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The effects on milk marketing of cooperative partnership of dairy farmers: a case study from Türkiye

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In the agricultural sector, dairy cattle farming is a sector with a significant economic impact. One of Türkiye's priority goals in agricultural development is to raise awareness of organization among farmers. Cooperatives play a crucial role in ensuring the sustainability of farmers in production. For dairy cattle farmers, one of the most effective means to market their milk is through cooperatives. The aim of this study is to reveal the socioeconomic characteristics, cooperative status and the effect of the cooperative on milk marketing of dairy cattle farmers who are members of the cooperative in Derince district of Kocaeli province. The main material of the study consisted of the data obtained by questionnaire method from 61 farmers who are members of Cavuslu Village Agricultural Development Cooperative in Derince district of Kocaeli province, Türkiye. The research includes data obtained during the 2020 production period. Dairy cattle farms were divided into 3 groups according to the presence of dairy cows and analyzed. Logistic regression analysis was used to determine the factors affecting the marketing of milk produced by the dairy cattle farms through cooperatives. According to the results of the research, 57.38% of the farmers market their milk through cooperatives. On average, there are 4.94 heads of domestic breed, 11.78 heads of culture breed and 9.20 heads of crossbred cows in the farms. The average milk selling price is 0.37 USD/kg. It was determined that the most effective factor for farmers to give milk to the cooperative was the selling price of milk. Dairy cattle farms with fewer milking cows and those without cooling tanks are more likely to sell their milk to the cooperative. In conclusion, for cooperatives to play a more effective role in dairy cattle farming, it is necessary to increase the competitiveness of cooperatives and ensure their effectiveness in the milk market through the establishment of processing and packaging facilities in the region.

KEYWORDS

cooperative partnership, dairy cattle farming, cow milk marketing, sustainable, livestock, Türkiye

1 Introduction

Agriculture played an important role in meeting the nutritional needs of the world population. The agricultural sector is also one of the critical sectors in the economic development of countries. Population growth and the problem of balanced nutrition increase the demand for animal products. Therefore, the development of animal husbandry and the increase of animal products have become an important issue today (Paksoy and Bulut, 2020). The livestock sector is a sector that develops the national economy, creates the highest added value per unit investment and provides employment opportunities at the lowest cost (Yilmaz

and Koknaroglu, 2007). Thus, animal husbandry is the locomotive sector in the development of the agricultural economy.

In a balanced diet, most of the daily protein requirement is met from animal products. More than half of Türkiye's animal protein needs are provided by cattle. The importance of cattle for Türkiye is not only due to its high contribution to animal protein production. The meat and milk provided by cattle, especially milk, is processed into many products, bringing benefits to both the nutrition sector and the economy in all its dimensions.

Demand for milk and dairy products is increasing due to increasing urbanization, high population and income level of consumers. Small milk farmers are therefore expected to achieve a higher level of market integration (Ishaq et al., 2016). There are ongoing efforts to invest in innovation and improve the productivity of small-scale dairy farmers for sustainability in developing countries (Banda et al., 2021). In developing countries, milk production is carried out by smaller families and milk production contributes to their livelihood, food security and nutrition. For small families, milk production is an important source of cash income, with relatively fast cash returns (Faye and Konuspayeva, 2012).

World agricultural production value is the sum of crop and animal production values. Milk has a significant share in the value of animal production (Celik and Semerci, 2023). Türkiye ranks 10th in world cow milk production with a share of 2.64% according to 2022 data. The total amount of raw milk production in the country was 19.9 million tons, with cow milk accounting for 92.34%, sheep milk for 4.95%, goat milk for 2.51% and buffalo milk for 0.20% (FAOSTAT, 2022).

The dairy cattle sector has low competitiveness due to high production costs compared to EU countries. One of the most important factors affecting the production costs of dairy farmers in Türkiye is feed costs. High feed prices and increasing input costs negatively affect the continuity of our dairy cattle farming (Vlontzos and Theodoridis, 2013; Mitsopoulos et al., 2021; Akbay and Akdogan, 2022).

In Türkiye, especially in rural areas, milk marketing is dominated by milk collectors. Dairy farmers are therefore deprived of high profits and negatively exploited. For the rapid development of dairy cattle farming, it is necessary to organize small-scale milk farmers, integrate the marketing system with production, improve the milk collection mechanism, improve market information and increase the profitability of the farm (Milford, 2014). In addition, to prevent fluctuations in the agricultural economy, dairy cattle farmers should be encouraged to gather under the roof of cooperatives. The cooperative should ensure the continuity of the cooperative, use resources rationally and appropriately, provide credit to farmers, and contribute to the social and economic development of its members (Ors, 2018).

Cooperatives are now seen as one of the most important tools for achieving sustainable development (Hacisuleyman and Sanli Gulbahar, 2019). Cooperatives have a significant positive impact on the communities in which they are located by mediating the dissemination of new technological knowledge to farmers (Mulayim, 1999) and the establishment of a more efficient organization (Zijun, 2006). Cooperatives are an important stakeholder in the dairy sector, involved in milk collection, processing, input supply and marketing (Artukoglu and Olgun, 2008). Dairy farmers gathered under the roof of cooperatives also have the potential to have competitive power. Kunte and Patankar (2015) reported that cooperatives have a positive impact on milk production and income. Khan et al. (2014) also noted the important role of milk cooperatives in marketing. Cooperatives create sustainable employment opportunities for local people, and the surplus income generated by the cooperatives is redistributed back to the local members of the cooperative, rather than going to any external investor, thus increasing local people's spending within the region and strengthening the regional economy (Hacisuleyman, 2019).

Agricultural Development Cooperatives have the largest share among cooperatives affiliated to the Ministry of Food, Agriculture and Livestock with 62.92% (Ministry of Trade, 2021). Agricultural Development Cooperatives provide dairy cattle farms, which are small family-owned dairy farms, with inputs for milk production and provide important layers in the marketing of the product (Kinikli et al., 2017). Therefore, it is necessary to investigate the situation of dairy cattle farms that are members of cooperatives, which have an important role in agricultural development, at the regional level. In this way, it is thought that the potential of the region in dairy cattle farming will be revealed, and it will be useful as a resource and guide for the relevant institutions and organizations.

There have been several studies of foreign origin analyzing on cooperatives in dairy cattle farming so far, including the effectiveness of dairy cooperatives in marketing (Habiyaremye et al., 2023), their impact on production (Astuti et al., 2010; Tanwar et al., 2015; Chagwiza et al., 2016), productivity and quality (Francesconi and Ruben, 2012), the role of cooperatives in the socio-economic development of milk producers (Khan et al., 2014), the sustainability of cooperatives in dairy cattle farming (Bijman, 2018; Sultana et al., 2020), and the performance of cooperative member milk producers (Asmara et al., 2017).

When the studies on cooperatives in dairy cattle in Türkiye are examined; economic analysis of cooperative partner farms (Dedeoglu and Yildirim, 2006; Bulut and Paksoy, 2023), comparison of the characteristics of cooperative and non-cooperative farms (Gencdal et al., 2016), situation analysis (Ikikat Tumer and Kumbasaroglu, 2008), the role of cooperatives in the evaluation of milk and dairy products (Acar and Yildirim, 2000), the effect of cooperatives on marketing (Koc and Uzmay, 2018), the tendency of cooperative member farmers to produce organic milk (Engindeniz et al., 2017), the problems faced by cooperative member farmers (Aydin Can et al., 2023), the level of organizational trust of cooperative member farmers (Yercan and Kinikli, 2018).

The aim of this study is to determine the socio-demographic structure of dairy cattle farms that are members of the Agricultural Development Cooperative (Cavuslu ADC), their organization status, their thoughts about the cooperative, the effect of the cooperative on milk marketing, the factors that are effective in the farmers' giving their milk to the cooperative and to develop various suggestions for increasing the efficiency of the dairy cattle farms.

In line with the goal of the research, the hypotheses are as follows:

> *H1*: Most of the farmers are members of a cooperative.
>
> *H2*: The daily milk production of farmers per animal increases as the size of the dairy cattle farm increases.
>
> *H3*: Farmers with large-scale dairy cattle farms sell their milk at a higher price.

H4: Most of the farmers who give their milk to the cooperative have cooling tanks.

H5: Most of the farmers give their milk to the cooperative.

H6: Farmers think that cooperation is useful in the marketing of milk.

H7: The most effective factor for farmers to give their milk to the cooperative is the price.

H8: There is a significant relationship between the number of dairy cattle owned by the farmers and the amount of milk they give to the cooperative.

H9: The fact that the farmers have a cooling tank affects the cooperative to give their milk.

H10: The increase in the age level of farmers increases the likelihood of giving milk to the cooperative.

2 Materials and methods

2.1 Data collection

The main material of the research consisted of the data obtained through face-to-face surveys with the dairy cattle farms that are members of Cavuslu Village Rural Development Cooperative of Derince District of Kocaeli Province, Türkiye. The results obtained from previous studies on the subject and statistics published by various institutions were also utilized in the research. The number of active cooperative members is 70. In the research, all the dairy cattle farms that accepted to be interviewed and could be reached were interviewed with a complete census approach. Within the scope of the research, 61 dairy cattle farms that are members of the cooperative, continue their dairy cattle farming activities, continue to live in the village and accept to be interviewed were interviewed.

An ethics committee report, dated January 13, 2021, was obtained from The Science and Engineering Ethics Committee of Kocaeli University with the number -10017888-600-5825. Research surveys were carried out between September and November 2021. The questionnaire form used in the research consisted of questions about the socio-economic characteristics of the farmers, number of cattle, milk production, organization status, their opinions about the cooperative, the effect of the cooperative on milk marketing, and the factors that influence the farmers to give their milk to the cooperative.

2.2 Data analysis

In the analysis of dairy cattle farms, the number of milking animals is very important in economic terms. While the average number of cattle in livestock farms in Türkiye is 4 heads, this number is 44 heads in EU countries (Yilmaz and Koknaroglu, 2007). Considering this situation, in the analysis of the research data, the dairy cattle farms were first divided into three groups according to the number of dairy cows. Farms with 5 or less dairy cows formed group I (19 farms), farms with 6–10 dairy cows formed group II (21 farms), and farms with 11 or more dairy cows formed group III (21 farms). In many previous studies, similar groups were formed in terms of the number of dairy cows (Bal and Yildirim, 1999; Gunlu et al., 2001; Sahin, 2001; Keskin and Dellal, 2011; Susanty et al., 2017; Ozdemir et al., 2022).

The data obtained from the questionnaires were analyzed and interpreted using SPSS 22.0 (Statistical Package for Social Science) program. In the analysis of the survey data, simple averages and percentage calculations were used. In the analysis of the data, firstly the general characteristics of the farms were presented, then the cooperative structure of dairy cattle farms, the place where the farms give their milk, the opinions of the farms about the cooperative and the factors that are effective in giving milk to the cooperative were evaluated. The 5-point Likert scale was used to evaluate the opinions, expectations and satisfaction of the farmers towards the cooperative in the analyzed farms (Bilgin, 1995).

In the study, binary logistic regression analysis, which is one of the logistic regression analysis methods, was applied to determine which factors and how much they affect the factors that are effective on the preferences of the dairy cattle farms to market or not to market the milk through the cooperative in the marketing of the milk they produce.

In logistic regression, the dependent variable is discrete and the estimated probability values range between 0 and 1. The logistic regression model based on the cumulative logistic probability function is expressed as follows (Gujarati, 1995).

Pi = Probability that the i'th individual chooses a particular option,

F = Cumulative probability function,

$z = \alpha + \beta Xi$,

α = Constant coefficient,

β = The parameter to be estimated for each explanatory (independent) variable,

Xi = i' refers to the i'th independent variable.

In the study, it was also statistically tested whether there was a difference between the groups. The Chi-square test was applied for comparisons of the data obtained by counting. For continuous variables, the normal distribution test was first performed with the Kolmogorov–Smirnov test. The Kolmogorov–Smirnov test is used to determine the normal distribution in parametric tests. The $p < 0.05$ value obtained from the Kolmogorov Smirnov test indicates that the data are normally distributed (Miran, 2014). For the variables that did not show normal distribution, the Kruskal Wallis test was applied to examine whether there was a statistically significant difference between the groups.

3 Results and discussion

3.1 Socio-demographic characteristics of farmers

Information about the socio-demographic characteristics of the farmers is shown in Table 1. The age range of the farmers is 35–67 years, with an average age of 52.41 years. The agricultural experience of the farmers varies between 10 and 55 years, with an average of 38.46 years. The period of education varies between 5 and 15 years and the average period of education is 6.60 years. The average

TABLE 1 Socio-demographic characteristics of the farmers.

Variable	Mean	Std. Dev	Min	Max
Age (year)	52.41	8.728	35	67
Education (year)	6.60	2.531	5	15
Experience (year)	38.46	9.575	10	55
Family size (person)	4.70	1.773	1	8
Land size (ha)	15.14	84.612	4	41.5
Dairy cows number (head)	8.64	8.155	1	40
Partnership period in Cavuslu ADC (year)	16.64	2.696	5	18

TABLE 2 Dairy cattle numbers, milk production, and milk prices in the farms.

Animal number, milk production, and price		Farmer groups			
		Group I (19 farmers)	Group II (21 farmers)	Group III (21 farmers)	Total
Animal number (head)	Domestic dairy cattle	2.00	5.10	4.54	4.94
	Culture dairy cattle	2.64	7.44	23.97	11.78
	Crossbred dairy cattle	2.89	6.57	20.90	9.20
	Number of dairy cattle	2.51	6.37	16.47	8.64
Animal unit (LU)		7.11	11.90	32.19	17.02
Milk production (kg/day/head)		10.24	12.43	15.13	12.68
Lactation period (day)		268.42	273.81	278.33	273.69
Milk price (USD/kg)		0.34	0.35	0.41	0.37

household size in farms is 4.40. The average land size of farms is 15.14 hectares. Maize, barley, oat, wheat and clover are mostly produced on farmlands. In a study conducted by Boyar and Yumak (2000) in Isparta and Burdur provinces, it was determined that 60% of the farmers in Isparta province produced maize as a wedge forage crop. The average number of animals owned by the dairy cattle farms is 8.64 heads.

3.2 Information on the number of farmers' dairy cattle, milk production and storage

The livestock owned by the dairy cattle farms are generally small family farms. There are 4.94 heads of domestic cows, 11.78 heads of culture cows, 9.20 heads of crossbred cows and the average number of dairy cows is 8.64 heads (Table 2). In similar studies conducted in different provinces in Türkiye, the number of dairy cows per farm was calculated as 13.36 heads (Akbay and Akdogan, 2022), 8.29 heads (Ozdemir et al., 2022). When the daily milk production amount of the dairy cattle farm is analyzed, the average daily milk yield is 12.68 kg. In previous studies, daily milk yield was found to be 21.6 liters in Thrace Region (Keskin and Dellal, 2011), 6.98 liters in Kars province (Demir et al., 2014), 15.1 liters in Kırklareli province (Yildirim et al., 2008), 19.80 liters in Burdur province (Ata and Yilmaz, 2015), 23 liters in Izmir province (Uzmay, 2017; Engindeniz et al., 2017). These results show that milk yield in Kocaeli province is lower than in most provinces. The average lactation period was 273.69 days. Milk price received by the farmer vary between 0.34 and 0.41 USD/kg, while the average milk selling price is 0.37 USD/kg.

All the dairy cattle farms examined obtain the milk they produce by milking with a machine. Farmers use machines for milking because it is easier and faster. In Table 3, when the way of storing the milk of the dairy cattle farm is analyzed, 49.18% stated "Direct sale to cooperative," 44.26% stated "cooling tank" and 6.56% stated "in my refrigerator." It is seen that the first and second group farms do not have a high number of cooling tanks, while the third group farms have the highest number of cooling tanks.

3.3 Organization status of farmers

All the farms examined consist of farmers who are members of Cavuslu Village Agricultural Development Cooperative and Chamber of Agriculture. Among the dairy cattle farms, Agricultural Credit Cooperative is the cooperative they are members of the second most with 60.66%. Farmers who are members of the Milk Farmer Union have a share of 50.82%, while farmers who are members of the Breeding Union have a lower share with 36.07%. It is seen that the second group of farms is the group with the highest membership to the Milk Farmer Union (Table 4). In a similar study conducted by Sahin (2001) in Kayseri Province, Türkiye it was determined that 60.37% of the farmers were members of the union.

3.4 Milk marketing channels of farmers

Information on milk marketing situation in the analyzed dairy cattle farms is given in Table 5.

TABLE 3 The way farmers store milk.

The way store milk	Farmer groups							
	Group I (19 farmers)		Group II (21 farmers)		Group III (21 farmers)		Total	
	n	%	*n*	%	*n*	%	*n*	%
Refrigerator	3	15.79	–	–	1	4.76	4	6.56
Cooling tank	3	15.79	6	28.57	18	85.72	27	44.26
Direct sale to cooperative	13	68.42	15	71.43	2	9.52	30	49.18

TABLE 4 Membership status of farmers to cooperatives.

Membership status of farmers		Farmer groups							
		Group I (19 farmers)		Group II (21 farmers)		Group III (21 farmers)		Total	
		n	%	*n*	%	*n*	%	*n*	%
Cavuslu ADC	Member	19	100.00	21	100.00	21	100.00	61	100.00
	Not member	–	–	–	–	–	–	–	–
Agricultural credit cooperative	Member	8	42.11	16	76.19	13	61.90	37	60.66
	Not member	11	57.89	5	23.81	8	38.10	24	39.34
Milk farmers association	Member	7	36.84	13	61.90	11	52.38	59	96.72
	Not member	12	63.16	8	38.10	10	47.62	30	50.82
Breeding union	Member	5	26.32	10	47.62	7	33.33	22	36.07
	Not member	14	73.68	11	52.38	14	66.67	39	63.93
Chamber of agriculture	Member	19	100.00	21	100.00	21	100.00	61	100.00
	Not member	–	–	–	–	–	–	–	–

TABLE 5 The place of milk sales of farmers.

Place of sale	Farmer groups							
	Group I (19 farmers)		Group II (21 farmers)		Group III (21 farmers)		Total	
	n	%	*n*	%	*n*	%	*n*	%
Cooperative	16	84.21	16	76.19	3	14.29	35	57.38
Milk processing companies	3	15.79	5	23.81	18	85.71	26	42.62

Person Chi Square 24.578, *p*:0. 000 < 0.05.

Among the farms, 84.21% of the first group farms, 76.19% of the second group farms and 14.29% of the third group farms give the milk produced to the cooperative. In general, 57.38% of the farms give their milk to the cooperative, while 42.62% give it to the milk factory through the neighborhood. As the size of the farm increases, the rate of giving to cooperatives decreases. It has been determined that especially large farms do not give their milk to the cooperative because the milk factory gives higher prices. In addition, the fact that the newly built North Marmara Highway is very close to this region creates strategic importance for a large market such as Istanbul province, Türkiye in the marketing of milk produced. This situation causes the dairy cattle farms to give their milk-to-milk processing companies there, as it creates the opportunity to sell it at a better price in the Istanbul market. As a result of the Chi-square analysis, the relationship between the milk sales place of the farms in dairy cattle production branch and the farm groups was found to be statistically significant ($p < 0.05$).

3.5 Farmers' opinions, attitudes and expectations about the cooperative

The opinions of the farmers in the analyzed dairy cattle farms on whether the cooperative is useful or not in marketing the milk they produce are given in Table 6. The first group of farms is the group that thinks that Cavuslu Village Agricultural Development Cooperative is useful in milk marketing with 78.95%. In general, 62.30% of the farmers think that cooperative is useful in the marketing of milk, while 37.70% think that it is not useful. As a result of the Chi-square analysis, the relationship between the usefulness of cooperative marketing of milk in dairy cattle farming and farm groups was found to be statistically significant ($p < 0.05$).

The 5-point Likert scale was used to evaluate the participation of the farmers in the factors that may be effective in giving or not giving the milk produced by the farmers to the cooperative. According to this, the most influential factor for farms to give their milk to the

TABLE 6 The opinions of farmers about whether the cooperative is useful in the marketing of milk.

The opinions of farmers	Farmer groups							
	Group I (19 farmers)		Group II (21 farmers)		Group III (21 farmers)		Total	
	n	%	*n*	%	*n*	%	*n*	%
Yes	4	21.05	5	23.81	14	66.67	23	37.70
No	15	78.95	16	76.19	7	33.33	38	62.30

Person Chi Square 24.578, *p*:0. 000 < 0.05.

TABLE 7 The level of importance of the factors that are effective for farmers to give milk to the cooperative*.

Effective factors	Farmer groups							
	Group I (19 farmers)		Group II (21 farmers)		Group III (21 farmers)		Total	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Purchase price of milk	4.89	0.315	4.95	0.218	4.86	0.655	4.90	0.436
Support of the cooperative in feed*** the supply of feed at an affordable price	4.79	0.535	4.67	0.913	3.95	1.627	4.46	1.177
The cooperative sells the milk itself**	4.95	0.229	4.38	1.117	3.24	1.758	4.16	1.406
Making payments for milk sales in a short time	4.58	0.607	4.33	0.913	3.52	1.778	4.13	1.284
The cooperative provides training for the production of yield and feed crops for dairy cattle farming	3.79	1.357	3.81	1.250	3.19	1.504	3.59	1.383
The cooperative collects milk ** itself in cooling tanks	4.37	1.499	3.76	1.814	1.57	1.434	3.20	1.982
The cooperative provides its members with cooling tanks to preserve milk	2.37	1.342	2.90	1.670	2.05	1.359	2.44	1.489

5-point Likert scale; * 1 = strongly disagree; 5 = strongly agree. Kruskal Wallis test: **, *** Statistically significant at the levels of 0.01 and 0.05, respectively.

TABLE 8 The relationship between the number of dairy cattle and whether farmers give their milk to the cooperative (ANOVA test).

Number of dairy cattle	The situation of giving your milk to the cooperative							
	Giving			Not Giving			*F*	*p**
	n	Mean	Std. Dev	*n*	Mean	Std. Dev	Value	*n*
	35	6.37	3.499	26	15.65	9.402	2.789	0.003

* Statistically significant at the levels of 0.01.

cooperative is the purchase price of milk. Dairy cattle farms in Groups I and II attach more importance to the cooperative's support in providing feed at affordable prices than farms in Group III. It was determined that there was a statistically significant difference between the groups in terms of the cooperative providing feed at affordable prices ($p < 0.05$), making payments in a short time ($p < 0.01$), and the cooperative collecting the milk in cooling tanks ($p < 0.01$). For the other factors, there was no statistically significant difference between the groups (Table 7). Koc and Uzmay (2018) also stated in their study that the increase in milk price decreased the possibility of marketing through cooperatives. Paksoy and Bulut (2020) found that the highest expectations of dairy cattle farming cooperative member farmers from the cooperative were marketing of products (55.5%) and providing production inputs (54.4%). These results are in line with the findings of the study.

In the normal distribution test conducted between whether the farms give their milk to the cooperative and the number of milking cows they have, it was determined that the variables showed a normal distribution. In the analysis of variance, the difference between the status of giving milk to the cooperative according to the number of dairy cows owned by the farms was found statistically significant ($p < 0.05$) (Table 8). The average number of dairy cows was 6.37 heads in the farms that gave their milk to the cooperative and 15.65 heads in the farms that did not give their milk to the cooperative. In a study on milk marketing channels in Pakistan, it was found that 89% of the farmers who give their milk to cooperatives are small-scale dairy cattle farms, constituting the majority (Ishaq et al., 2016). In a study conducted in the Thrace Region of Türkiye, it was determined that 69% of small-scale dairy cattle farms gave their milk to the cooperative (Koc and Uzmay, 2018). The fact that farms with fewer dairy cows are more likely to give their milk to the cooperative is like the results of the study.

Findings on the status of having a cooling tank and giving milk to the cooperative are given in Table 9. 67.21% of the farms stated that

TABLE 9 Relationship between the farmers have/have not cooling tank and give/not give their milk to the cooperative.

Cooling tank status	Gives to the cooperative		Does not give to the cooperative		Total	
	n	%	*n*	%	*n*	%
Cooling tank available	2	5.71	18	69.23	20	32.79
Cooling tank not available	33	94.29	8	30.77	41	67.21

Person Chi Square 27.311, *p*:0. 000 < 0.05.

they do not have a cooling tank. Of the farmers who give their milk to the cooperative, 94.29% do not have a cooling tank. As a result of the Chi-square analysis, the relationship between whether the milk is given to the cooperative and whether the farm has a cooling tank or not was found to be statistically significant ($p < 0.05$). Farms without cooling tanks stated that they could not keep their milk for a long time and preferred to give their milk to the cooperative to support the cooperative. It has been determined that most of the large farms with high milk yield have cooling tanks. Similarly, study examining the technical efficiency in milk production of Burdur province reported that the dairy farms equipped with the fixed milking unit and cooling tanks and were found to be more efficient (Yilmaz et al., 2020). Small-scale dairy farms generally farming with low capital. Therefore, they may have difficulty purchasing such equipment. In addition, the amount of milk produced may not be high enough to economically use a cooling tank. This may cause small farms to find investing in individual cooling tanks unnecessary or costly. For this reason, cooperatives help small farms collect their milk, store it under suitable conditions and marketing it.

3.6 Factors that influence farmers to give their milk to the cooperative

Binary logistic regression analysis, one of the logistic regression methods, was used to reveal the factors affecting whether farmers give their milk to Cavuslu Village Development Cooperative. The dependent variable (Y) of the model is based on the responses of the farmers to the question "Do you give the milk you produce to the cooperative?" as yes (Y = 1), no, I do not (Y = 0). In the model, age, experience, total land size, purchase price of milk, average daily milk production, presence of dairy cows, and the presence or absence of cooling tanks were included in the analysis as independent variables affecting the dependent variable (Table 10).

The estimation model developed for these variables is given in Table 11. According to the final model results of logistic regression analysis, age (Wald = 0.244; $p = 0.621$), experience (Wald = 1.730; $p = 0.188$), total land (Wald = 0.741; $p = 0.389$), daily milk yield (Wald = 0. 829; $p = 0.363$), presence of dairy cows (Wald = 1.326; $p = 0.515$) and availability of cooling tanks (Wald = 1.839; $p = 0.175$) were not significant, while the contribution of milk purchase price (Wald = 6.162; $p = 0.013$) to the model was found to be significant. According to the results in Table 11, the higher the age level of the farmers, the more likely they are to give their milk to the cooperative. In addition, the higher the price at which farmers sell their milk and the higher the average amount of milk they produce per day, the less likely they are to give their milk to the cooperative. In the UK, low milk prices also reduce members' commitment to cooperatives (Bhatti, 2010). In Pakistan, farmers who marketed their milk through cooperatives had higher incomes (Ishaq et al., 2016).

TABLE 10 Variables used for logit models.

Dependent variables	Explanation
Situation of giving milk to the cooperative	1: Yes 0: No

Independent variables	Explanation
Age of farmer	Continuous
Experience of farmer (year)	Continuous
Land size (ha)	Continuous
Milk sales price (USD/kg)	Continuous
Average daily milk production (kg)	Continuous
Number of dairy cattle (head)	1: <5 2: 5–15 3: >15
Availability of cooling tank	1: Yes 0: No

The explanatory power of the model was evaluated with Cox & Snell or Nagelkerke R^2 values. The Nagelkerke R^2 value of 0.920 in Table 11 indicates that the multivariate model explains the response variable (giving milk to the cooperative) very well. Insignificant over-variable assignment increased R^2. They were included in the model primarily to show that they were not significant. The correct classification rate of the model was calculated as 93.4%. These values also show that the logistics model is appropriate. One of the tests used to test the goodness of fit provided by all variables of the model is the Hosmer and Lemeshow test statistic, which is Chi-square distributed. In a sense, the goodness of fit of the model shows a measure of the effectiveness of the best model created to explain the dependent variable (Lee and Koval, 1997). The results of the Hosmer and Lemeshow test were evaluated to determine whether the model is a good model. As a result of the Hosmer-Lemeshow test, it is decided that the fit of the model is very good with a significance level of $p = 0.991$ estimated for the H-L test statistic value.

As a result of the findings reached by the analyses performed; H1, H2, H3, H6, H7, H8, H9 and H10 were accepted and H4 and H5 were rejected. Details of the hypotheses are shown in Table 12.

4 Conclusion

Milk production is an important product in meeting the animal protein needs of countries and in terms of food security. In our country, dairy cattle farms face problems such as small scale, dispersed, lack of capital, inability to market the product at the appropriate time and price. Therefore, for farmers to play an effective role in the milk market, they

TABLE 11 The logistic regression model predictions for farmers' decisions.

Dependent variables					
Situation of giving milk to the cooperative 1: Yes 0: No					
Independent variables	**Beta**	**S.E**	**Wald**	***p***	**Exp. (ß)**
Age of farmer	−0.100	0.202	0.244	0.621	0.905
Experience of farmer	0.212	0.161	1.730	0.188	1.236
Land size	0.012	0.014	0.741	0.389	0.988
Milk sales price	−7.540	0.037	6.162	0.013*	0.001
Average daily milk production	−0.022	0.025	0.829	0.363	0.978
Number of dairy cattle					
1: <5					
2: 5–15	1.258	5.004	0.063	0.802	3.518
3: >15	3.850	4.104	0.880	0.348	46.992
Availability of cooling tank	3.356	2.474	1.829	0.175	28.668
Constant	17.754	13.386	1.759	0.185	5.13E+10
Log likelihood-LL: 12.739; Cox & Snell R^2: 0.685; Nagelkerke R^2: 0.920. Hosmer-Lemeshow $x^2 = 1.581$; $p = 0.991$. Correct classification rate: 0.934.					

* It is significant at the 0.01 level.

TABLE 12 Level of acceptance of hypotheses.

No	Hypothesis	Result
H1	Most of the farmers are members of a cooperative.	Accepted
H2	The daily milk production of farmers per animal increases as the size of the dairy cattle farm increases.	Accepted
H3	Farmers with large-scale dairy cattle farms sell their milk at a higher price.	Accepted
H4	Most of the farmers who give their milk to the cooperative have cooling tanks.	Rejected
H5	Most of the farmers give their milk to the cooperative.	Rejected
H6	Farmers think that the cooperative is useful in the marketing of milk.	Accepted
H7	The most effective factor for Farmers to give their milk to the cooperative is the price.	Accepted
H8	There is a significant relationship between the number of dairy cows owned by the farmers and the amount of milk they give to the cooperative.	Accepted
H9	The fact that the farmers have a cooling tank affects the cooperative to give their milk	Accepted
H10	The increase in the age level of farmers increases the likelihood of giving milk to the cooperative	Accepted

should be organized under the umbrella of cooperatives. In particular, the unification of small farmers under the cooperative roof is considered appropriate for the food safety of milk production and beneficial for quality production (Chlebicka and Pietrzak, 2018; Zhou and Jin, 2009). A study conducted abroad also found that large dairy cattle farmers receive incentives because they produce more milk, and because they buy a high number of agricultural inputs, they can supply them at a more affordable price from factories. For this reason, it has been found that large farms are reluctant to become members of the cooperative (Jitmun et al., 2020). However, most of the dairy cattle farms in our country are small-scale (Inan, 2008; Engindeniz et al., 2017; Torgut et al., 2019; Demirbas, 2020; Paksoy and Bulut, 2020; Yercan and Kinikli, 2018; Ozdemir et al., 2022) due to the fact that farms should be gathered within the cooperative structure.

In this research, the socio-economic structure of the dairy cattle farms of Cavuslu Village Agricultural Development Cooperative member in Derince District of Kocaeli, the socio-economic structure, the thoughts about the cooperative and the factors that are effective in giving milk to the cooperative in milk marketing were revealed, problems were identified, and solutions were tried to be brought. According to the results of the research, all the dairy cattle farms are members of the Chamber of Agriculture, Agricultural Credit Cooperative is the second cooperative with 60.66%, after Cavuslu Village Agricultural Development Cooperative. While 57.38% of the farms give their milk to the cooperative, the others sell it to the milk processing companies. It was determined that 67.21% of the farms did not have a cooling tank, and this situation was a factor in giving the milk to the cooperative. The most effective factor for the farms to give their milk to the cooperative is the sale price of the milk, while the cooperative's supply of suitable feed, short payment terms, and the cooperative's collection of milk with its own cooling tanks are other effective factors.

According to the logistic regression results, the purchase price of milk affects the probability of farmers to give their milk to the cooperative. According to other analysis results, there is a statistically

significant relationship between the number of dairy cows owned by the farms and the marketing of milk through cooperative. It was determined that small-scale dairy cattle farms without cooling tanks gave their milk to the cooperative. It attracts attention that large-scale dairy cattle farms also sell their milk-to-milk processing companies due to higher prices. It is noteworthy that the most decisive factor in the marketing of milk is the price, and the cooperative price is lower than the price offered by milk processing companies. In this context, it will be possible to increase the efficiency of the cooperative in the market, to establish milk processing companies where milk is produced, to sell in addition, giving high prices to farmers who produce quality milk will play an incentive role for farmers to produce quality milk. The most important constraint in this regard is the high investment cost. For this reason, local governments should provide more support to add value to the region's milk production. The fact that the research region is close to the newly built North Marmara Highway causes the milk in the region to go to the big market such as Istanbul province due to the high prices given by the milk processing companies. This situation causes the loss of the added value that Kocaeli province, Türkiye, can obtain from milk.

As a result, ensuring sustainability in dairy cattle farming depends on the continuity of farmers in production. Because most of the farms in our country are small-scale, it is possible for our farmers to have a say in the market only through cooperativization. For this reason, training should be given in order to create the awareness of cooperativization of farmers. In addition, more support should be provided to cover input costs, and incentives should be given for the supply of animals for dairy cattle farms that do not have economic farm size. Legal arrangements should be made to ensure full competition in milk production, quality milk should be priced at its real value and cooperatives should play an active role in this market. Thus, the number of intermediaries between farmers and consumers will be reduced, leading to an increase in the income of farmers and a decrease in the price paid by consumers.

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Kocaeli University Ethics Committee. An ethics committee report, dated 13 January 2021, was obtained from The Science and Engineering Ethics Committee of Kocaeli University with the number -10017888-600-5825. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

BC: Project administration, Resources, Writing – original draft, Writing – review & editing. SE: Formal analysis, Methodology, Resources, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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