suggested for exploiting the production potential of local sheep flocks, which would increase the production contributing to income of Taleshi sheep in rural areas in Iran (Lavvaf et al., 2014). Kumar et al. (2013) indicated that government supports had to do to enhance the productivity and sustainability of sheep production in India. (Bohan et al., 2018) indicated that lambs weaned per hectare linked with grass growth and utilisations are the key drivers of profitability on Irish grass based sheep production systems.

Zekeri, 2015 reported that more than a quarter of managers (28.5 %) cited inadequate capital as their major problem in sheep production; followed by diseases incidence, inadequate feed and water shortages with 26.9, 20 and 16.9 %, respectively. Selvakkumar (2017), who carried out a survey with 113 Vembur sheep farms in Tamil Nadu, India, drew attention to better management strategies in feeding and disease management for increasing profitability. In a study conducted with 130 women sheep reares in Kano State, Nigeria, inadequate capital (28.5%) was cited as the major problem affecting sheep rearing in the erea. Encouraging more intensive production of sheep and financing at convenient conditions were recommended. Tsega et al. (2014) pointed out that high feed costs, lack of improved breed, capital and labor shortages were major constraints for urban and peri-urban sheep farms in towns of Debre Berhan and Dessie, Ethiopia.

Many research findings in different part of Turkey indicate that there exist a positive relationship between the farm size and profitability rates. Kaymak and Sarıözkan, (2016), who made a survey on 62 sheep farms in Muş Province pointed out that net income increased in line with farm size. Tamer and Sarıözkan, (2017) based on a research conducted with 52 sheep farm managers in Yozgat Province, reported that the unit costs decreased and, thus, gross profit increased in proportion to farms size. Pamukova and Momchilov, (2017) suggested the optimum number of sheep on the farm of should be at least 500 head, which indicate the significant of farms size in terms of unit production costs and profitability rates. Ayvazoğlu et al. (2015) who made a research on 66 small-scale family sheep farms in Ardahan Province that were not resistant to market competition suggested increasing flock size. Dağıstanlı et al. (2008) who made a survey on sheep farms in Center and Southern Anatolia pointed out that there existed a positive relationsip between farm size and profit.

Popescu (2012), who made a survey on two groups of Carabasa Breed managers with 62 ewes and 255 ewes in Romaina, reported that the larger group farms recorded a higher economic efficiency and suggested increase of farm size in order to go up the profitability and competitiveness. Milan et al. (2014) pointed out that allocative efficiency and farm size had directly positive relationship. Toro-Mujica et al. (2015a) reported that larger farms carrying Merino Assaf dairy sheep farms in the semiarid zone of Central Chile produced more lambs per ewe and had lower unitary costs. Toro-Mujica et al. (2011), who conducted a research on thirty one organic dairy sheep farms in Castilla-La Mancha, a Spanish region with a tradition of sheep rearing indicated that 74% of farms operated at medium or low rates of technical efficiency. Differences in technical efficiency were largely due to the consumption of feeding supplements and productivity. They suggested that the most efficient farms had to increase their size, moderately efficient farms needed to focus their efforts on improving the management of resources and improving competitiveness of the less efficient farms required an increase of productivity. Kumm (2009) indicated that only large-scale sheep farms that had at least 500 sheep number would have a positive profitability rate in Swedish.

4.8. Coob-douglas production function

Cobb-Douglas production function, which was constructed to determine the relationship between total milk production per farm during the lactation period and the inputs used was as follows:

$$Y= -0,822X_1^{\,0,601}\, X_2^{\,0,600}\, X_3^{\,0,413}\, X_4^{\,-0,00119.}\, X_5^{\,0.135}\, X_6^{\,-0,0398}$$

Where,

Y= Milk production quantity per farm during a lactation period

X_1=Numbers of sheep and goat

X_2= Lactation Period (Days)

X_3=Total forage feed intake of sheep and goats during the lactation (kg)

X_4= Total concentrate feed intake of sheep and goats during the lactation (kg)

X_5= the capacity of sheep barn (m^2)

X_6= the labour demand in terms of man-power (hour)

Determination coefficient (R^2) was 0.963, which means 96.3 % of variances in milk production quantity is explained by inputs used in the model. The production elasticities of X_1 (number of sheep and goat), and X_3 (forage feed quantity) were statistically significant at 5 % probability level ($P<0.05$) while the other inputs used in the sheep production unit was not significant at 5 % probability level ($P>0.05$). The total production elasticity of inputs (Σbi) was 1.71, which means increasing return to scale. In case of duplicating the inputs used, milk production quantity is expected to increase by 1.71 times. While the other factors being constant, a decreasing return is valid for X_4 (Concentrate feed quantity) and X_6 (labour demand) variables.

On the other hand, milk production quantity is expected to increase by 60.1, 60.0, 41.3, and 13.5 % , respectively in cases of doubling the inputs of X_1 (number of sheep and goat), X_2 (lactation periods), X_3 (roughage feed intake), and X_5 (barn capacity) individually; while the other inputs remained unchanged.

5. Conclusions and Recommendations

Given daily milk yield per sheep production unit of small-scale farms (0.28 g) near to that of large-scale farms (0.29 g) and feed cost per sheep production of large-scale farms being higher ($ 60) than that of small-scale farms ($ 57), there is no clear-cut that the size matter. Although gross profit per sheep production unit was 5.4 % higher than that of small-scale farms, this don't support our hypothesis that large-scale farms would be more profitable in clear way. Furhermore, the economical profitability rate of large-scale farms in terms of gross profit (33.1 %) is lower than that of small-scale farms (34.1 %). However, we still don't recommend the small-scale farms (less than 50 sheep numbers) due to low gross profit per farm per year ($ 2,206), which is not sufficient to meet the very basic needs of family.

Even the gross profit per farm of large-scale farms ($ 7,586), which have average 100 sheep, may not be pretentious.

Well-known some general constrains especially inadequate capital, high feed costs, productivity and efficiency, market prices and agricultural extension programs was observed in the farms. Well-designed programs in cooperation of producers, market players and public institutions is required towards solutions of problems to some extent..

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