Kafkas Univ Vet Fak Derg
16 (2): 329-335, 2010
DOI:10.9775/kvfd.2009.1191

RESEARCH ARTICLE

The Factors Affecting Milk Production and Milk Production Cost: Çanakkale Case - Biga [1]

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[1] *This study was supported by Çanakkale Governence, Çanakkale City Administration, MARA Çanakkale Provincial Directorate, COMU Agriculture Faculty and Turkish Agriculture Chamber Association*

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Makale Kodu (Article Code): KVFD-2009-1191

Summary

In this study, the relationship between milk production and the factors used in milk production have been analyzed and the cost of milk production has been calculated. The data used for this study has been acquired from 94 dairy cattle breeder enterprises by the face to face survey method. It has been determined that the forage and concentrated feed costs compose 57% of the total production costs and 71% of the variable costs. It has been also determined that the dairy cattle breeding production division of the costs belong to 20.99% of productive stock value (PSA), 76.31% of milk production and 2.7% of manure production and 1 kg milk cost has been calculated as 0.29$. Additionally, according to the path analysis, it has been found out that the 61.49% variation resulting from the milk production can be explained with the changes resulting in the use of forage and concentrated feed. Through the path analysis, the direct and indirect effects of the feed materials used on the milk production have been analyzed. As a result, it has been found that silage maize (20%) and barley(14%) have the biggest effect on the milk yield.

Anahtar sözcükler: *Dairy cattle breeding, Cost analysis, Path analysis, Maize silage*

Süt Üretimini Etkileyen Faktörler ve Süt Üretim Maliyeti: Çanakkale İli Biga İlçesi Örneği

Özet

Süt üretimi ile süt üretiminde kullanılan faktörler arasındaki ilişkilerin incelendiği ve süt üretim maliyetinin hesaplandığı bu çalışmada kullanılan veriler süt sığırcılığı üretim faaliyetinde bulunan 94 işletmeden yüz yüze anket yöntemi ile elde edilmiştir. Süt sığırcılığında kaba ve kesif yem masraflarının toplam üretim masrafları içerisinde %57 ve değişen masraflar içerisinde ise %71'ini oluşturduğu belirlenmiştir. Süt sığırcılığı üretim masraflarının %20.99'unun PDKA'na (Prodüktif Demirbaş Kıymet Artışı), %76.31'inin süt üretimine ve %2.7'sinin gübre üretimine ait olduğu belirlenmiş ve 1 kg süt üretim maliyeti 0.407 TL olarak hesaplanmıştır. Ayrıca yapılan path analizi sonucunda süt üretiminde meydana gelen varyasyonun %61.49'unun kesif ve kaba yem kullanımında meydana gelen değişmelerle açıklanabildiği belirlenmiştir. Path analizi ile süt üretiminde kullanılan yem maddelerinin süt üretimi üzerindeki doğrudan ve dolaylı etkileri incelenmiştir. Sonuç olarak süt verimi üzerine en fazla etkiyi silajlık mısır (%20) ve arpanın (%14) yaptığı belirlenmiştir.

Keywords: *Süt sığırcılığı, Maliyet analizi, Path Analizi, Mısır silajı*

INTRODUCTION

While the comparative importance in the economy of Turkey has reduced, agriculture and animal husbandry, being a sub-sector of agriculture are important in terms of our country for several reasons. Such as providing healthy alimentation of the society, development of the stockbreeding industry, creation of jobs in short-term, securing a regular income to the families by eliminating the risk in agricultural production, development of the primary regions, increasing the efficiency in agriculture, securing the foreign trade balances and because of being one of the critical sectors while entering the EU. The proportion of animal husbandry in the agricultural production value is in EU-25 41.9%. This ratio is 31% in Turkey [1].

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According to the 2001 general agricultural count, there are 3.076.650 agricultural enterprises in our country and 67.43% of them perform animal and vegetative production together. The ratio of the enterprises performing only animal production is 2.36%, and the ratio of the enterprises performing only vegetative production is 30.21%. While the distribution of the cattle in terms of enterprises has been analyzed; the enterprises having 1-4 cattle are 59.71%, having 5-9 cattle are 25.59%, 10-19 cattle are 11.23% [2].

Although there is a large capacity in Turkey in terms of developing animal husbandry and increasing the animal products, animal husbandry could not be developed depending on the desired level. To illustrate, the annual cow milk production according the 2001 average is 7840 kg in USA, 5450 kg in the EU (average of 15 countries) and 1500-2000 kg in Turkey because still the local dairy cattle are at the level of 38%. This value decreases to 1000 kg in the Southeast and Northeast Anatolian Regions [2]. This situation shows us that although there are important increases in the yield of the dairy animals, the increases are higher in the west regions than those of in the east and the adequate level in the total milk production could not be obtained. Although the ratio of the animal alloyed products are very high in the developed countries, in Turkey the ratio of the vegetative alloyed products are higher. This shows us that there is an imbalance in alimentation.

In order to be nourished healthy and balanced, the production of milk and meat products must be increased according to the demands.

The relationship between the inputs and outputs used in the production and the cost analysis of the milk production have been analyzed econometric within the context of this study. Thus, having knowledge about the relationship between the input and output in the production activity is important in terms of using the rational sources used in the production.

MATERIAL and METHODS

Material

The main material of the study is data acquired from 94 sample enterprises collected by this survey. These enterprises have been selected by simple coincidental sampling method from the 6682 animal enterprises performing milk cattle breeding in Çanakkale-Biga [3].

Methods

Data Collection and Cost Analysis

According to the face to face surveys from the sample enterprises, the population, labor force and usage situation, capital structure related to production activities, animal presence, physical input usage situation, product and input cost, production costs, feeding ground duration, lactation duration, economic existence of animals, encouragements given to production activities (milk contribution, insemination, feed plants production encouragement) and milk production have been analyzed.

Product cost has been calculated according to the joint cost calculation method, manure value and incentive premium has been taken into account as by-product income. The by-product income has been excluded from the sum of the production costs, the lasting value has been divided into the total production amount and so one kilogram production cost has been calculated [4].

Path Analysis

In the study, the analysis of the factors affecting the milk yield in the animal enterprises, being active in Çanakkale-Biga have been made. The studies, in which the input-output relations are analyzed, are very common, and different methods are used. However, the most known method for analyzing the effects of the inputs used on the output is the regression analysis. With the regression analysis, the relationship between one input and output can be examined and also the relationship between more than one input or independent variable /output or dependant variable can also be examined [5]. Besides, the correlation analysis is used for the examination of the relationship between one input and one output. However, the coefficients acquired from the regression and correlation analysis have limitations. Regression coefficients have effects of other coefficients except from the effect makes on the dependant coefficient. In other words, it has not been known how much of R^2, being the explanation rate for explaining the changes occurred in dependent variables on independent variables, is explained by which variable has not yet been known. The correlation coefficient states the linear relationships between the two coefficient, and changes between +1 and -1 [6].

For eliminating this disadvantages and examining the relationships between the independent and dependant variables the path analysis has been used [7-9].

The path analysis is one of the powerful and useful statistical methods because of its stated feature. Today, the path analysis is mostly applied in the population genetic, in the examination of input output relationships in the animal and vegetative production activities [10-12], in the resolution of sociological problems [13,14] .

The path analysis has also some assumptions like

other statistical analysis:

1) The relationships between the variables in the model must be leaned on the linear, additional and casual relationship.

2) The errors within the model must be in relation with themselves and with the other variables in the model.

3) There must be a one way cause flow.

4) The measurement must be acquired from the quantitative variables.

5) The measurements must be done faultless [15].

According to these presumptions the $P_{YX} = b.\frac{\sigma_X}{\sigma_X}$ equation has been used for the calculation of the path coefficient. The P_{yx} coefficient shows the path coefficient, and X notes the direct effect of the per-unit change of the independent variable on the Y dependent variable [16]. In the equation, b states the regression coefficient, σ_X states the standard deviation of the independent variable and σ_y states the standard deviation of the regression equation. For acquiring these coefficients, the standard data set can also be used. The standard data set and estimated regression coefficients give the path coefficients. For this reason, the standard data has been used in the context of this study.

The direct and indirect effect of the independent variables on the dependent variables are calculated with the help of the acquired path coefficients and correlation coefficients between the variables [17,18].

$$R^2 = b_1'^2 + b_2'^2 + b_3'^2 + b_4'^2 + 2* b_1'* r_{12}* b_2' + 2* b_1'* r_{13}* b_3' + 2* b_1'* r_{14}* b_4' + 2* b_2'* r_{23}* b_3' + 2* b_2'* r_{24}* b_4' + 2* b_3'* r_{34}* b_4'$$

In this equation b_1', b_2', b_3', b_4' gives the partial regression coefficients estimated with the standard data's, r_{nn} gives the correlation coefficient between the variables.

The factors effecting the milk efficiency have been collected by taking into account the previous works.

The variables have been determined as maize silage, hay, barley, wheat, the age of the dairy animals, the labor force used at the milk production and the purchased concentrated feed. Stepwise analysis has been made with these acquired variables and the variables whose milk yield explaining power is not meaningful have been excluded from the model. Therefore, the variables used for explaining the milk yield and remained in the model after the stepwise analysis are as follows and are composed of feeds used in the milk production. Thus, it has been determined that more than 60% of the milk production composes of feed costs and that the most efficient factor is the used feed [19].

Yield (Y): is an dependent variable, shows the total production per enterprise milk amount as kg produced in the enterprises in the context of the study.

Maize silage (X1): Shows the total maize silage used for milk production produced in the enterprises in the context of the study.

Hay (X2): States the dried grass and clover amount used for the milk production in the enterprises in the context of the study

Barley (X3): States the barley amount as kg which is used for milk production in the enterprises in the context of the study.

Wheat (X4): States the wheat amount as kg which is used for milk production in the enterprises in the context of the study.

RESULTS

Cost Analysis

The average size of the farms is 12.3 hectares and this area of the land is allocated as follows: 62.77% for field crops, 13.94% for rangeland, 12.90% for vegetables, 3.67% for fruits, 5.54% for fruits and 1.18% vineyard. A part of crop field production is used as fodder crops which are wheat, barley, maize, vetch and alfalfa. Their shares in the field crops production are respectively; 30.25%, 9.35%, maize 7.25%, 5.25% and 3.25%. Average number of animals in the farms is 19.18 and converted as 13.96 animal units. The profile of the farms is by animals is cows (61.52%), bulls (6.96%), male veils (7.61%), female veils (7.97%), female calves (1.51%) and is male calves (1.22%).

The production costs belonging to the milk production activities of the enterprises making dairy cattle breeding in animal production are given in *Table 1*. The total production costs of the examined 94 enterprise is 21126.06$, and it is composed of 79.96% variable costs and 20.04% stable costs. The highest proportion in the total production costs belongs to the feed costs with a percentage of 57.04, after that comes the 15.57% labor costs. The highest proportion among the variable costs belongs to the feed (71.34%) and labor (19.47%) costs. In similar studies made in Çanakkale and Aydın the proportion of the feed and labor costs are as follows: 62.43% and 16.43%; 62.60% and 18.81% [19,20].

The gross production value has been found by taking into account the milk, manure and productive stock value in the enterprises in the context of the study.

Table 1. *Milk production costs (per herd)*
Tablo1. *Süt üretim masrafları (sürü için)*

Cost Elements	**Proportional Distribution of Costs**		
Variable Costs	$	%	%
1. Feed Costs			
a) Feed Concentrate	7728.87	36.58	45.75
b) Fodder	4323.24	20.46	25.59
2. Seasonal Labor Wages	3288.73	15.57	19.47
3. Salt (Licking stone)	57.75	0.27	0.34
4. Veterinary and Medicine Costs	657.04	3.11	3.89
5.Artificial Insemination Cost	254.23	1.20	1.50
6. Water Cost	130.99	0.62	0.78
7. Electricity Cost:	217.61	1.03	1.29
8. Bedding Cost	40.85	0.19	0.24
9. Cleaning Stuff Cost	53.52	0.25	0.32
10. Variable Cost for Machinery and Equipment	139.44	0.66	0.83
11. Total Variable Costs (A)	16892.25		100.00
Fixed Costs			
12. Overheads Cost	511.27	2.42	12.08
13. Building Capital Depreciation	287.32	1.36	6.79
14. Building Capital Interest	247.18	1.17	5.84
15. Building Repair and Maintenance Cost	217.61	1.03	5.14
16. Cattle Depreciation	815.49	3.86	19.26
17. Cattle Capital Interest	562.68	2.66	13.29
18. Machinery and Equipment Depreciation	1233.10	5.84	29.13
19. Machinery and Equipment Capital Interest	359.15	1.70	8.48
20. Total Fixed Costs (B)	4233.80		100.00
21. TOTAL PRODUCTION COSTS (A+B)	21126.06	100.00	

The average milk production amount acquired per enterprise is 50.883 kg. Among the examined enterprises, the income of the dairy cattle breeding farming consists of 76.31% milk, 20.99% productive stock value, 2.70% manure cost *(Table 2)*.

While calculating the portion of the milk in the total production cost, the milk portion within the total income has been taken into account.

While calculating 1 kg milk cost, the total production costs of the milk has been excluded from the manure value, being a by-product income and milk incentive premium and the lasting value has been divided into the acquired milk production amount. While taking into account the 0.316$, being the price of 1 kg milk, it has been determined that the enterprises made profit of 0.026 $/kg. The proportion of the per product profit to the sale price is 8.2%.

Path Analysis and Analyzed Effects

The correlation matrix, showing the level of the relationship between the factors affecting the milk efficiency in the examined enterprises is given in *Table 3*. Maize silage has the highest correlation (0.603) with the milk efficiency and this is followed by hay (0.337) and wheat (0.324). Thus, maize silage has an important place in animal husbandry.

The regression analysis results of the factors effecting the milk yield and used very commonly in the milk cattle breeding activities in the examined enterprises have been given in *Table 4*. The explanation ratio of the changes

Table 2. *Unit milk cost on the sample farms*
Tablo 2. *İşletmelerde birim süt maliyeti*

Animal Products	**Gross Value of Production ($)**	**%**	**Production Cost ($)**	**Secondary Product Revenue ($)**	**Production (Kg)**	**Unit Milk Cost ($/Kg)**
PSA	4705.68	20.99	4433.44			
Manure	606.55	2.7	571.46			
Milk	17111.10	76.31	16121.16	1553.18	50.883	0.290
Total	22423.32	100.00	21126.06			

Table 3. *The correlation matrix of the variables*
Tablo 3. *Değişkenlere ait korelasyon matrisi*

Variable	Efficiency	Maize Silage	Hay	Barley	Wheat
Maize Silage	0.603	**	0.162	0.327	0.026
Hay	0.337	0.162	**	0.203	0.201
Barley	0.588	0.327	0.203	**	0.167
Wheat	0.324	0.026	0.201	0.167	**

in the milk yield of the variables in the model is (R^2) 61.49%. This ratio has been found meaningful at the 1% importance level. Thus, it has been known that inputs except maize silage, hay, barley and wheat have been used during the production activity. Additionally, the other used inputs have an important effect on production, and can be indispensable for production. R^2 value obtained as a result of the regression analysis explains how much of the changes occurred in dependent variable arise from independent variables. It has been known that there is a difference between the examined enterprises in the milk yield. Thus, the milk yield in the enterprises is not same per enterprise and dairy animal. For analyzing the main reason of this difference this analysis has been made. It has been found out that the most important effects of the difference in the milk yield are the variables in the model. 61.49% of the variation in the milk yield can be explained with the variables in the model, 38.51% can be explained with the factors which are not in the model. Thus, the milk production is a biological process, and is effected by the structure of the burrows, the ecological structure of the region where the burrow is placed, feed etc. [21,22].

The variables in the model like hay is 5% and other variables are 1% meaningful. Besides, the multiple connection problems between the variables have been researched with the "Variation Distention Factor (VIF)" and it has been found out that there is not a multiple connection. Also the autocorrelation existence has been examined with the DW statistics and it has been found out that there is not an autocorrelation.

The parameters acquired from the regression analysis have been used for calculating the path coefficients. However, in this study the path coefficients have been acquired from the parameters of the regression analysis made with the standard data's. The parameters of the standard regression analysis is equal to the path coefficients. The path coefficients acquired with the regression analysis are given in *Table 5.* The level of the relationships between the data's do not change by standardizing the data's. Because of this, the R^2, DW, VIF, F and the T statistics belonging to the variables are same in each model.

In *Table 6* the analyzed effects of the factors which effect the milk yield are given. The analyzed effects are classified as direct and indirect effects. The direct effects explain the effects of the factors used in the milk production on the direct contribution of the milk yield. Direct effects are equal to the path coefficient. The indirect effects are effects resulting from the interaction of the factors used

Table 4. *Regression analysis*
Tablo 4. *Regresyon analizi*

Predictor	Coefficients	SE Coef	T	P Value	VIF
Constant	76.69	11.14	6.88	0.000	
Maize Silage	0.0009206	0.0001436	6.41	0.000	1.1
Hay	0.0015968	0.0007629	2.09	0.039	1.1
Barley	0.006573	0.001257	5.23	0.000	1.2
Wheat	0.0026494	0.0008176	3.24	0.002	1.1
S = 73.8732 DW = 2.12	R-Sq = 61.49%	F = 35.05		0.000	

Table 5. *Regression analysis made with the standard coefficients*
Tablo 5. *Standardize edilmiş katsayılar ile yapılmış regresyon analizi*

Predictor	Coefficients	SE Coef	T	P Value	VIF
Constant	76.69	11.14	6.88	0.000	
Maize Silage	0.0009206	0.0001436	6.41	0.000	1.1
Hay	0.0015968	0.0007629	2.09	0.039	1.1
Barley	0.006573	0.001257	5.23	0.000	1.2
Wheat	0.0026494	0.0008176	3.24	0.002	1.1
S = 73.8732 DW = 2.12	R-Sq = 61.49%	F = 35.05		0.000	

in the milk production. Thus, like it is in all the production factors, the factors used in milk production increase their efficiency.

20.35% of the variation resulting from the milk production results from the maize silage. Thus, the effect of the maize silage resulting from the interaction of the barley is also high (11.34%). Another important production factor in milk production is barley. The direct effect of barley on the variation of milk production is 13.99%. The variation in milk production is explained as follows; 4.87% wheat, 2.08% hay, 2.11% maize silage+hay, 0.52% maize+wheat, 2.19% hay+barley, 2.76% barley+wheat. 41.29% of the variation in milk production can be explained directly and 20.02% can be explained indirectly but 38.51% cannot be explained.

Table 6. *Analysed effects*
Tablo 6. *Ayrıştırılmış etkiler*

Variable	R^2	R^2 %
Direct Effects		**41.29**
Maize Silage	0.20	20.35
Hay	0.02	2.08
Barley	0.14	13.99
Wheat	0.05	4.87
Indirect Effects		**20.02**
Maize Silage + Hay	0.02	2.11
Maize + Barley	0.11	11.34
Maize + Wheat	0.01	0.52
Hay + Barley	0.02	2.19
Hay + Wheat	0.01	1.28
Barley + Wheat	0.03	2.76
Total R^2	**0.6149**	**61.49**

DISCUSSION

In the studies oriented to dairy cattle breeding in Turkey it has been determined that the acquired milk yield has not reached the yield level in the USA and EU countries although the animal ratio which have high genotypic features increase in recent years. The important reasons of the low milk efficiency can be stated as follows; deficiency in alimentation conditions, not having healthy burrows, high feed prices, not having the sufficient knowledge about animal health, not securing sufficient hygienic conditions.

While making an evaluation in terms of the expense factors in the per milk cost calculation; both the distribution of variable and stable expense factors and the ratio of the expense factors in the total production expenses have been relatively close in the same studies [19,20].

One of the most important factors which effect the increase of the milk yield is the amount of concentrated and forage feeds. While analyzing the effects of the feeds used in dairy cattle breeding in the research region on the milk yield it has been found out that maize silage has the highest effect on it. Also the other studies state the importance of the maize silage. While taking into account the direct and indirect effects of the maize silage on the milk yield, we can see that it has an important effect on the milk yield [23] .

Maize, with its grain, has an important place in human alimentation and agricultural industry, but in the recent 30 years the production has become as an forage which has been produced in the most important cultivable area in the world and is used as silage in the animal feeding [24,25]. Maize silage is the most economic and common forage produced in the world, and is used very commonly in the dairy cattle breeding by enriching it with protein in USA, Netherlands, Germany and France [26-28] .

The silage feed, being commonly used for the alimentation of the dairy cattle are low in dry material and rich in water. Therefore, for meeting the need of dry material of the milk and stock farming, it is a necessity to give every day at least 5 kg hay and additional concentrated feed according to the yield level [29]. Thus, it can be said that all the feeds used in the milk production increase each other's efficiency. Because of this the indirect effects of the production factors used in the milk production has been calculated. As the results of the analyzes, it is defined that the effect of maize silage and barley is high on the milk yield.

In this study the variables in the estimated model on the analysis of the factors effecting the milk yield consist of forage and concentrated feeds. But there are many factors on milk yield. This study has realized in an area which do not show a difference in terms of ecological and agricultural. Also all the enterprises which are in the population of the study continue to produce milk with the animals which have a high culture genotype. So that it is an expected situation that the source of the variation occurring in the milk yield results from the concentrated and forage feeds. Thus, the stepwise analysis has been used for determining these changes in the model.

Within the context of supporting dairy cattle breeding and increasing milk production, the developed government politics and the silage maize farming are in the framework of the support. It is important to do conscious feeding for the rational usage of sources and the increase of the feed transformation ratio in the dairy cattle breeding.

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