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Effects of Farm Size and Raw Milk Quality on Farm Gate Milk Prices in Dairy Cattle Farms within the Province of Izmir, Turkey; Path Analysis Approach

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Abstract: The study has two main objectives; first to determine raw milk quality and farm gate milk prices at variously scaled dairy farms within the province of Izmir; second to determine the effects of raw milk quality and farm size on farm gate milk prices. For November 2005, 285 farms and for May 2006, 375 farms could be included in the study (the data was collected from milk collection centers, which agreed on revealing their records to the researchers). Averages for November 2005 were: fat ratio, 3.75%; non-fat dry matter, 8.61%, 99,676 bacteria mL^{-1}. For May 2006, values for the same averages were: 3.58% for fat; 8.50 for non-fat dry matter and 58 314 bacteria mL^{-1}. Direct and indirect effects (internal relationships of milk quality and farm size) of milk quality and farm size on received milk prices have been calculated through the approach of path analysis. According to the results of calculations, the effect of farm size is 50.3% and it is the highest. Number of fat ratio and bacteria have 3.2% and negative effects by 3.5%, respectively. Since, dairy farms in Turkey are small scaled and scattered the cost of collecting milk at milk collection centers rise. Therefore, scale efficiency is of great importance on farm gate milk prices. In this respect, apart from precautions in order to improve milk quality, the importance of farmers investing on expanding their farm sizes (daily milk delivery) and subsidies being paid to be expansion oriented, turn out to be having great importance. Additionally, compulsory milk quality analyses and increased monitoring at milk collection centers are considered necessary.

Key words: Dairy cattle farms, farm size, raw milk quality, farm gate milk prices, path analysis approach, Izmir

INTRODUCTION

Milk prices in Turkey emerge depending on the market conditions. On the other hand, due to the fact that most of the dairy farmer's unions and modern dairy plants are accumulated in the Western (Marmara and Aegean) part of the country, auction prices occurred in this part of the country become effective all over the country. Out of 2513 dairy plants country wide, 1098 (nearly 50%) are in Marmara and Aegean regions (MARA, 2004). The reasons for this intensity might be stated as, population density, intensive dairy farming compared to other regions and the easiness of collecting required amounts of milk by dairy plants (Uzmay *et al*., 2006a).

Milk collection centers in Turkey, when determining milk prices, either add premium to their base price according to their criteria (ratios of fat, non-fat dry matter, number of bacteria mL^{-1}, amount of daily milk delivery, cooling facility use on the farm and somatic cell count) or charge the farmers for the milks below the quality standard. The fact that dairy farms are small scaled and scattered, causes collection costs for the dairy plants to increase. Therefore, milk collection centers (collecting contractors, collecting cooperatives, dairy plants) also consider the amount of milk delivered daily when determining raw milk prices. In Turkey, studies on the economics of milk focus on milk policies and marketing milk.

Reasons such as; difficulties in gathering data directly from the farmers; lack of desired quality analyses at milk collection centers or reluctance of companies, even if they perform proper analyses to share their records, cause the studies on how milk quality and farm size affect the farm gate milk price to be non-comprehensive. Therefore, a generalization on this issue, either regional or nation wide cannot be made. However, on the other hand, chemical composition and hygiene conditions of milk are not only important for human health, but also for its being economically valuable and marketability (both nationally and foreign sales).

This study was conducted within the province of Izmir, with 17% production rate in Aegean region. That the study was conducted in Izmir is important because Izmir is an example for a well advanced area in the country in terms of dairy cattle breeding. In the area, premium payments are added on different base prices, although, the prices are affected by auction prices, depending on the quality of milk and its daily amount. While, a generalization concerning milk quality in terms of countries, particularly the EU countries is possible, unavailability of generalizations even for regions in Turkey is a failure/deficiency. According to the results of this study, a generalization in terms of farm gate milk prices and milk quality within the province of Izmir will be possible.

In this regard, the study has two main objectives; to determine raw milk quality and farm gate milk prices on various farm sizes within the province of Izmir and to determine the effects on the farm gate milk prices of raw milk quality and farm size.

MATERIALS AND METHODS

In this study, the study group had considerable difficulties gathering the data concerning the farm gate milk prices by dairy farmers. Number of registered dairy farms by the union of dairy cattle breeders in the province of Izmir is 4784 (Bergama, Tire, Odemis, Bayindir, Kiraz). Farm gate milk prices for November, 2005 were gathered for 770 dairy farms and for May, 2006, price records of 900 dairy farms were obtained. The data was obtained from 23 milk collection centers (10 dairy plants, 8 cooperatives, 5 private establishments), which accepted revealing their records. Total amount of milk collected daily by 23 milk collection centers is 1493 tons. However, since some of them didn't make the prices depending on the quality or didn't keep a proper record, they were not included in the extensive study. They were evaluated in terms of their base prices. The data of nine milk collection centers (2 milk cooperatives, 3 privately owned milk collection centers, which only collect and distribute and milk collection centers of four ultra-modern dairy plants), which made its prices depending on quality, could be evaluated. Total amount of milk collected by these nine collection centers is 1425 tons and this constitutes 95% of the milk collected by all subject collection centers. Four of these 9 milk collection centers belong to ultra modern dairy factories and the rest (5 centers) deliver 75% of their milk to ultra modern dairy plants as well. Therefore, it should be stated that all farms dealing with milk collection centers, whose data was assessed, provide milk for ultra modern dairy plants. Data for 30 dairy farms were taken from each milk collection center. Number of dairy farms, which were subject to analyses was 285 in November 2005 and 375 in May 2006. In milk quality assessments, fat ratio, non-fat dry matter, number of bacteria and amount of delivered milk were taken into consideration. Other criteria such as, somatic cell count and freezing point were excluded from assessments due to the fact that they were not available except for ultra modern dairy plants.

Table 1: Distribution of dairy farms according to their sizes (according to the amount of milk they delivered daily)

Farm groups and amounts of milk delivered daily	Number of farms November 2005	May 2006
Group 1 (100-250 L)	43	44
Group 2 (251-500 L)	116	133
Group 3 (501-1000 L)	75	119
Group 4 (1001-1500 L)	23	47
Group 5 (>1500 L)	22	31

The fact that most dairy farms in the province of Izmir deliver their milk to single milk collection center enables assessments for farm size (amount of daily milk delivery). The distribution of dairy farms, whose data was evaluated according to their farm sizes is shown in Table 1.

In order to see whether, there were differences among the dairy farm groups, first, whether variables had a normal distribution was checked. According to Kolmogorov-Smirnov test, among the investigated variables, only fat data for November, 2005 has a normal distribution. In evaluation of November 2005 data variance analysis (one-way ANOVA) was benefited from (Ozdamar, 1999). As for non-parametric variables, Kruskal Wallis analysis was conducted. Evaluations of data for both November, 2005 and May, 2006 are important for they include samples from both Spring and Winter.

In the study, effects on the received milk prices of farm size and raw milk quality were only evaluated for November 2005. A multi linear regression model was formed between farm gate milk Prices (P_m) by the farmers and factors (fat ratio (X_1), number of bacteria (X_2), non-fat dry matter (X_3) and daily amount of delivered milk (X_4)) that affect them. Commonly, when a relationship between two or more variables is aimed to be shown stochastically, regression analysis is carried out. As for the direction and ratio of the relationship, correlation analysis is conducted.

$$P_m = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + U_i$$

However, traditional regression and correlation analyses are inefficient in determining direct and indirect relationships dually between variables. In these cases, path analysis is benefited from. Through path analysis, importance/significance and scales of direct and indirect reasonable relationships between variables can be estimated and accordingly, policies can be made (Deliktas *et al.*, 2008). Therefore in the study, to detect whether independent variables (fat, non-fat dry matter, bacteria and daily delivered milk amount) have a particular direct effect on raw milk prices, path analyses were practiced. This enables distinguishing the indirect effects emerging from the interrelationships of reason variables and therefore, avoiding faulty evaluations. Since, path analysis technique investigates the relationships between standardized variables, variables in the model are standardized; the Constant (C) is always 0 and coefficients of other standardized variables are known as beta coefficients in the study Deliktas *et al*. (2008). The linear regression model for standardized variables can be re-organized as follows Duzgunes *et al*. (1987) and Isci *et al*. (2004).

$$Y = P_{yx1}x_1 + P_{yx2}x_2 ..... + P_{yxk}x_k + P_{yxe}x_e$$

Path coefficient (P_{yx}), showing the effect on dependent variable (Y) in respond to a standard deviation change in any independent variable (X) is calculated through the equation:

$$P_{YX} = b\frac{S_x}{S_y}$$

Here, S_x represents standard deviation belonging to X characteristic

$$S_x = \sqrt{\frac{1}{n-1}\left(\sum\left(X-\bar{X}\right)^2\right)} = \sqrt{S_{xx}}$$

S_Y = Y represents standard deviation due to effects of all factors belonging to S_Y = Y characteristic;

$$S_Y = \sqrt{\frac{1}{n-1}\left(\sum\left(Y-\bar{Y}\right)^2\right)} = \sqrt{S_{yy}}$$

b, represents partial regression coefficients.

The square of path coefficient represents the coefficient of any independent variable (X), defining the dependent variable (Y) on its own (Duzgunes *et al*., 1987);

$$P^2{}_{YX} = \frac{b^2S^2{}_x}{S^2{}_y}$$

As stated above, direct and indirect effects of reason variables on the result variables can be determined by the help of path coefficients. The correlation coefficient (r_{yx}) between reason and result coefficients is equal to the summation of the direct effect of the reason variable and indirect effects that emerge from the relations with other reason variables. When, the total effect is expressed through multi regression analysis the equation system below can be formed;

$$\begin{aligned} P_{yx1} + P_{yx2}r_{x1x2} + \ldots\ldots + P_{yxk}r_{x1k} &= r_{yx1} \\ P_{yx2} + P_{yx1}r_{x2x1} + \ldots\ldots + P_{yxk}r_{x2xk} &= r_{yx2} \\ P_{yx2} + P_{yx1}r_{x2x1} + \ldots\ldots + P_{yxk}r_{x2xk} &= r_{yx2}, \end{aligned} \quad (1)$$

Here, while, P_{yx1} represents the direct effect of x_1 on y, $P_{yx2}r_{x1x2}$ represents the indirect effect of x_1 over x_2. Within the equation system, correlations between reason/cause variables and correlations between cause/reason and result/effect variables are known. Accordingly, path coefficients, depending on these correlations, can be calculated. To do so, the multiple equation system is converted into matrix format. In the matrix shown below, P represents path coefficients vector and B represents the column vector formed by the correlations between cause and result variables (Kaygisiz *et al*., 2009).

$$\begin{bmatrix} P_{yx1} \\ P_{yx2} \\ . \\ P_{yxk} \end{bmatrix} = \begin{bmatrix} 1 & r_{x1x2} & . & r_{x1xk} \\ r_{x2x1} & 1 & . & r_{x2xk} \\ . & . & . & . \\ r_{xkx1} & r_{xkx1} & . & 1 \end{bmatrix}^{-1} x \begin{bmatrix} r_{yx1} \\ r_{yx2} \\ . \\ r_{yxk} \end{bmatrix} \quad (2)$$

In the equation, P = A^{-1} B, the term A^{-1} represent the opposite of A matrix.

Matrix (DE), which is formed fort he indirect effects of cause/reason variables is formed by multiplying Path Coefficients diagonal Matrix (PCM), which determines the direct effect and Correlation Matrix (CM) related to cause/reason variables (DE = PCM × CM) (Eq. 3).

$$\begin{bmatrix} P_{yx1}r_{x1x1} & P_{yx1}r_{x1x2} & . & P_{yx1}r_{x1xk} \\ P_{yx2}r_{x2x1} & P_{yx2}r_{x2x2} & . & P_{yx2}r_{x2xk} \\ . & . & . & . \\ P_{yxkx1}r_{xkx1} & P_{yxk}r_{xkx2} & . & P_{yxk}r_{xkxk} \end{bmatrix} = \begin{bmatrix} P_{yx1} & 0 & 0 & 0 \\ 0 & P_{yx2} & 0 & 0 \\ 0 & 0 & P_{yx3} & 0 \\ 0 & 0 & 0 & P_{yx4} \end{bmatrix} \begin{bmatrix} r_{x1x1} & r_{x1x2} & & r_{x1xk} \\ r_{x2x1} & r_{x2x2} & & r_{x2xk} \\ . & . & . & . \\ r_{xkx1} & r_{xkx2} & . & r_{xkxk} \end{bmatrix} \quad (3)$$

Values on the main diagonal of the matrix (DE) represent path coefficients. Values, which are not on the diagonal, represent indirect effects within cause/reason variables internally. The way of analysis for the total effect of cause/reason variable on result/effect variable is shown in Table 2.

In the study, path coefficients were calculated through both standardized coefficients and the matrix equation formed, which were determined in regression analyses using 15.0 version of SPSS statistical software. In addition in forming the matrix (DE) to analyze the internal indirect effects of cause/reason variables, Pearson correlation coefficients were benefited from.

The relationships between variables were separately shown on a path diagram. In path diagram one way arrows are used. These arrows are drawn from each independent variable to its dependant ones. As for the correlations between independent variables, dual way arrows are

Table 2: Total effects of reason variable on result/effect variable

Cause/ reason variables	Direct effect (P_{yxi})	Indirect effect (r_{yxi}- P_{yxi})	Total effect (correlation coefficients)
x_1	P_{yx1}	$P_{yx2}r_{x1x2} + P_{yx3}r_{x1x3} + P_{yx4}r_{x1x4} = r_{yx1} - P_{yx1}$	r_{yx1}
x_2	P_{yx2}	$P_{yx1}r_{x2x1} + P_{yx3}r_{x2x3} + P_{yx4}r_{x2x4} = r_{yx2} - P_{yx2}$	r_{yx2}
x_3	P_{yx3}	$P_{yx1}r_{x3x1} + P_{yx2}r_{x3x2} + P_{yx4}r_{x3x4} = r_{yx3} - P_{yx3}$	r_{yx3}
x_4	P_{yx4}	$P_{yx1}r_{x4x1} + P_{yx2}r_{x4x2} + P_{yx3}r_{x4x3} = r_{yx4} - P_{yx4}$	r_{yx4}

drawn as uniting curves. Symbolic or numerical values of path coefficients are written on the diagram. On the dual way curved arrows, symbolic or numerical values of correlation coefficients are written.

RESULTS AND DISCUSSION

Raw milk quality and farm gate milk prices in dairy cattle farms in various sizes: The average milk production of subject farms was 850 L day^{-1} in the 2005. Average fat ratio was 3.75 g/100 mL; non-fat dry matter 8.61 g/100 mL and the amount of bacteria was 99.676 mL. the average farm gate milk price was 0.458 TL. When, farms were grouped depending on their sizes (Table 3), a difference in fat ratios was observed ($p = 0.002$, <0.01 through one way anova test). As shown in the table, the difference is in group 4 (according to Duncan test as well the difference is in group 4; other groups of farms, 1-3, 5, have no difference in between). There are also, differences in non-fat dry matter, amount of bacteria and raw milk prices (Kruskal-Wallis test, $p = 0.000$, <0.01). For non-fat dry matter (group 5) for amount of bacteria, groups 1 and 2 showed differences statistically. When, the reason why the averages of fat and non-fat dry matter ratios of large farms (group 5) are just a little higher than the base ratios of ultra modern milk processing factories was investigated, modern factory executives stated that bigger farms (group 5) shoot on target by adjusting their feed rations in a just adequate manner (feed costs and feed conversion concerns) but small farms do not have consciously managed ration preparing methods. As the bases for November, modern factories take 3.60 g/100 mL for fat ratio and 8.60 g/100 mL for dry matter. As for May, they take 3.5 g/100 mL, for fat ratio and 8.50 g/100 mL, for dry matter. These ratios are similar to the ones of big farm groups. When, the amount of bacteria between groups was examined, it was noticeable that farms with daily milk delivery below 1000 L had higher amounts of bacteria. When, the groups were investigated in terms of prices, differences between groups were observed that is when sizes of farms increased, which means an increase in the amount of delivered milk, farm gate milk price increases (Kruskal-Wallis test, $p = 0.000$, <0.01). Price difference between group 1 and 2 is 13% in favor of group 5.

For May 2006, data from 375 dairy farms was evaluated (Table 4). Average daily milk delivery of the farms was 852 L. Ratios for fat and non-fat dry matter were 3.58 and 8.5 g/100 mL, respectively. Number of bacteria per mL was 58314. Differences between groups were assessed through Kruskal-Wallis test. There are differences between groups for all variables. When farm sizes get bigger fat ratio decreases. As for non-fat dry matter and number of bacteria, while, the ratio of non-fat dry matter had no significant change, there was a decrease in number of bacteria inversely proportional to the increase in farm sizes except for group 5. Farm gate prices increase in proportion to the increase in farm sizes. The price difference between group 1 and 5 is 16% in favor of group 5.

Raw milk quality and effect of farm size on farm gate milk price: A multiple linear regression model between received milk price and factors (fat ratio (X_1) number of bacteria (X_2) non-fat dry matter (X_3) daily amounts of milk delivered by farms X_4) that affect the farm gate milk price was formed. The equation given below formed following the analysis and the results of regression model are shown in Table 5.

$$\text{Ln}(P_{m}) = 6.496 + 0.328\,\text{Ln}(X_1) - 0.507\,\text{Ln}(X_2) - 0.011\,\text{Ln}(X_3) + 0.054\,\text{Ln}(X_4) + 0.03517$$

It is observed that farm gate milk price (Y) is explained by independent variables at a ratio of 66%. The multiple correlation coefficient for this equation shows that there is intense multiple relationships between handled variables and raw milk prices.

Correlation coefficients between dependent and independent variables shown in Table 6 were obtained using SPSS software.

Path coefficients are calculated through the Eq. 2 in material and method section and correlation coefficients (Pearson correlation) in Table 6. As stated before, these values are equal to the coefficients, which were standardized in regression analysis.

$$P = A^{-1}B \Rightarrow \begin{bmatrix} 1.000 & 0.182 & -0.068 & -0.009 \\ 0.182 & 1.000 & -0.131 & -0.136 \\ -0.068 & -0.131 & 1.000 & -0.248 \\ -0.009 & -0.136 & -0.248 & 1.000 \end{bmatrix}^{-1} \times \begin{bmatrix} 0.160 \\ -0.173 \\ -0.356 \\ 0.772 \end{bmatrix}$$

$$\hat{P}_y = \begin{bmatrix} 0.178 \\ -0.134 \\ -0.186 \\ 0.709 \end{bmatrix}$$

Table 3: Data from 285 dairy farms was evaluated (November 2005)

Number of farms in each group	Daily milk delivery average (L)	Fat (g/100 mL)	Non-fat dry matter (g/100 mL)	Bacteria (bacteria/1000 mL)	Price (TL*)
43	199.98	3.75	8.60	180.50	0.43637
116	370.65	3.75	8.62	93.05	0.44864
75	714.49	3.74	8.63	90.60	0.46497
23	1214.87	3.84	8.60	54.25	0.48682
22	4722.69	3.70	8.50	55.07	0.49393
Average	849.55	3.75	8.61	99.68	0.45786

*Exchange rate is 1 US$ = 1.341 TL

Table 4: Data from 375 dairy farms was evaluated (May 2006)

Number of farms in each group	Daily milk delivery average (L)	Fat (g/100 mL)	Non-fat dry matter (g/100 mL)	Bacteria (bacteria/1000 mL)	Price (TL*)
44	195.31	3.64	8.59	71.61	0.43241
133	372.08	3.63	8.52	63.94	0.44310
119	711.57	3.57	8.48	57.51	0.45236
47	1181.62	3.50	8.46	41.38	0.46035
31	3881.14	3.51	8.51	44.06	0.50131
Average	851.52	3.58	8.51	58.31	0.45179

*Exchange rate is 1 US$ = 1.4294 TL

Table 5: Effects on farm gate milk prices of raw milk quality and farm size (November 2005)

Model	r	r^2	Adjusted (r^2)	SE of the estimate	Durbin-Watson
	0.816	0.665	0.660	0.03517	1.200

ANOVA	Sum of squares	df	Mean square	F	Sig.
Regression	0.676	4	0.169	136.606	0.000(a)
Residual	0.340	275	0.001	-	-
Total	1.016	279	-	-	-

	Unstandardized coefficients		Standardized coefficients		
	B	SE	β	t-value zero-order	Sig. partial
Constant	6.496	0.299	-	21.693	0.000
X_1 log	0.328	0.065	0.178	5.025	0.000
X_2 log	-0.507	0.138	-0.134	-3.681	0.000
X_3 log	-0.011	0.002	-0.186	-5.080	0.000
X_4 log	0.054	0.003	0.709	19.386	0.000

a: According to Durbin Watson test results, there is no auto-correlation in the data

Table 6: Correlation coefficients (Pearson correlation) (November 2005)

Correlation coefficients	X_1	X_2	X_3	X_4	Y
X_1	1.000	0.182	-0.068	-0.009	0.160
Sig.	-	0.001	0.129	0.437	0.004
X_2	0.182	1.000	-0.131	-0.136	-0.173
Sig.	0.001	-	0.014	0.011	0.002
X_3	-0.068	-0.131	1.000	-0.248	-0.356
Sig.	0.129	0.014	-	0.000	0.000
X_4	-0.009	-0.136	-0.248	1.000	0.772
Sig.	0.437	0.011	0.000	-	0.000
Y	0.160	-0.173	-0.356	0.772	1.000
Sig.	0.004	0.002	0.000	0.000	-

Path error coefficient (P_{yxe}) related to the term error in the regression equation is calculated as follows (Deliktas *et al*., 2008):

$$P^2_{yxe} = 1 - \begin{bmatrix} 0.160 \\ -0.173 \\ -0.356 \\ 0.772 \end{bmatrix}' \times \begin{bmatrix} 0.178 \\ -0.134 \\ -0.186 \\ 0.709 \end{bmatrix} = 0.334774$$

and

$$P_{yxe} = 0.578597$$

An output path diagram (Fig. 1) is formed considering the correlation coefficients between above obtained path coefficients and internal correlation coefficients for variables (Table 6). Path coefficients in the output path diagram show direct effect levels (Fig. 1). Indirect effects of cause variables on one another are calculated using the Eq. 3 as follows:

$$DE = PCM \times CM \Rightarrow \begin{bmatrix} 0.178 & 0 & 0 & 0 \\ 0 & -0.134 & 0 & 0 \\ 0 & 0 & -0.186 & 0 \\ 0 & 0 & 0 & 0.709 \end{bmatrix}$$

$$\times \begin{bmatrix} 1 & 0.182 & -0.068 & -0.009 \\ 0.182 & 1 & -0.131 & -0.136 \\ -0.068 & -0.131 & 1 & -0.248 \\ -0.009 & -0.136 & -0.248 & 1 \end{bmatrix}$$

$$DE = \begin{bmatrix} 0.178 & 0.032 & -0.0121 & -0.002 \\ -0.024 & -0.134 & 0.018 & 0.018 \\ 0.012 & 0.024 & -0.186 & 0.046 \\ -0.006 & -0.096 & -0.176 & 0.709 \end{bmatrix}$$

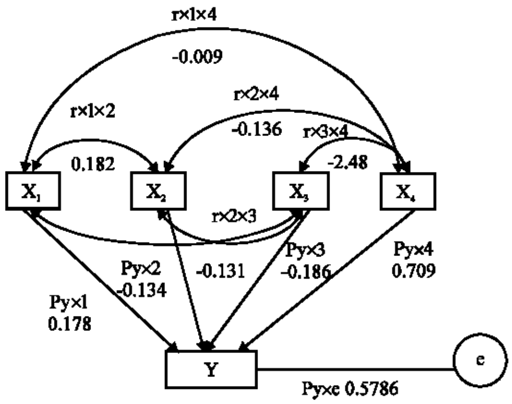

Fig. 1: Output path diagram

Table 7: Separation of total effect as direct and indirect effects

Cause variables	Direct effect	Indirect effect	Total effect (correlation coefficients)
Fat	0.178	-0.018	0.160
Non-fat dry matter	-0.134	-0.039	-0.173
Bacteria	-0.186	-0.170	-0.356
Daily milk production	0.709	0.063	0.772

Multiple regression equation related to farm gate milk price (Y), fat ratio (X_1), non-fat dry matter (X_2), number of bacteria (X_3) and daily delivered milk amount (X_4) is formed using path coefficients and error path coefficients as follows:

$$Y = 0.178x_1 - 0.134x_2 - 0.186x_3 + 0.709x_4 + 0.5786$$
$$R^2 = 0.66$$

Having been explained in the text before, the determination coefficient is the square of correlation coefficient. Direct determination coefficients for independent variables can be calculated by taking the squares of Path coefficients. Examinations on direct determination coefficients revealed that received milk price was primarily affected by daily amount of delivered milk by 50.3% and was followed by number of bacteria and fat ratio, by 3.5 and 3.2% respectively. The least effective variable was non-fat dry matter by 1.8%.

When, model parameters are examined, it is noticeable that when daily milk delivery changed by 0.01 milk gate prices changed by 0.709 units when, the amount of fat changed at the same ratio (0.01) milk gate prices changed by 0.178 unit. A 0.01 unit change in the number of bacteria resulted in 0.186 units of inverse change in farm gate milk price.

Direct and indirect effects on the result variable of cause variables, determined using the equations in Table 2 are given separately in Table 7. When correlation coefficients between farm gate milk prices and variables are observed in Table 7, there is indirect effect for all variables, but the indirect effect for number of bacteria is the highest. It is noticeable that the relationship between number of bacteria and milk price is -0.356 and almost half of this total effect is of indirect effect (0.170). For other variables, indirect effect varies between 1.8 and 6.9%.

It is noticeable that among the examined milk collection centers 14 out of 23 centers had no quality analysis routine. These centers are small centers and they collect 8 tons of milk daily. In a study, conducted in Izmir in 2004 (Uzmay *et al*., 2006a, b), within dairy factories that handle <5000 tons of milk annually, 50% examined the fat ratio; 40% examined acidity and 4% examined protein ratio. As for the ones that handle >5000 tons of milk annually, all factories examined fat ratio and non-fat dry matter; 20% examined protein ratio and 75% examined acidity. Ultra modern dairy plants are reported to have practiced all analysis on milk quality. Another study also from Izmir reports that 40% of milk collection centers paid no attention to the chemical composition of the milk they received (Demirbas *et al*., 2007).

One of the noticeable results of this study is that the most effective factor on the farm gate milk price is farm size (daily amount of milk delivered). In contrast, milk collection centers in the EU, for which Turkey is a candidate state, determine prices in proportion with milk quality considering the milk quality standards. In addition, in most EU countries collectors adopted different pricing methods for whole milk and skim milk (Anonymous, 2006). In Turkey, 59.71% of dairy farms have 1-4 heads in their herds and these farms constitute 27.71 of total dairy cattle in the country. The ratio of farms with 1-9 heads in their herds are 85.30% and these farms constitute 56.62 of the total (TSI, 2001). Average number of dairy cattle per herd in the EU states had been 53.4 before the latest expansion of the EU. As for Turkey, this number is 6 cows $herd^{-1}$, which shows that Turkey has smaller farms unlike the ones in the EU countries. These small scaled dairy farms increase the milk collection cost in Turkey, hence, farm size plays an important role on the farm gate milk price.

In 15 previous EU countries (before the latest expansion of the EU), the average for fat ratio was 4.08% (varied between 3.6 and 4.4%); for protein it was 3.31% (varied between 3.0 and 3.4%) and the average for dry matter was 12.5% (Anonymous, 2006). When, fat ratios determined for some of the EU countries for the years 2008-2015 were examined, among the earlier (before the latest expansion of the EU) members of the EU, the average for Germany was 4.01%, for Belgium, 3.59%, Denmark, 4.37%, France, 3.95%, Ireland, 3.58%, Spain, 3.64% Portugal, 3.73% and for Greece it was 3.61%. As for the new member states, it was 4.21% for the Chez

Republic; 3.90% for Poland; 3.71% for Slovakia; 3.85% for Hungary; 3.99% for Latvia and 4.07 for Latonia (Council Regulation (EC), 2003). When the data, documented in this study, for fat ratios (3.58-3.75%) within the province of Izmir is compared to those of the EU, the fact that Izmir is not behind is noticeable.

In this study, the effects of somatic cell count could not be verified due to the fact that somatic cell count analyses were not in practice in all collection centers. On the other hand, according to the results of another study (Kaya *et al*., 2001) conducted in Izmir through somatic cell counts on 933 cows at 23 dairy farms, somatic cell counts for all dairy farms found above 400.000 cells mL^{-1}. Eight farms out of 23 had (38.1%) 401000-800000 cells mL^{-1}, 9 farms had (42.9%) 801.000-1.200.000 cells mL^{-1} and they were within >1.200.000 cells mL^{-1} group. Aritmetic average of somatic cells for 23 farms was 933.190 cells mL^{-1}. These values are around 186000-426000 cells mL^{-1} (Kaya *et al*., 2001).

It is stated by 66.6% of dairy facility owners that producer price for milk is determined by modern dairy factories (Uzmay *et al*., 2006a, b). In contrast, producer prices for milk at modern factories are higher than those of small dairy facilities. In fact, the survey conducted in this study in May 2006 proved that the base producer price in small dairy facilities was between 0.380-0.400 TL whereas, it was around 0.420 TL in ultra modern factories. In milk cooperatives it was around 0.400 TL, but some of them, only collected but not processed, paid around 0.390 TL. Interestingly, the highest base price was given by contractor collectors at 0.440 TL.

CONCLUSION

Averages for November 2005 were 3.75% for fat ratio; 8.61% non-fat dry matter; 99676 bacteria mL^{-1}. For May 2006 values for the same averages were: 3.58% for fat; 8.50 for non-fat dry matter and 58314 bacteria mL^{-1}. According to the results of the study, for November 2005 and May 2006, there were differences between the groups in terms of fat ratios, non-fat dry matter and number of bacteria mL^{-1}. For November 2005, number of bacteria in farms with <500 lt daily milk delivery was (between 93050-180500 bacteria mL^{-1}) noticeably higher than other farm groups. But for May 2006, farms with daily milk deliveries <500lt had the average number of bacteria between 63000 and 71610 mL. Although, they remained higher than other farm groups that level was within the acceptable levels of the EU standards.

There is difference among dairy plant groups regarding farm gate milk prices and for bigger dairy plants (with more milk delivered daily), farm gate milk price increases. According to the results of regression analysis carried out in order to verify the effects of raw milk quality on the farm gate milk prices, independent variables explain the dependent variable at a ratio of 66%. Direct effect of independent variables has been calculated through the approach of Path analysis. According to the results of the calculations, within the standardized determination coefficient, the direct determination coefficient of farm size is 50.3% and it is the highest. It is observed that the most important factor in the farm gate milk price is the farm size. Since dairy farms in Turkey are small scaled and scattered the cost of collecting milk at milk collection centers rise (Artukoglu and Olgun, 2008). That's why collection centers pay higher premiums to large scaled dairy farms. In Turkey, programs that encourage the enlargement of dairy plant sizes should be increased. When it is done, farm gate milk prices will be affected rather by factors related to milk quality and hygiene as it is in other countries. Additionally, another aspect in respect to the efforts on increasing milk quality is the subsidies given to animal farming in Turkey. Within overall animal farming subsidies, for milking hygiene and milk quality, 0.33%; for food safety, 0.83% and for disease-free animal farming 0.83% were allocated (Uzmay, 2007). It should be mentioned that the given premiums have had a positive effect on increment of milk production.

However, since some of the subsidy items such as the ones for disease-free animal farming, milking hygiene and milk quality, battling against diseases and food safety have a very small percentage within the overall subsidies, discourages the farmers to pay attention to these issues. It is important that subsidies on these items should be increased and that the enforcements in the directory concerning raw milk quality (Bright Milk) should be in practice in a mandatory way together with a stricter monitoring mechanism. Another handicap is that some milk collection centers still don't do pricing according to quality criteria. The ones, which do the pricing according to milk quality only consider some certain criteria- except for ultra modern dairy factories. Constructive measures on this issue should be taken as well.

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