The effect of dairy farm size on the economic structure and feed consumption: A case study of the Aegean Region

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ABSTRACT

Dairy farming has an important role in agriculture and livestock sector in Türkiye. Cow's milk production constitutes 92.11% of the total milk production in Türkiye. The purpose of this study is to demonstrate the effect of scale size on the economic structure and feed consumption in dairy farms. The research data were obtained from face-to-face surveys conducted with 147 farmers in the Aegean Region. In the study, the farms were divided into four groups based on the number of cows: 5-15 cows, 16-25 cows, 26-40 cows, and 41 cows and above. The total variable cost per livestock unit in the 4th group farms was 26.07% less than the farms in the 1st group. The total production cost per livestock unit in the largest farm group is 25.81% less than that of the smallest farm group. The research findings indicate that large-scale farms take advantage of economies of scale, resulting in lower cost per livestock unit. Additionally, it was observed that as farm size increases, the feed conversion ratio also increases. As farms grow larger, they often have access to economies of scale, better management practices, and improved infrastructure.

Introduction

Dairy farming has an important role in agriculture and livestock sector in Türkiye. The total amount of milk produced was 23.20 million tons in 2021 and cow's milk made up 92.11% (21.37 million tons) of the total milk production in Türkiye. 2.86% of the global cow's milk production, which was 746.06 million tons in 2021, was realized in Türkiye (12). Cow's milk production value in 2020 was 46.82 billion Turkish Liras (TL) (6.68 billion US Dollars) in Türkiye. This value constitutes 8.51% of total agricultural production value in Türkiye. In addition, cow's milk production value made up 43.11% of the total animal product value (36).

İzmir and Manisa, where the study was conducted, are located in the Ege Region at level-1 sub-region according to the Statistical Regions Classification. In 2019, the Aegean Region of Türkiye produced 3.75 million tons of cow's milk, which accounted for 18.05% of the total production of 20.78 million tons. Within the Aegean Region, 37.81% (1.42 million tons) of cow's milk was produced in İzmir and Manisa (36).

To determine feed efficiency has significant importance in the economic analysis of dairy farming. Feed efficiency (FE) is an essential parameter used to evaluate the productivity of livestock, especially in the context of milk production. It provides valuable insights into how effectively animals convert the feed they consume, specifically the dry matter, into milk or other animal products. Feed efficiency is crucial for dairy farming because it directly impacts the profitability and sustainability of their operations. Feed efficiency is typically measured as the amount of milk produced per unit of dry matter intake. This parameter allows comparing the revenue generated from the milk sale based on the amount of dry matter ingested by the animal (1, 16).

There are numerous studies available that assess the economic structure of dairy farms in Türkiye (6, 7, 9, 13, 14, 18, 20, 22, 25, 27, 28, 37). In some of these studies,

along with the economic structure, the feed conversion ratio has also been presented.

The primary objective of this study is to examine the economic structure of dairy farms based on the farm size. Besides that, the study presents feed efficiency and feed conversion ratio according to the farm size scale.

In line with these objectives, the following hypotheses were tested in the research: (i) the demographic characteristics of the farmers differ according to the farm size; (ii) the existence of family and paid labor differs according to the farm size; (iii) the existence of property, rented, and common land differs according to the farm size; (iv) milk yield, lactation period, and annual milk yield per cow differs according to the farm size; and (v) the variable costs per livestock units differs according to the farm size.

Materials and Methods

The main material of this study consists of data obtained from face-to-face surveys conducted with dairy cattle farmers in İzmir and Manisa in Türkiye. İzmir and Manisa are located in the Aegean Region, which ranks first in cow's milk production among the 12 regions designated by Turkish Statistical Institute (TURKSTAT). Approximately 6.83% of the cow's milk produced in Türkiye was produced in İzmir and Manisa in 2019 (36).

The number of registered farmers (3175) in İzmir and Manisa Cattle Breeders' Association has been considered as the main population, and the sample size has been calculated. Accordingly, the number of farmers to be interviewed is calculated as 143, with a 95% confidence interval and an 8% margin of error. The sample size has been increased by 4 to reach 147. When calculating the sample size, the formula for proportional sample size has been utilized (23).

$$n = \frac{Np(1-p)}{(N-1)\sigma_{px}^2 + p(1-p)}$$

In the formula, n represents the sample size; N is the total number of dairy farmers, and p indicates the proportion of farmers that will be included in the sample. σ_{px}^2 represents the variance of the proportion. In order to achieve the maximum sample size in the calculation, "P" has been set as 0.50, and (1-p) is also taken as 0.50.

The surveys were conducted with dairy farmers in the research area in 2018. The survey data were analyzed using SPSS statistical software. The data were initially evaluated using basic statistical methods such as percentages and means, and the results were presented in tables. Differences between farm groups were tested statistically. The Mann-Whitney U test was applied to compare two groups for continuous variables that did not follow a normal distribution and had heterogeneous variances. The Kruskall-Wallis test was used to compare more than two groups for the same type of variables.

The farms were divided into four groups based on the number of cows: 5-15 cows, 16-25 cows, 26-40 cows, and 41 cows and above. In order to enable comparisons between the groups, it was important to have a minimum of 30 farms in each group and to ensure that the percentage distribution of farms was relatively similar for homogenous distribution. There were 32 farms in the 1st group, 46 farms in the 2nd group, 36 farms in the 3rd group, and 33 farms in the 4th group.

In the study, in order to evaluate the animal populations in a homogeneous manner, the animal populations in the farms were converted into livestock units (LU). The conversion coefficients for livestock units were taken into account as 1.00 for cow, 1.40 for bull, 0.70 for heifer, 0.50 for calf and 0.20 for calf less than six months old (11).

The male labor unit (MLU) was taken into account in determining the current labor force in farms. Accordingly, the calculation is as follows: 0.50 for males and females in the 7-14 age group, 1.00 for males and 0.75 for females in the 15-49 age group, and 0.75 for males and 0.50 for females who are 50 years and older (26).

Feed efficiency is a parameter frequently used in animal husbandry and is also called dairy efficiency. FE is calculated by dividing the amount of milk expressed by the amount of dry matter consumed (19).

$$FE = \frac{Daily\ milk\ yield\ of\ cow\ (kg)}{Daily\ dry\ matter\ consumption\ (kg)}$$

Feed conversion ratio (FCR) is the gross production value (GPV) obtained per value of feed consumed. FCR was calculated by the following formula in this study (28):

$$FCR = \frac{Gross\ Production\ Value}{Value\ of\ Feed\ Consumed} x\ 100$$

To calculate the gross profit margin, total variable expenses have been subtracted from the gross production value, and the result has been divided by the gross profit.

Results

Information about the Farms: The average age of the farmers is 47.12 years, the duration of education is 7.29 years, and the number of family members is determined to be 3.61 individuals. Furthermore, the experience duration in crop production is 25.53 years, while the experience in dairy farming is found to be 22.75 years.

Although there is no difference in terms of age, number of individuals in the family, plant production experience and dairy farming experience by the size of the farm, it has been determined that there is a difference

between the groups in terms of education level (P<0.05). The period of education of the farmers in large-scale farms is longer than the farmers in small-scale farms (Table 1).

The existence of family labor force in the farms has been calculated in terms of male labor units (MLU), and the average is determined to be 2.73 MLU. As for paid labor, there are 0.37 MLU employed in the farms.

It has been determined that the existence of paid labor force (P<0.01) and total labor force (P<0.01) differs by size of farm size. As the size of the farm increases, the existence of paid labor force and total labor force also increase (Table 2).

The total land of the farms is an average of 76.80 decares. Within the total land, the property land is 51.88 decares, the rented land is 24.51 decares, and the common land is 0.41 decares. The average number of parcels per farm is 4.79.

According to farm size, there is a statistical difference between the farms in terms of property (P<0.01), rented (P<0.01), and total land (P<0.01), and the number of parcels (P<0.01). It has been determined that as the size of the farm increases, the number of parcels of land increases as well as the property, rented and total land (Table 3).

Table 1. Demographic characteristics of farmers by farm size (head).

Characteristics	1. Group (32) 5-15 Head		2. Group (46) 16-25 Head		3. Group (36) 26-40 Head		4. Group (33) 41≥ Head	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (year)	46.94	9.43	47.37	11.38	46.50	12.16	47.64	10.07
Education level (year)*	6.13	2.12	7.02	2.84	7.33	2.70	8.73	4.13
Number of individuals in the family	3.37	1.01	3.70	1.13	3.50	1.08	3.85	1.15
Plant production experience (year)	22.53	12.52	26.72	12.57	27.25	12.15	24.91	11.60
Dairy farming experience (year)	21.59	10.20	23.65	13.08	23.17	12.63	22.15	11.04

* P<0.05.

Table 2. The existence of labor force by farm size (Male labor unit).

Labor Force	1. Group (32) 5-15 Head		2. Group (46) 16-25 Head		3. Group (36) 26-40 Head		4. Group (33) 41≥ Head	
	Person	%	Person	%	Person	%	Person	%
Family labor force	2.75	100.00	2.74	97.51	2.65	93.97	2.80	67.31
Paid labor force **	-	-	0.07	2.49	0.17	6.03	1.36	32.69
Total labor force**	2.75	100.00	2.81	100.00	2.82	100.00	4.16	100.00

** P<0.01.

Table 3. The existence of land by farm size (decares).

Land Ownership	1. Group (32) 5-15 Head			2. Group (46) 16-25 Head			3. Group (36) 26-40 Head			4. Group (33) 41≥ Head		
	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD	%
Property**	14.87	16.69	61.73	45.04	65.07	72.75	40.56	41.90	62.69	109.67	275.82	67.74
Rented **	9.22	12.40	38.27	16.72	32.51	27.01	23.22	38.60	35.89	51.61	51.62	31.88
Common	-	-	-	0.15	1.03	0.24	0.93	5.50	1.42	0.61	3.48	0.38
Total **	24.09	21.45	100.00	61.91	81.33	100.00	64.71	51.47	100.00	161.89	306.13	100.00
Number of parcels **	3.42			4.19			5.83			5.82		

** P<0.01.

Table 4. Feed conversion ratio by farm size (head).

Incentive Status	Variables	1. Group (32) 5-15 Head	2. Group (46) 16-25 Head	3. Group (36) 26-40 Head	4. Group (33) 41≥ Head
Without Incentive	GPV	159188	277194	427752	1098972
	Value of Feed Consumed	108277	180254	266130	652892
	FCR	147.02	153.78	160.73	168.32
With Incentive	GPV	162021	281736	435409	1120168
	Value of Feed Consumed	108277	180254	266130	652892
	FCR	149.64	156.30	163.61	171.57

Table 5. Milk yield (kg), lactation period (day) and annual milk yield per cow (kg/year) by farm size.

Variables	1. Group (32) 5-15 Head		2. Group (46) 16-25 Head		3. Group (36) 26-40 Head		4. Group (33) 41≥ Head	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Milk Yield	22.06	4.30	23.33	4.11	23.11	2.48	23.79	4.39
Lactation Period	290.68	6.23	292.25	7.37	291.60	3.98	288.50	16.36
Annual Milk Yield	6406.25	1215.45	6817.08	1211.40	6738.85	723.98	6856.02	1301.31

Feed Efficiency and Feed Conversion Ratio: In cows with 150-225 days of milking, feed efficiency is considered normal between 1.4-1.6. However, FE varies depending on many factors and can take values between 1.2-2.0 (16, 19). From the first group to the fourth group, FE was 1.50, 1.54, 1.61 and 1.69, respectively. In addition, FE was calculated as 1.61 across the farms.

Feed conversion ratio was calculated as 162.09 across the farms. It was determined that FCR with incentive calculated by adding milk incentive pay and calf support, increased to 167.09. As the size of the farm increases, the feed conversion ratio also increases. Accordingly, from the first group to the fourth group, FCR was 147.02, 153.78, 160.73 and 168.32, respectively (Table 4).

Production Cost: The daily average milk yield per herd size is 23.10 kg, the lactation period is approximately 290.91 days, and the annual milk yield per cow is 6717.23 kg. There is no statistically significant difference in milk yield, lactation period, and annual milk yield per cow among the groups based on farm sizes (Table 5).

According to the research results, the share of feed cost in variable costs is 87.95%. As the size of the farm increases, the share of concentrate feed in total feed cost increases, but the concentrate feed cost per livestock units decreases. It was determined that there was a significant difference at the level of 1% between the farm groups in terms of feed, veterinary, pharmaceutical and vaccine, artificial insemination, water-electricity, fuel, temporary labor, cleaning materials and salt costs. There was a significant difference at the level of 5% between the farm groups in terms of repair and maintenance costs. Such that, as the size of the farm increases, the cost per livestock units decreases. In order to compare the variable cost between the farm groups, an index was prepared by equating the total variable cost per 1 LU to 100 units in the 1st group. The variable cost of the other groups were evaluated by taking the variable cost of 1st group as a reference. According to the index, while the total variable cost is 100.00 units in the 1st group which includes the small farms, it is 91.10 units in the 2nd group farms, 81.39 units in the 3rd group farms, and 73.93 units in the 4th group farms. The total variable costs per LU in the 4th group farms is 26.07% less than the farms in the 1st group (Table 6). In addition, total variable costs constitute 71.30% of the total production costs.

When the fixed costs of the farms are examined by their sizes, there is a statistical difference between the farm groups in terms of fixed cost components. Among the examined farms, the total fixed costs of the farms in the 4th group are 418.15% higher than those in the 1st group. The most significant factor causing this difference is the depreciation value in the 4th group farms. In terms of the proportion of depreciation in total fixed costs based on farm sizes, it is 55.99% in the 1st group, 54.77% in the 2nd group, 55.88% in the 3rd group, and 52.38% in the 4th group (Table 7).

In the index prepared by assigning a value of 100 units to the first group, the total production cost is found to be 155.50 units in the 2nd group, 214.33 units in the 3rd group, and 513.78 units in the 4th group. Therefore, the total production cost per livestock unit in the largest farm

group is 25.81% less than that of the smallest farm group (Table 8).

The gross profit margins by the size of the farms increase from the first group to the fourth group, with percentages of 21%, 29%, 34%, and 41%, respectively. This indicates that larger farms tend to have higher gross profit margins compared to smaller farms. As the scale of the farm increases, the total variable cost per livestock unit tend to decrease. This situation has enabled larger farms to achieve a higher gross profit margin, despite the lower gross production value per livestock unit in these farms (Table 9).

Table 6. The variable costs by farm size.

Variable Costs	1. Group (32) 5-15 Head			2. Group (46) 16-25 Head			3. Group (36) 26-40 Head			4. Group (33) 41≥ Head		
	Cost (TL)	%	Cost per LU (TL)	Cost (TL)	%	Cost per LU (TL)	Cost (TL)	%	Cost per LU (TL)	Cost (TL)	%	Cost per LU (TL)
Feed**	103964	82.29	5617	171686	87.00	5364	245395	87.36	4853	574670	88.85	4483
Concentrate**	65291	62.80	3527	94531	55.06	2953	130773	53.29	2586	301774	52.51	2354
Roughage**	38674	37.20	2089	77155	44.94	2410	114622	46.71	2267	272896	47.49	2129
Veterinary, Pharmaceutical, Vaccine**	5208	4.12	281	6100	3.09	191	8699	3.10	172	21438	3.31	167
Artificial Insemination**	3479	2.75	188	4418	2.24	191	6647	2.37	131	13082	2.02	102
Water-Electricity**	2377	1.88	128	3416	1.73	107	5323	1.89	105	13554	2.10	106
Fuel**	3535	2.80	191	3518	1.78	110	5178	1.84	102	11433	1.77	89
Temporary Labor**	2592	2.05	140	2828	1.43	88	3615	1.29	71	4811	0.74	38
Repair, Maintenance*	1749	1.38	95	1926	0.98	60	2409	0.86	48	3075	0.48	24
Cleaning Materials**	1461	1.16	79	1469	0.74	46	1633	0.58	32	2431	0.38	19
Bedding	1454	1.15	79	1495	0.76	47	1465	0.52	29	1565	0.24	12
Salt**	512	0.41	28	491	0.25	15	553	0.20	11	756	0.12	6
Total Variable Cost	126334	100.00	6825	197348	100.00	6218	280916	100.00	5555	646815	100.00	5046
Index		-	100.00	-	-	91.10	-	-	81.39	-	-	73.93

* P<0.05 ** P<0.01.

Table 7. The fixed costs by farm size.

Fixed costs	1. Group (32) 5-15 Head		2. Group (46) 16-25 Head		3. Group (36) 26-40 Head		4. Group (33) 41≥ Head	
	Cost (TL)	%	Cost (TL)	%	Cost (TL)	%	Cost (TL)	%
Depreciation**	29085	55.99	43754	54.77	56541	55.88	140986	52.38
Building Depreciation*	9814	33.74	11093	25.35	10213	18.06	26103	18.51
Equipment Depreciation**	7836	26.94	12689	29.00	15455	27.33	36699	26.03
Cow Depreciation**	11435	39.32	19972	45.65	30874	54.60	78183	55.45
Land Rent**	7245	13.95	13115	16.42	14851	14.68	39405	14.64
Interest on Debt **	5973	11.50	9875	12.36	11662	11.52	34128	12.68
General Administrative Expenses**	3790	7.30	5920	7.41	8427	8.33	19404	7.21
Permanent Labor Costs**	-	-	1330	1.67	3967	3.92	28873	10.73
Family Labor Wage	5775	11.12	5764	7.22	5556	5.49	5870	2.18
Cooperative-Association Dues**	74	0.14	123	0.15	181	0.18	476	0.18
Total Fixed Costs	51943	100.00	79881	100.00	101185	100.00	269142	100.00
Index	100.00		153.79		194.80		518.15	

* P<0.05 ** P<0.01.

Table 8. Total production costs by farm size (TL).

Costs	1. Group (32) 5-15 Head		2. Group (46) 16-25 Head		3. Group (36) 26-40 Head		4. Group (33) 41≥ Head	
	Per Farm	Per LU	Per Farm	Per LU	Per Farm	Per LU	Per Farm	Per LU
Total Variable Costs (1)	126334	6825	197348	6165	280916	5555	646815	5046
Total Fixed Costs (2)	51943	2806	79881	2496	101185	2001	269142	2100
Total Production Costs(1+2)	178277	9631	277229	8661	382101	7556	915957	7146
Index	100.00	100.00	155.50	89.92	214.33	78.45	513.78	74.19

Table 9. Gross production value, total variable costs and gross profit by farm size (TL)*.

Variables		1. Group (32) 5-15 Head		2. Group (46) 16-25 Head		3. Group (36) 26-40 Head		4. Group (33) 41≥ Head	
		Per Farm	Per LU	Per Farm	Per LU	Per Farm	Per LU	Per Farm	Per LU
Revenues	**Milk Income**	111243	6010	194834	6087	301879	5970	763035	5953
	Increase in Inventory Value	15760	851	23840	745	31440	622	89080	695
	Calf Income	23740	1283	43915	1372	71360	1411	188375	1470
	Manure Income	8445	456	14605	456	23073	456	58482	456
Without Incentive	**Gross Production Value (1)**	159188	8600	277194	8660	427752	8459	1098972	8574
	Total Variable Costs (2)	126334	6825	197348	6165	280916	5555	646815	5046
	GROSS PROFIT (1-2)	32854	1775	79846	2494	146836	2904	452157	3528
	GROSS PROFIT MARGIN (1-2)/(1)	0.21	0.21	0.29	0.29	0.34	0.34	0.41	0.41
With Incentive	**Gross Production Value (1)**	162021	8753	281736	8801	435409	8610	1120168	8739
	Total Variable Costs (2)	126334	6825	197348	6165	280916	5555	646815	5046
	GROSS PROFIT (1-2)	35687	1928	84388	2636	154493	3055	473353	3693
	GROSS PROFIT MARGIN (1-2)/(1)	0.22	0.22	0.30	0.30	0.35	0.35	0.42	0.42

* During the research period (2018), 1 dollar is approximately 4.40 Turkish Lira.

Discussion and Conclusion

The research results indicate that total variable costs constitute 71.30% of the total production costs. In the study conducted by Semerci (31), the share of total variable costs was determined to be 64.26%. According to the research results, the share of feed cost in variable costs is 87.95%. When previous studies are examined, this rate is found to be 71.30% (4), 87.50% (5), 81.68% (8), 86.30% (20), 72.82% (24), 74.80% (33), and 81.60% (34).

Feed conversion ratio was calculated as 162.09 in this research. In previous researches in Türkiye, it was calculated as 273.17 (6), 194.00 (9), 207.43 (14), 226.00 (17), and 195.72 (31). In addition, feed efficiency was calculated as 1.61 in this research. In another study conducted in İzmir (2), the feed efficiency was calculated as 1.60.

The most produced forage crop among feed crops is corn silage. Additionally, sorghum production is widespread for use as artificial pasture on farms. Corn silage is cultivated in 56.83% of the total forage crop planting area, while sorghum is grown in 16.66% of it. Furthermore, barley, oats, alfalfa, peas, and triticale are produced for use as feed for animals. Except for a small amount of wheat grown on the farms, grain feed production is not widespread. It can be said that this situation increases the farms' concentrated feed expenses. Indeed, a study conducted by Demir et al. (10) in Kars found that the proportion of feed expenses in the total costs was quite low (25%). This was attributed to the intensive use of pasture and forage areas for animal feeding in the region. In a study conducted by Santos et al. (29) in Brazil, which examined three family farms, it was determined that the share of feed expenses in the total costs was 63.09%. The high share of feed expenses was explained by the direct relationship of feed costs with milk production, and the fact that cows were allowed to feed freely without being dependent on milk yield.

Despite corn silage being the most produced forage crop, it is also the most purchased feed. Following corn silage, the most purchased roughage feeds, in order, are hay and alfalfa. Among concentrated feeds, dairy feed is

the most commonly purchased feed. Following dairy feed, there are beef feed, corn flakes, and calf growing feed, in that order. When examining feed consumption by type of roughage in the farms, it was found that 9.32 kg of roughage and 5.08 kg of concentrated feed were consumed daily. Among roughage feeds, corn silage has the highest consumption share (73.50%), while among concentrated feeds, dairy feed is the most consumed (65.75%). Considering this situation is important for reducing the feed costs of dairy farming when planning support for livestock farming.

The daily milk yield per herd average is 23.10 kg, the lactation period is approximately 290.91 days, and the annual milk yield per cow is 6717.23 kg in this research. The studies conducted in Türkiye, milk yield has been found to vary across different provinces. In the research conducted by Talim et al. (34) in Balıkesir, İzmir and Manisa, the average daily milk yield per cow was 19.84 kg and the annual milk yield was 6090 kg. In the research conducted by Tandoğan (35) in Afyonkarahisar, it was determined that the milk yield was 5187 lt/year. According to the size of the farms, the milk yield in small (1-15 head), medium (16-35 head), and large (36 and above head) farms was 5159 lt, 5155 lt, and 5313 lt, respectively. In the research conducted in the Thrace region (20), milk yield was 21.6 lt per day and 6093.6 lt per year. In this research, according to the size of the farm, the daily milk yield was 18.6 lt (5204.2 lt/year) in small (1-5 heads) farms, 20.0 lt (5611.8 lt/year) in medium (6-9 head) farms and 26.3 lt (7685.7 lt/year) in large (10 and above head) farms. In the research conducted by Sarıözkan et al. (30) in Kayseri, the daily milk yield was determined to be 22.7 liters per cow, and the lactation milk yield was found to be 6925 liters per cow. In another research conducted in İzmir (22), the daily milk yield per cow was 21.40 kg and the milk yield obtained in a lactation period was 5711.9 kg. In the study conducted by Semerci (31) in Hatay, milk yield in a lactation period was determined to be 5.619 lt/year.

It is known that in addition to the animal's genetic characteristics, environmental factors also have an impact on milk yield (15). In the examined farms, almost all of the animals are of the Holstein breed. However, there is also a presence, albeit in small numbers, of hybrid and Simmental breeds. To increase milk yield, it is advisable to improve shelter conditions on the farms, especially by using cooling fans during the hot summer months when temperatures rise significantly and by promoting the use of feed mixers for homogeneous ration mixing. Additionally, feed mixers that save labor contribute to reducing labor costs. It was determined that feed mixers are present in 39.46% of the farms.

The calculations of feed efficiency and feed conversion ratio were used to assess the influence of scale size on feed consumption in this research. In particular, the inclusion of the gross production value in the formula of the feed conversion ratio leads to its correlation with the economic structure of the farm. Indeed, the research findings indicate that large-scale farms take advantage of economies of scale, resulting in lower cost per livestock unit. Additionally, it was observed that as farm size increases, the feed conversion ratio also increases. Moreover, as the size of the farm increases, the cost per livestock units decreases. The average total land ownership in the farms is 76.80 acres, of which 67.55% (51.88 acres) are owned lands. The average number of parcels is 4.79. It has been determined that in larger-scale farms with a higher number of cows, irrigated farmland and total land ownership are greater compared to smaller-scale farms. This situation provides an advantage to larger-scale farms in terms of being able to produce the feed they need on their farms and reduce farm expenses. The research findings are similar to the results of a study conducted in Balıkesir by Mat and Cevger (21). In their study, a clear distinction was noted in the profit and loss statuses of the farms based on their scales, showing a rise in profitability levels as farms transitioned from small to large scale. Additionally, in the study conducted by Akbay et al. (3), which covers the seven geographical regions of Türkiye, it has been determined that with the increase in farm size, the farm land, forage crop planting area, and the share of forage crop planting area within the farm land have increased. In the study conducted by Semerci and Çelik (32) in Hatay, dairy farms were evaluated in three size categories: small, medium, and large. Accordingly, the highest yield per cow, milk production value per cow, and the highest profit per liter were achieved in the large-scale dairy farms.

As farms grow larger, they often have access to economies of scale, better management practices, and improved infrastructure. These factors can contribute to increased efficiency in animal production, including better feed utilization.

It was determined that 42.86% of the farmers sell their milk to dairies, 27.89% to middlemen, and 23.81% to cooperatives. In practice, milk collectors (buyers) often require the farmers from whom they purchase milk to also buy feed from them. Farmers with strong capital can manage to meet this requirement, but those facing capital issues are often obliged to comply with this requirement. The potential of dairies and middlemen to provide capital support to farmers through cash advances is much higher compared to cooperatives, which influences the preference of farmers to choose dairies and middlemen for milk collection.

The results of the study indicate that larger-scale farms are more advantageous compared to smaller-scale

farms. At the same time, larger-scale farms have a lower need for borrowing/credit, and their participation rates in cooperatives are higher. Semerci and Çelik's (32) study has revealed that organized dairy farms sell their milk at a higher unit price and achieve higher profit per liter.

It has been determined that farms derive 80.19% of their total gross production value from dairy farming and fully specialize in this production branch. Specialization, although considered unfavorable in terms of capital risk distribution, is a positive aspect in terms of achieving efficiency. Farms can enhance profitability by supporting their specialization trend in dairy farming with technological innovations.

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Conflict of Interest

The authors declared that there is no conflict of interest.

Author Contributions

DG and GS designed the research. DG conducted the surveys and obtained the data. All authors provided critical feedback and helped shape the research, analysis and manuscript.

Data Availability Statement

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Ethical Statement

This study does not present any ethical concerns.

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