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Research Article

Economic Analysis of Dairy Cattle Farms in Turkey: A Case of Karacabey District

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Abstract

The aim of this study was to analyse the economic structure of dairy cattle farms in Karacabey district of Bursa province in Turkey. The number of farms in the research area was determined through stratified random sampling method. The data were collected from a total of 208 selected farms by means of survey method. The selected farms were divided into three groups (5 to≤11 cattle, 12 to ≤26 cattle and equal 27 and >27 cattle). The data were based on the 2017 production period. The study concluded that the average daily milk yield and lactatiton milk yield per cow of farms were 18.72 kg and 4835.81 kg year^{-1}. The total production cost was found to be $49103.07. The average feed cost per farm was accounted for 52.11% of the total production costs. As a result, the study will potentially contribute to the increase of the amount of milk production in farms and the development of dairy farming in Karacabey district, which is the research are of this study.

Keywords: Dairy cattle, Karacabey, production cost, profit, variable cost.

Türkiye'deki Süt Sığırcılığı İşletmelerinin Ekonomik Analizi: Karacabey İlçesi Örneği

Özet

Bu çalışmada, Türkiye'nin Bursa ili Karacabey ilçesindeki süt sığırcılığı işletmelerinin ekonomik yapısının analiz edilmesi amaçlanmaktadır. Araştırma alanındaki işletmeler tabakalı tesadüfi örnekleme yöntemiyle belirlenmiştir. Veriler, 208 işletmeden anket yöntemiyle toplanmıştır. İşletmeler üç gruba ayrılmıştır (5-11 sığıra sahip olan işletmeler, 12-26 sığıra sahip olan işletmeler ve 27 ve üzeri sığıra sahip işletmeler). Veriler, 2017 üretim dönemini kapsamaktadır. Analiz sonuçlarına göre; işletmelerin inek başına günlük süt verimi ve laktasyondaki süt verimi 18.72 kg ve 4835.81 kg/yıl olarak belirlenmiştir. İşletmelerin toplam üretim maliyeti $49103.07 olarak hesaplanmıştır. İşletmelerin ortalama yem maliyeti, toplam üretim maliyetinin %52.11'ini oluşturmaktadır. Sonuç olarak, araştırma bulgularının Karacabey ilçesindeki süt sığırcılığı faaliyetinin geliştirilmesine ve onların süt üretim miktarlarının artmasına katkı sağlaması beklenmektedir.

Anahtar kelimeler: Süt sığırı, Karacabey, üretim maliyeti, kâr, değişken maliyet.

Introduction

Livestock plays an important role in agricultural development, i.e. in providing cash flow to the household and reduction to unemployment in the rural area. Dairy farming is one of the most important activities in this sector (Schaik et al., 1996; Jabir, 2007). In Turkey, the total number of milk cow was 5 969 047 and the total milk production was 18 762 319 tonnes in 2017. Bursa is the 4th biggest city in Turkey, located in the northwest of Turkey and southeast of the Marmara Sea. The province has been witnessed significant increases in the culture race of animal population in the recent years. The total number of cattle was 199 575 and the milk production in Bursa amounted to 241 561 tonnes in 2017. Approximately 27% of the total milk production in the province was provided by Karacabey district, and the total cattle population in this district is 42 050 (Turkstat, 2017). Dairy cattle activity is also a particularly significant source of

income for most farmers in Karacabey. Therefore, it can be argued that Karacabey is of great importance for dairy cattle activities in Bursa. There are a number of studies on the assessment of productivity and profitability in farms as well as the comparison of farms in terms of economic and technical aspects in the literature (Sharma et al., 1999; Dağıstan et al., 2009; Vallapureddy, 2013; Daş et al., 2014). Yet, it is notable that no comprehensive study regarding this subject has been conducted in the Karacabey district in Bursa. Hence, it seems paramount to evaluate the economic structure in dairy cattle farms in this district to improve dairy farming. The aim of the present study is to examine the economic structure of the farms of dairy cattle in the Karacabey district of Bursa in Turkey. With such aim, this study would potentially contribute to the economy of the Karacabey district in terms of the sustainability of dairy cattle activities.

Material and Methods

The data of the study were used to analyse the economic structure of the farms and obtained through survey method at the farms in the Karacabey district with the highest number of dairy cattle in Bursa. Records of Directorate of Provincial Agriculture and Forestry was used to determine the number of dairy cattle in district (Anonymus, 2017). Data were based on the production period between September 2016 and September 2017. The stratified random sampling method was employed to determine the sample size of the study. The number of dairy cattle was taken into consideration to determine the sample size was calculated by Neyman Method (Yamane, 1967).

$$n=\frac{(\sum N_h S_h)^2}{N^2 D^2+\sum N_h S_h^2} \qquad D^2=\frac{d^2}{z^2} \qquad [1]$$

Where, sample size is (n), the number of farm in district is (N), the number of farm in the h stratum refers to (N_h), the standard deviation of the h stratum is (S_h), the variance of h stratum is (S_h^2), desired absolute precision refers to ($\overline{X} * 0.05$; $\overline{X}$=mean) (d), desired confidence level (1.96 equates to the 95% confidence interval) (z) and acceptable error limit in population mean (D). The sample consists of the farms, randomly selected from these strata by dividing the strata with regards to the number of dairy cattle by the farms in the Karacabey district. Furthermore, it was used data obtained from 5 to ≤100 head animal to prevent of deviations from mean in evaluation of available data due to be scarce of the number of farms that have the bovine animal more than 100 head and less than 5 head in population of study. They were divided into three groups as 5 to≤11 cattle (67 farms-group I), 12 to ≤26 cattle (38 farms-group II) and equal 27 and >27 cattle (103 farms-group III). The total sample size was calculated to be 208 dairy farms. In order to calculate the variable costs, fixed costs and milk income of the farms in this study, the equations used in the studies similar to this present study in the literature were employed (Kıral et al., 1999; Yılmaz et al., 2016; Oğuz and Yener, 2017). Thus, *Gross Production Value*=(milk production amount*milk price paid to farmer) + productive stock value + farm manure income, *Productive Stock Value*=(year-end animal value + value of animal sold + value of animal slaughtered) - (value of animal at beginning of year + value of animal purchased), *Fixed Costs in Milk Production*=general administrative costs + family labour force fee return + permanent labour force fee + depreciation (building, cow, tool and machine) + interest (building, cow, tool and machine) + building repair and maintenance costs, *Variable Costs in Milk Production*=concentrate feed + roughage + temporary labour + veterinary and drug + artificial insemination + electricity and water + repair and maintenance + cleaning + other (salt, mineral etc.). The depreciation values and interest costs include not only animals but also tools, machinery and buildings used in a farm. The straight-line method was employed to calculate depreciation values (Oğuz and Yener, 2017). *Depreciation Value*=(new value of tool/machine/building-salvage value)/economic life (year), *Depreciation Value for Cow*=(brood value-butchery value) / economic life of animal (year), *Tool/Machine/Building Interest*=(value of tools + salvage value/ 2)*interest rate, *Cow Capital Interest*= (brood value + butchery value /2)*interest rate, *Gross Profit*= (gross production value - total variable costs), *Net Profit*=(gross production value - total production costs), *Relative Profit*=(gross production value/total production costs). The year-end values were also taken into consideration to determine machinery, tool, building and cow capital. The real interest rate was used in order to calculate the nominal values of inputs used during the production period. The relevant formula is as follows:

$$i=[(1+r)/(1+f)]-1 \qquad [2]$$

Where real interest rate is (i), nominal interest rate is (r), and rate of inflation is (f) (producer price index). The nominal interest rate and inflation rate were respectively 14.4% and 12.10% in the period when the survey was conducted. Based on these values, the real interest rate was calculated to be 2.1%. The general administrative costs were considered to be 3% of the variable costs (Yılmaz et al., 2016). To calculate the family labour force, the wage rate of a worker was taken into consideration. Milk cost was computed using relative sales value method. In this method, the total of the expenses for the branches of activity is distributed according to the

contribution share of each joint product in the total gross production value. Thus, the unit product cost is calculated by dividing the production amount of products that is obtained from the portion of expense falling each product (Kıral et al., 1999). The farmers' declaration and current prices were also taken into consideration to determine the price for milk and farm manure sales in farms. The calculations indicated that the milk prices varied between 0.31 and $0.35, and farm manure prices varied between 8.4 and $9.2. The farmers' declaration was also considered to determine the economic life of animals in farms, and to determine their brood value and butchery value.

Results and Discussion

The technical parameters regarding the dairy cattle production activities in the farms in Karacabey (Table1).

Table 1. Technical parameters in dairy cattle activity*

Parameters	Group I	Group II	Group III	Average
Number of cow milked (head)	6.21	8.30	18.22	9.63
Milk yield per cow (litres/day)	18.30	19.11	21.40	18.72
Lactation milk yield per cow (litres/year)	4561.33	4928.82	5317.51	4835.81
Economic life (year)	6.31	6.70	7.13	6.53
Breeding value ($/head)	1754.62	1833.11	1934.42	1821.92
Butchery value ($/head)	1052.41	1124.63	1170.25	1100.11
The amount of milk production (litres/farm/year)	49748.13	131644.70	253934.08	138732.53
Price of milk ($/litres)	0.32	0.33	0.34	0.33
The amount of farm manure (tonnes/farm/year)	114.40	254.81	478.03	270.99
Price of farm manure ($/tonnes)	8.50	8.80	8.91	8.72

*1 USD ($) = 3.56 TRY (Turkish lira) in January 2017 (CBRT, 2017).

Table 2. Variable and fixed costs in dairy cattle farms ($/farm/year)

Costs	GroupI		GroupII		GroupIII		Average	
	$	%	$	%	$	%	$	%
Concentrate feed	7352.88	39.18	18078.77	39.11	34156.32	39.96	18762.42	38.21
Roughage	2630.56	14.02	6197.18	13.41	11308.44	13.23	6822.06	13.90
Temporary labor	357.81	1.91	1055.79	2.28	1284.71	1.50	912.44	1.86
Veterinary and drug	326.12	1.74	903.72	1.96	2244.68	2.63	1058.17	2.15
Artificial insemination	283.61	1.51	1465.01	3.17	3423.22	4.00	1523.95	3.10
Electricity and water	314.15	1.67	891.95	1.93	1461.84	1.71	885.31	1.80
Repair and maintenance	63.22	0.34	154.71	0.33	267.65	0.31	160.56	0.33
Cleaning	31.53	0.16	101.62	0.22	215.41	0.25	106.19	0.22
Other (salt, mineral etc.)	16.62	0.09	32.84	0.07	115.80	0.14	50.09	0.10
Total variable costs (A)	11376.50	60.62	28881.59	62.48	54478.07	63.73	30281.19	61.67
Administrative costs (A*0.03)	341.29	1.82	866.45	1.87	1634.02	1.91	908.44	1.85
Family labor force fee return	3271.32	17.43	4316.11	9.34	5629.41	6.60	4305.61	8.77
Permanent labor force fee	-	-	1526.72	3.30	4004.16	4.68	2565.44	5.22
Building capital depreciation	886.40	4.72	2644.75	5.72	5372.31	6.28	2867.82	5.84
Building capital interest	553.21	2.95	1420.21	3.07	2113.11	2.47	1360.18	2.77
Building repair and maintenance	577.30	3.08	1829.73	3.96	3256.40	3.81	1877.25	3.82
Cow capital depreciation	880.10	4.69	2243.04	4.85	4602.63	5.38	2473.16	5.04
Cow capital interest	410.05	2.19	1183.61	2.56	2205.31	2.58	1166.32	2.38
Tool and machine depreciation	289.14	1.54	877.16	1.89	1368.22	1.60	840.63	1.71
Tool and machine interest	180.71	0.96	434.19	0.94	816.20	0.96	457.03	0.93
Total fixed costs (B)	7389.52	39.38	17341.97	37.52	31001.77	36.27	18821.88	38.33
Total production costs (A+B)	18766.02	100.0	46223.56	100.0	85479.84	100.0	49103.07	100.0

The number of cow milked per farm, the daily milk yield per cow, the lactation milk yield per cow, the amount of milk production per farm and the amount of farm manure per farm were found to be 9.63, 18.72 litres, 4835.81 litres year^{-1}, 138732.53 litres year^{-1} and 270.99 tonnes year^{-1}, respectively. The milk yield in lactation per cow of farms in Karacabey district is higher than those of Turkey (3090.4 litres year^{-1}) and the World (2407.6 litres year^{-1}). Nevertheless, it is lower than the average milk yield per cow in European Union countries (6701.5 litres year^{-1}) (Faostat, 2017). Thus, it can be claimed

that the average annual milk yield per cow in this district is above both Turkey and the world average. The total production costs on milk production in farms were examined based on two categories: variable costs and fixed costs (Table 2).

The average production cost and variable cost per farm were found to be 49103.07 and $30281.19. The share of the variable costs in the total production costs per farm was 61.67%. The results showed that the ratio was the lowest for the first farm group and was the highest for the third farm group. The total fixed cost per farm was found to be $18821.88. The share in the total production costs in the fixed costs per farm was 38.33%. Similar results were reported in previous studies (Demircan et al., 2007; Gündüz and Dağdeviren, 2011; Semerci et al., 2015; Yılmaz et al., 2016; Oğuz and Yener, 2017). In these studies, the shares for variable costs and fixed costs were determined as 68.31 and 31.69%, 74.58 and 25.4%, 64.26 and 35.74%, 65.92 and 34.08% and, 72.02 and 27.98%, respectively. Dairy farming has the largest share in production value in agriculture and livestock activities. In this activity, feed costs constitute about 70-80% of the inputs (Oğuz et al., 2013). Hence, the smallest optimisation to be made for feed costs can reduce the production cost of milk, and thus contribute to farm profitability. In this study, feed costs (52.11%) constitute a major portion of the total production costs for all farms. Besides, the share in the total variable costs of feed costs was 84.49%. The concentrate feed costs had the largest ratio in both total production costs and total variable cost for all farm, and it was followed by roughage costs. In previous studies, the share of feed costs in the total production costs and total variable costs were calculated as 58.20% and 85.20% in Burdur province (Demircan et al., 2007), 57.05% and 71.35% in Biga province (Aktürk et al., 2010), 57.03% and 86.52% in East Mediterranean region (Yılmaz et al., 2016), 60.76% and 84.36% in Konya province (Oğuz and Yener, 2017), 49.83% and 90.36% in Eastern Anatolia region (Gençdal and Yıldırım, 2018). These results demonstrated that the ratio of feed costs in the total production costs of farms in Karacabey district was lower than those of others, and the share of feed costs in total variable costs of farms was higher than those of in Biga and in Konya provinces, but it was lower than those of in Burdur province, in East Mediterranean region and in Eastern Anatolia region. Thus, this study claims that feed costs in the variable costs vary depending on regions and farms, and these costs constitute more than 70% of the variable costs. In farms, the share of feed costs in the variable costs is important and thus, farmers should seek a way in order to decrease to feed costs. Hence, it can be said that the share of the feed costs in the variable costs of the farms in the district decreased depending on the increase in the size of the farm. The most important sources of input were feed and labour costs for the farms in Karacabey. The family labour force fee return held the largest share in the total fixed costs for all farm, and this ratio per farm was 22.88%. The average total fixed cost per farm was determined as $18821.88. The family labour force fee return in milk production in farms was higher than the temporary labour cost, which indicated that the dairy cattle activities performed by the farmers were mostly based on family labour force. In order to improve the activities of farms and to maintain their continuity, it is vital to increase the share of the income obtained from milk sales in the gross production value. Since, farms may have to withdraw from the market if this share decreases (Demircan et al., 2007). In this study, the gross production value was obtained from the dairy cattle activities in farms, which consist of milk sales, productive stock value and farm manure sales. On average, the income obtained from milk sales accounted for 84.76% of the total gross production value (Table 3).

Thus, the average gross productionvalue per farm was determined as $53583.48, and significant difference was determined asstatistical in this value for three groups ($P<0.05$). The income obtained from milk sales had the largest share in the gross production value for all farms, and it was followed by productive stock value and farm manure sale. The milk cost of farms was calculated using relative-sales-value method where the share in gross production value is calculated per product obtained from dairy cattle activities. The average production cost for products which was obtained from this area for per farm was found to be $49103.07 (Table 3).

The product with the largest share in distribution related to production costs was milk cost with 84.76%, and it was followed by productive stock value with 11.02% and farm manure with 4.22%. The milk production cost per farm in district was found to be $41619.76. Similar results were reported in the previous studies (Semerci et al., 2015; Oğuz and Yener, 2017), but this value was found to be higher than the value reported in the previous studies in the literature (Demircan et al., 2007; Yılmaz et al., 2016). The unit milk cost of farms was found by dividing the amount of produced milk by the total production costs of farms (Table 4).

Accordingly, the average unit milk cost per farm was calculated to be $0.30/litres. The farm with the highest unit milk cost was the first farm group and the farm with the lowest unit milk cost was the third farm group. This study revealed that there is a decrease in their unit milk costs depending on the increase in the size of farm in Karacabey district. This result is congruent with the previous findings of the studies in the literature (Demircan et al., 2007;

Semerci et al., 2015; Yılmaz et al., 2016; Oğuz and Yener, 2017; Gençdal and Yıldırım, 2018). The average profit margin per farm was determined as $0.03/litres. The profit margin was low ($0.30/litres) because of small differences in these prices. Therefore, increasing the difference between milk sale price and unit milk cost can enhance the profit margin in the farms. These findings are congruent with a study in the literature (Demircan et al., 2007). Gross profit is considered as an important success criterion in the determination of competitive power of production activities in farms (Keskin and Dellal, 2011; Semerci et al., 2014). Thus, it can be argued that increasing the size of the farm may also lead to an increase in the gross profit and net profit values of farms. The gross profit per farm and net profit were calculated as $23302.29 and $4480.41, and the ratio of gross profit in gross production value was 43.49% (Table5).

Table 3. Gross production value of farms ($/farm) / distribution of production costs for products obtained from dairy cattle activity ($/farm)

Gross production value of farms								
Incomes	**Group I**		**Group II**		**Group III**		**Average**	
	$	**%**	**$**	**%**	**$**	**%**	**$**	**%**
Milk	15919.40	82.18	43442.75	85.44	86337.58	86.15	45781.73	84.76
Productive stock value	2479.54	12.80	5160.86	10.15	9620.90	9.60	5438.72	11.02
Farm manure	972.40	5.02	2242.32	4.41	4259.25	4.25	2363.03	4.22
Total	19371.34	100.0	50845.93	100.0	100217.73	100.0	53583.48	100.0
Distribution of production costs for products obtained from dairy cattle activity								
Incomes	**Group I**		**Group II**		**Group III**		**Average**	
	$	**%**	**$**	**%**	**$**	**%**	**$**	**%**
Milk	15421.92	82.18	39493.41	85.44	73640.88	86.15	41619.76	84.76
Productive stock value	2402.05	12.80	4691.69	10.15	8206.06	9.60	5411.16	11.02
Farm manure	942.05	5.02	2038.46	4.41	3632.89	4.25	2072.15	4.22
Total	18766.02	100.0	46223.56	100.0	85479.83	100.0	49103.07	100.0

Table 4. Unit milk cost and profit margin of farms ($/farm)

Items	**Group I**	**Group II**	**Group III**	**Average**
Share of milk sale value in gross production value (%) (A)	82.18	85.44	86.15	84.76
Total production costs ($/farm) (B)	18766.02	46223.56	85479.84	49103.07
Milk production cost in total production costs ($/farm)(C=A*B)	15421.92	39493.41	73640.88	41619.76
Total amount of milk production (litres/farm) (D)	49748.13	131644.70	253934.08	138732.53
Unit milk cost ($/litres) (E=C/D)	0.31	0.30	0.29	0.30
Milk sale price ($/litres) (F)	0.32	0.33	0.34	0.33
Profit margin ($/litres) (G=F-E)	0.01	0.03	0.05	0.03

Table 5. Gross profit, net profit and relative profit of farms ($/farm)

Parameters	**Group I**	**Group II**	**Group III**	**Average**
Gross production value (F)	19371.34	50845.93	100217.73	53583.48
Total variable costs (G)	11376.50	28881.59	54478.07	30281.19
Total production costs (H)	18766.02	46223.56	85479.84	49103.07
Gross profit (F-G)	7994.84	21964.34	45739.66	23302.29
Net profit (F-H)	605.32[a]	4622.37[b]	14737.89[c]	4480.41
Relative profit (F/H)	1.03	1.10	1.17	1.09

[a,b,c]means with different parameters are different (P<0.05).

The farm groups II and III had more net profit than the farm group I. Accordingly, it can be stated that we have differences among farm groups in terms of net profit which result from higher milk prices in the second and third farm groups according to first farm group in Karacabey district (P<0.05). Similar results were reported in the previous studies (Keskin and Dellal, 2011; Semerci et al., 2014; Oğuz and Yener, 2017). Relative profit can be accepted as good criterion for farmers in investment that will be made regarding production activities determined in farms. The relative profit rate per farm was calculated to be 1.09. Accordingly, $1.09 profit was obtained for per $1 cost made for milk production, and the farm with the highest relative profit was the third farm group, and the farm with the lowest relative profit was the

first farm group. Thus, the third group farm has high relative profit and more advantage than other farm groups, and it is so important in terms of sustainability of farms of having high relative profit in farms. These results are consistent with the findings of some studies (Demircan et al., 2007;Keskin and Dellal, 2011).

Conclusion

The present study aimed to analyse the economic structure of dairy cattle farms in Karacabey district of Bursa province in Turkey. The results showed that the profit margin of the farms in the district is rather low. Therefore, farmers should take necessary precautions for the reduction of feed costs, and they should give more importance to forage plant breeding. The study indicated that large-scale farms in the district were more profitable. Thus, farmers should find out practices that will have a positive impact on the increase of the number of dairy cattle in the farm. Besides, encouraging the farmers in the district to become more interested in supports and subsidies on livestock may lead to a decrease in their feed costs and an increase in their income from milk production. In conclusion, dairy farming has the largest share in terms of production value for the farms in Karacabey. Feed costs constituted a major portion of the total production costs for all farms. The profit margin of the farms in district was rather low. Therefore, farmers should take necessary precautions for the reduction of feed costs, and attach more importance to forage plant breeding. Also, the study revealed that large-scale farms in the district were more profitable. Hence, farmers should find out practices that will have a positive impact on the increase of the number of dairy cattle, and encouraging the farmers in the district to become more interested in supports and subsidies on livestock may have a positive effect on the income.

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