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Determination of factors affecting profit by quantitative methods in broiler enterprises

[*Determinação dos fatores que afetam o lucro por métodos quantitativos em empresas de frangos de carne*]

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ABSTRACT

This study was carried out to demonstrate how a regression model can be used as a decision support tool in the poultry sector, using variables that affect profit, within the scope of broiler enterprises that are engaged in contract production depending on broiler integrations. Enterprises included in the study were selected from Bolu, Sakarya and Ankara provinces those have the 24% of the rearing flocks and the integrations in Turkey. The 68 out of 9872 broiler enterprises existing in Turkey in 2017 were included in the study by random sampling method. The regression model obtained because of this study allows producers and institutions providing consultancy services in the broiler sector to monitor the marginal effect of variables that affect profit. As a result, when price and cost factors change under different risk conditions, the research model can be used as a decision support tool.

Keywords: broiler enterprises, broiler integration, broiler production, husbandry, regression analysis

RESUMO

Este estudo foi realizado para demonstrar como um modelo de regressão pode ser utilizado como uma ferramenta de apoio à decisão no setor avícola, utilizando variáveis que afetam o lucro, dentro do escopo de empresas de frangos de corte que se dedicam à produção sob contrato, dependendo das integrações de frangos de corte. As empresas incluídas no estudo foram selecionadas das províncias de Bolu, Sakarya e Ancara, que possuem os 24% dos lotes de frangos de corte e as integrações na Turquia. As 68 das 9872 empresas de frangos de corte existentes na Turquia em 2017 foram incluídas no estudo pelo método de amostragem aleatória. O modelo de regressão obtido devido a este estudo permite aos produtores e instituições que prestam serviços de consultoria no setor de frangos de corte monitorar o efeito marginal das variáveis que afetam o lucro. Como resultado, quando os fatores preço e custo mudam sob diferentes condições de risco, o modelo de pesquisa pode ser usado como uma ferramenta de apoio à decisão.

Palavras-chave: empresas de frangos de corte, integração de frangos de corte, produção de frangos de corte, pecuária, análise de regressão

INTRODUCTION

Although various animal species such as chicken, turkey, goose, and duck are included in the poultry all over the world, when it comes to poultry breeding, the first thing that comes to mind in the sector is the chicken. Chicken is the most widely produced poultry species both in rural areas and modern facilities and consumed in the world (Eşidir and Pirim, 2013).

In Turkey, in the poultry sector, especially broiler enterprises are the focus of considerable debate with the rapid changes in general economic and sectorial conditions. After the 2000s, this sector offering high value-added

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production, especially in a short time with less manpower, is one of the leaders of the areas covered by the cheapest cost that provides the animal protein needs of the growing population in Turkey. In these developments in the broiler sector in Turkey, it has been an important criterion for investors to see that it is a profitable business field for investing in this sector. However, while making long-term profit estimates, companies should predict which parameters are effective in profitability, and the results of these parameters should be taken into account holistically in a model.

The profit to be gained by the entrepreneur who will invest in the broiler sector is the most important criterion in the model to be established. In this study, it was aimed to establish a practical decision support tool model in the investment decisions of broiler enterprises. The regression model, which is established using the data obtained from the field, will allow the estimation of important parameters such as the expected profit margin in broiler production, the rate of return on investment and the efficiency of the capital.

In the broiler sector, Quadratic, Square Root and Cobb Douglas production functions have been widely used in quantitative models as decision support tools since the 1960s. Flinn (1971) took an important step in the Canadian broiler industry through establishing a useful model for determining profitability in broiler businesses by using parameters such as feed, broiler price and fixed cost, which are factors that affect profit. Similar studies on determining the cost and profit function in broiler enterprises have been conducted by Yalçın and Cevger (2003) in Turkey, by Bandara and Dassanayake (2006) in Sri Lanka, by Chukwuj *et al*. (2006) in Nigeria, by Masad (2010) in Jordan, by Rana *et al*. (2012) in Bangladesh, by Emokaro and Emokpae (2014) in Nigeria, by Rifky (2016) in Sri Lanka and by Isa *et al*. (2019) in Malaysia.

In Turkey, the current determination of the results of the changes in profit function of broiler enterprises is an important research topic. Therefore, this study was performed to identify how new conditions, particularly, profitability in the broiler industry, affect the decision support process in 2017.

MATERIAL AND METHODS

Within the scope of the study, a face-to-face survey was conducted with business owners in broiler integrations and in broiler enterprises in Bolu, Sakarya and Ankara provinces in 2017. The data regarding the technical, financial, and economic characteristics obtained by recording detailed interviews in these enterprises and filling in questionnaires, which constitute the material of the study, were subjected to statistical and economic analysis.

According to Turkstat (Tüik), 9872 broiler enterprises were present throughout Turkey, and 68 enterprises determined by random sampling method were included in this study. They were visited by the project team. The following formula was used to calculate the sample from the main population (Turksat, 2018):

$$n_0 = \frac{Nt^2pq}{d^2(N-1) + t^2pq}$$

where, N = Population size; t = t-table value for 90% confidence interval = 1.96; p, q = The frequency of occurrence of the event in question, p = 0.5, q = 0.5 due to being the agent (+) and being the agent (-); d = deviation from the frequency of occurrence of the event.

Contracted enterprises investigated within the scope of the study are given in Table 1.

The enterprises selected within the scope of the study were visited in different times between September 2016 and March 2017, the information was given about the study then face to face interviews were performed with the volunteer owners, and the obtained information was evaluated.

Within the scope of the study, cost and income calculations of contracted broiler enterprises were made. After this calculation, multiple regression model procedures were used to estimate the effect of factors affecting the profitability of contracted broiler enterprises.

Model: Y=f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10})

Y: Profit (Turkish Lira-TL) per kg live-weight (LW)
X_1: Feed price (TL/kg)
X_2: Revenues (TL/kg LW)
X_3: Labor (kg)
X_4: Veterinary service and medication cost (TL/kg LW)
X_5: Electric and water cost (TL/kg)
X_6: Mortality cost (%)
X_7: Chick
X_8: Feed conversion rate FCR (kg feed consumed for per kg LW gain)
X_9: Other Costs
devX_{10}: Production Cycle (day)
dev$(X_{10})^2$: the quadratic term of devX_{10}

METHODS

A multiple regression model was used to estimate the effect of factors associated with the producer's profitability. The regression equation was estimated by the Stepwise method using the SPSS Statistical package program Version 23 (the SPSS Statistical Package, Version 23). Multiple linear regression analysis is based on Least Squares (LS) estimates. The multiple linear regression model has assumptions that must be met to use the found LS estimates effectively and reliably. The normality, linearity, zero mean of errors terms of the dependent variable, constant variance, no multiple connections between independent variables, and no autocorrelation were the assumptions (Kalaycı, 2006).

In the process of determining the regression model, firstly, the relationship types such as linear, logarithmic, and quadratic between the dependent variable (Y) and each independent variable (*Xi*) were examined with scatter graphs. It has been observed that the relationship between Y and all *Xi* except X_{10} is linear. When multiple regression analysis was performed, it was found that the variable X_{10} had a nonlinear relationship with the dependent variable ($p > 0.05$).

The square of the deviation from the mean for this variable, $(devX_{10})^2$, was found to be statistically significant, albeit slightly, by adding it to the model after making its quadratic transformation.

To use LS parameter estimates that will be obtained from multiple regression analysis effectively and reliably, another important assumption is no autocorrelation, which means that the observations are not related to each other. The statistical value of Durbin Watson (DW) test is used to examine whether this assumption is fulfilled (Durbin and Watson 1950, 1951). This value is compared with the lower (d_L) and upper (d_U) critical table values corresponding to n (sample size) and k (variable number) values in the DW table. As a result of this comparison, if the DW statistic is between zero and the d_L value, there is a positive autocorrelation, and between $4 - d_L$ and 4, there is a negative autocorrelation. If the DW statistic is between d_L and d_U or between $4 - d_U$ and $4 - d_L$, cannot be decided. There is no autocorrelation when the DW statistics is between d_U and $4 - d_U$ values (Draper and Smith, 1981).

Since the DW = 2.000 value obtained at the 5% significance level for the data in this study was between d_U=1.792 and $4 - d_U$ = 2.208 compared to the d_L =1.162 and d_U= 1.792 values, which correspond to the values (n = 68, k = 10), we can say there is no autocorrelation.

On the other hand, it should be determined whether there is any contrary observation in the data. For this purpose, there are various methods in the literature. In this study, we used the information that the standardized residual values greater than 3 in absolute value are the outlier value. These types of values need to be extracted from the data. In this sense, it has been seen in Figure 2 that there is only one observation that is greater than 3 in absolute value among the standardized residual values of the dependent variable in this study. This outlier corresponding to observation 3 was removed from the study and the regression coefficients were re-estimated. However, there was no significant difference between the predictions made by taking all the observations into account. Therefore, the coefficients of the regression model established in this study were estimated without removing the third observation.

Estimated regression results according to the established multiple regression model are presented in Table 1. According to this estimated model, 99% of the change in the dependent

variable can be explained by the independent variables included in the model ($R^2 = 0.99$, the standard error of the model = 0.003).

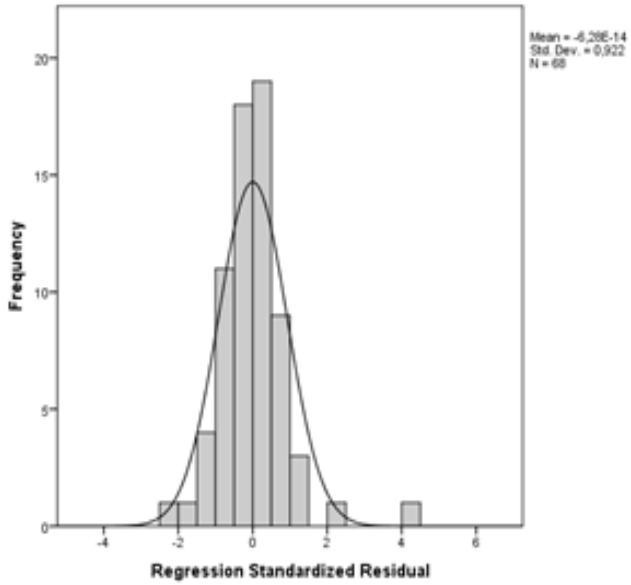

Figure 1. The distribution pattern of profit per kg live weight.

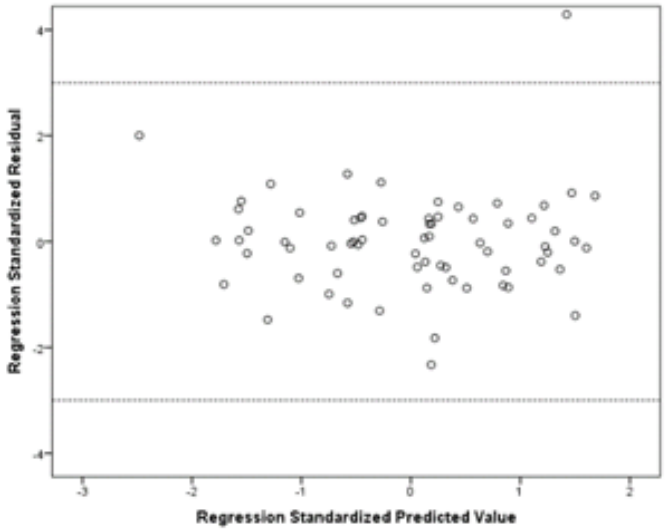

Figure 2. The relationships between standardized residuals and standardized predicted values of dependent variable

Table 1. Number of broiler enterprises in Bolu-Sakarya and Ankara provinces included in the study (number)

Provinces	1-10.000 (animal)	10.000-30.000 (animal)	≥30.000 (animal)	Total broiler enterprises
Bolu	2	23	9	34
Sakarya	9	12	6	27
Ankara	-	4	3	7
Total	11	39	18	68

RESULTS

The reliability of regression estimates made according to these models increases when assumptions are met while performing regression analysis. Among the necessary assumptions in the estimation made with the multiple regression model based on the LS estimation, for normality assumption, the statistics of Kolomogorov Simirnov (KS = 0.092, p = 0.200> 0.05) and Shapiro Wilks (SW = 0.972, p = 0.131> 0.05) and the histogram of the dependent variable Y (Figure 1) has been considered. Considering Figure 2 for constant variance (Homoscedasticity), correlation table (Table 3) and VIF <10 (Table 2) values for multiple connections, it can be seen that the necessary assumptions are generally provided for linear regression.

Predictive regression model

$$Y = 3.255 - 0.035X_1 + 1.036X_2 - 1.033X_3 - 0.983X_4 - 1.093X_5 - 0.413X_6 - 1.015X_7 - 0.860X_8 - 1.928X_9 - 0.001(\text{dev}X_{10})^2$$

According to this predictive model, the relationships between independent variables and dependent variables were as expected: X_2, it is possible to predict that a 1 unit increase in revenue (TL/kg LW) will result in an increase of 1.036 TL in profit per 1kg of live weight. On the other hand, cost-related increases such as X_1, X_3, X_4, X_5, X_6, X_7, X_8, and X9 caused the decreases of 0.035, 1.036, 1.033, 0.983, 1.093, 0.413, 1.015, 0.860 and 1.928 TL per kg-live weight in profit respectively. The most effective variable in the model was FCR (X_9). The length of the production cycle X_{10} did not have a linear contribution to the model but resulted in a quadratic reduction in profit $at\ a\ (devX_{10})^2$ 0.001 level. The reason this makes a meaningful contribution is that it is slightly affected by the change in the production cycle.

Table 2. The estimated coefficients, model significance results, variance inflation factors (VIF) values, Durbin Watson (DW), Kolmogorov Simirnov (KS) and Shapiro Wilks (SW) test statistics

Factors	β	t	Sig. P	VIF	R^2	F	Sig.F	DW	KS	Sig.p	SW	Sig.p
(Constant)	3.255	116.677	0.000		0.999	7997.084	0.000	2.000	0.092	0.200	0.972	0.131
X_1	-0.035	-2.811	0.007	5.066								
X_2	1.036	37.712	0.000	3.636								
X_3	-1.033	-67.060	0.000	1.839								
X_4	-0.983	-13.185	0.000	3.001								
X_5	-1.093	-14.437	0.000	2.495								
X_6	-0.413	-3.071	0.003	1.337								
X_7	-1.015	-19.375	0.000	7.758								
X_8	-0.860	-7.977	0.000	2.058								
X_9	-1.928	-119.642	0.000	3.673								
$(devX_{10})^2$	0.001	4.394	0.000	1.269								

Table 3. Correlation matrix of the variables entered in the regression model

	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	$(devX_{10})^2$
Y	1										
X_1	-0.541	1									
X_2	0.382	0.058	1								
X_3	-0.518	0.275	0.033	1							
X_4	-0.048	-0.308	0.386	0.145	1						
X_5	-0.386	0.065	0.252	0.522	0.603	1					
X_6	-0.191	0.264	0.221	0.247	0.078	0.106	1	,			
X_7	0.216	0.466	0.652	0.186	0.154	0.029	0.361	1			
X_8	0.056	-0.034	0.479	0.297	0.368	0.262	0.345	0.463	1		
X_9	-0.896	0.457	-0.413	0.117	0.012	0.179	0.067	-0.390	-0.257	1	
$(devX_{10})^2$	0.176	-0.207	0.175	0.006	0.013	0.057	0.136	0.186	0.254	-0.192	1

DISCUSSION

Feed (70.2%) took the first place in production costs, which was followed by chick (12.7%), energy and fuel (3.4%), labor costs (3.4), general management (2.8%), maintenance (1.5%), litter material (1.7%), cleaning-disinfection (0.4%), catching-loading (0.8%) and amortization (1.6%) in this study.

Similarly, in the study conducted by Tandoğan (2014) on 125 broiler farms in Afyon, regarding the production costs of feed (67.4%), chick (13.8%), energy and fuel (4.5%), labor (1.2%), general administration (%). 2.9), maintenance-repair (1.41%), litter material (1.1%), cleaning-disinfection (0.9%), catch-loading (0.7%) and depreciation (0.6%), it could be seen that the three largest cost items were the same.

Sheppard (2004) determined that the biggest three items in total costs in broiler enterprises in England are feed (58.3%), chick (20.9%) and building machinery and equipment (7.3%). Rana *et al.* (2012) determined the three largest cost items in broiler farms in Bangladesh as feed (68.9%), chick (18.9%) and veterinarian-medicine expenses (5.2%). In many studies in the literature, feed and chick costs appear as the two dominant cost items in broiler enterprises.

In this study, broiler enterprises had no effect on these prices for inputs such as feed and chick supplied by the integrations to the broiler holdings, because each of the integrations offered its own standard feed and chick price to the broiler enterprises. Thus, its scale has no importance. However, it can efficiently use chick costs with less mortality and feed expenses with a lower feed conversion rate (FCR).

Cost items that broiler businesses have advantages over scale are labor, energy and fuel, etc. Thus, certain advantages can be obtained depending on the size of the scale or the weather conditions of the region. In the study, it was determined that the cost of 1 kg LW decreases with the increasing business scale. Singh *et al.* (2010) who investigated the total meat costs in broiler enterprises by dividing the enterprises into 3 groups as small, medium and large scale in the Punjab region in Pakistan, found that total meat costs were the highest in small scale broiler enterprises, then in medium and large-scale broiler enterprises, which supports the results of the present study.

In this study, feed (61.4%) ranked first among the production costs of the integrations, which is followed by contract maintenance expense (15.4%), chick (10.8%), slaughterhouse and freight costs (10.6%), live broiler transport (1.1%), labor costs (0.6%) veterinary services-medicine (0.4%), general management (0.5%), building equipment maintenance-repair (0.5%), building and equipment amortization (5.0%) and other expenses (0.2%).

In the present study, in terms of integrations, feed and chick items were the dominant items in broiler meat costs. Hamra (2010) reported that on the one hand broiler demand in the market and on the other hand feed and chick prices predominantly determine broiler prices with triple combination in the broiler market in Lebanon.

In terms of integrations, the other major item is contract maintenance expense, since this item is generally under the pressure of integrations, integrations can predominantly determine the contract maintenance expenses given to broiler businesses. Therefore, in the market, the integrators can keep the contract maintenance costs they pay to the contracted producers in a minimum level in order to suppress the production costs under intense competition conditions.

Especially after 2014, within the framework of the IPARD program implemented by The Ministry of Agriculture and Forestry, the increase in the number of producers with the support given to entrepreneurs willing to enter the sector disturbed the supply-demand balance in unfavorable of the contracted producers, which solely resulted in supply-oriented interventions for supply without an increase in demand in the final market in the sector. This situation put pressure on the profit margins of contracted producers in the market, causing significant declines in expected profit levels. For example, in Turkey in 2010, white meat price for 1kg of carcass was 1.5 dollars and the contract maintenance expenses were 0.20 dollars whereas in 2018, 1kg of broiler meat price was still 1.5 dollars but the contract maintenance expenses reduced to 0.09 dollars. This price pressure has

increased the relative effect of the cost items of enterprises on the profit level. This situation has led to the conclusion that each cost item has a significant effect on the profit level.

In this study, the profit function of broiler enterprises in Turkey has been determined. Profit margins in the sector are arranged in the market depending on the structural changes that have occurred over the years.

The market mentioned here has two legs. The first market is the oligopoly market that emerging between a total of 20 integrations operating throughout Turkey and the final consumer, i.e. many buyers and limited sellers. The second market is the oligopsony formed between 20 integrations and many contracted broiler enterprises that make contract production for these integrations. In this study, model research has been done only in terms of broiler enterprises within this oligopsonic structure. In this context, the calculated regression model coefficients were compared with the results of the research conducted in the literature to determine the profitability of broiler enterprises.

Among the results of this study, it was seen that especially 1 unit increase in feed prices had a very small effect (-0.035) on profit. The reason why this effect is small, firstly, since the data of one production period was used in the scope of the study. Therefore, it was not possible to examine the long-term effect of the change in feed prices. In other words, this change can only be observed with a long-term study. The second reason can be attributed to the fact that the current competitive conditions have led to the emergence of a more homogeneous feed market by bringing feed prices closer to each other, and the feed prices given by integrated companies to broiler enterprises have remained very close to each other in recent years. In a study conducted by Altahat *et al*. (2012) in Jordan, an increase of 1 unit in feed prices had a very small effect on profit at the level of -0.048, which supports the results of the present study. Altahat *et al*. (2012) considered a short 3-month production period in a production period and determined that there would be a -3.012 decline. An increase of 1 unit in feed prices had -2.021 influence on profit in the study of Yalçın and Cevger (2003) for 140 enterprises in Bolu province in Turkey, Bandara and Dassanayake (2006) found this effect as -3.021 in their study conducted on 120 enterprises scale in Sri Lanka and Masad (2010) found as -1.112 at 120 enterprises in Jordan. However, the contrary results in the literature may be since these studies include more than one production periods in their research and the heterogeneity of feed prices.

Within the scope of the study, the feed cost was determined as 70.2% within the total costs. Shaikh and Zala (2011) found feed costs as 58.6% in Gucerat state in India. Emokaro and Emokpae (2014) analyzed the cost profitability functions in broiler production on 140 broiler farms in Edo State, Nigeria, and determined feed cost as 73% in total costs. Thus, the cost of feed has a large share in the total costs.

The second coefficient in the study was the revenue. The revenue item is calculated by multiplying the total tonnage of meat, received by the integrated company after slaughtering with a certain price that delivered to the integrated company by broiler enterprises at the end of a production period and it is called as "gross broiler income".

After deducting feed and chick cost items from the gross chicken income, 17.1% of the remaining part is defined as the "gross contract broiler maintenance fee" of the contracted producers. After this stage, the vaccine, medicine and disinfectant expenses are deducted from the remaining part and also items such as fuel and capacity support are added, and the calculation was finalized. However, if European Efficiency Productivity Factor (EPEF) is used as the account system between the integrated company and broiler businesses or the premium payment system, which is also referred to as a pool system, the premium amount calculated according to the EPEF score is added or subtracted to the revenue, and the remaining is actually the net receivable of the contracted producer from the integrated firm at the end of a production period. This part is paid to the broiler enterprise by the integrated company as "Contract broiler maintenance fee". On the other hand, the broiler enterprise pays the labor cost, electricity-water expense, cleaning cost, litter cost, broiler catching expense and all other additional costs from the income obtained as "Contract broiler maintenance fee". The remainder is the net profit of a broiler enterprise.

Within the scope of the study, X2, a 1 unit increase in average revenue (TL/kg LW), in other words, an increase in the average sales price of 1kg of live weight caused an increase of 1.036 TL in profit. Within the scope of the study, the calculation was made based on "gross broiler income", not "Net contract chicken maintenance". Yalçın and Cevger (2003) determined this value as 0.993 in Bolu province. Bandara (2006) determined 0.843 for 120 enterprises in Sri Lanka, and it was determined as 0.844 for 120 enterprises in Jordan (Masad, 2010).

The third coefficient within the scope of the study was the labor coefficient. Labor cost consisted of 3.4% part in the total costs of broiler enterprises. Sheppard (2004) determined the labor cost for broiler businesses as 3.4% in England whereas Anang *et al*. (2013) determined the labor cost in broiler enterprises as 5% in their study in Ghana.

In some of the broiler enterprises within the scope of this study, labor was provided family members instead of foreign workers, while others employ foreign workers. It has been observed that employing one worker of up to 30 000 heads in most of the enterprises is sufficient.

Yalçın and Cevger (2003) determined labor in broiler farms as insignificant $p < 0.05$ in their study. However, in the present study an increase of 1 unit in labor caused a decrease of 1.033 TL in the profit level. Bandara and Dassanayake (2006) determined this value as -1.345. Masad (2010) determined it as -1.401 while Altahat *et al.* (2012) determined it as - 0.962. These results indicate that labor is an important parameter.

The fourth coefficient within the scope of the study was the veterinary service and drug costs. The cost of interventions made outside of routine applications within the scope of biosecurity in a production period is collected from the contracted broiler enterprise by the integrated company. Within the scope of the study, it was determined that an increase of 1 unit in the cost of X4 veterinary service and medicine caused a decrease of 0.983 TL in profit. Bandara and Dassanayake (2006) reported that a 1-unit increase in the cost of veterinary service and medicine in Sri Lanka would result in a decrease of 2.067 in profits. Masad (2010) reported that there would be a 1.321 decline for 120 enterprises in Jordan. This situation reveals that the cost of veterinary service and medicine has a significant effect on profits. Veterinarian, medicine, and vaccine costs item constitutes 1.4% of the cost items of broiler enterprises. Sheppard (2004) determined this rate as 1.2% in England. Rana *et al*. (2012) also reported that it was 5.25% in Bangladesh.

Contrary to the results of aforementioned studies, Emokaro and Emokpae (2014) reported that the increase in drug costs positively affects profits unlike other costs in a study conducted on140 broiler enterprises in Edo state in Nigeria, and these authors attributed this effect to the reduction in mortality rate due to contribution of the drugs to productivity.

The fifth coefficient within the scope of the research was electricity-water cost. Accordingly, an increase of 1 unit in the cost of electricity and water costs caused a 1.093 TL of decrease in profit. Masad (2010) determined the same rate as 0.027. Yalçın and Cevger (2003) determined this ratio as -0.035 for only electricity. Since the study was conducted in the autumn and winter during the production period, it was thought that electrical heating systems increased the costs. Within the scope of this study, electricity-water expenses among the total cost items of broiler enterprises were at the level of 1.4%. On the other hand, Sheppard (2004) determined the electricity and water costs, including the heating system, as 3.3% in England.

The sixth coefficient within the scope of the study was the mortality rate coefficient. In the regression equation, a 1 unit increase in the mortality coefficient caused a 0.413 TL decrease in the profit. This rate was determined as -1.287 by Yalçın and Cevger (2003), and as -0.245 by Masad (2010).

The mortality rate was determined as 8.7% and 5.5 % in Sabah and Johor cities of Malaysia respectively by Isa *et al*. (2019). Rifky (2016) determined the same rate as 3.5% in 100 broiler farms in Sri Lanka. Within the scope of this study, the average mortality rate of broiler enterprises was determined as 4.9%.

Within the scope of this study, an increase of 1 unit in the cost of chick, X7, caused a decrease of

1,015 TL in the profit. In similar studies, this rate was found as - 0.671 by Bandara and Dassanayake (2006), -0.541 by Masad (2010) and -0.569 by Yalçın and Cevger (2003). Compared to these studies, the effect of price change in chick costs on profit was greater in the present study.

Within the scope of the present study, chick cost was determined as 12.7% among the total costs in broiler enterprises. This rate was found to be 18.0% in Ghana by Anang *et al*. (2013), and 18.5% in Bangladesh by Rana *et al*. (2012).

Changes in chick prices have a major impact on profit. Within the scope of this study, within the total costs for the contracted broiler enterprises, the biggest cost after the feed cost (70.2%) was the chick cost (12.7%).

In this study, other costs included all kinds of expenses such as loan interests, diesel expenses, casual workers, consultancy, income tax withholding and fuel, which are not shown separately in the economic analysis table. Thus, 1 unit increase in X8, other costs item caused a - 1.089 decrease in profit. This item was determined as -0.860 by Yalçın and Cevger (2003).

Within the scope of the study, an increase of 1 unit in X9, FCR, caused a 1.928 TL decrease in profit. Thus, among the independent variables, the variable that has the greatest effect on profit was the FCR variable. Yalçın and Cevger (2003) found this ratio as - 5.162, Bandara and Dassanayake (2006) as - 4.45 and Masad (2010) as 0.401. There was no strong relationship between FCR and profit solely in the study performed by Masad (2010).

Within the scope of the present study, the total number of animals raised in 68 broiler enterprises and shipped to slaughter was 1 541 274 in 2016. Total live tonnage was determined as 4 005 354kg. Thus, the mean FCR, which is defined as the level of converting feed into meat in enterprises, was realized as 1.70. This rate was found as 1.80 in Sri Lanka by Rifky (2016) as 1.74 and 1.90 in Sabah and Johor cities in Malaysia, respectively, by Isa *et al*. (2019). Singh *et al*. (2010) found it to be 1.68 in Pakistan.

In the present study, it was observed that the effect of the additional income received by the enterprises with a high FCR rate at the end of a production period through the premium given to them reflected in the research results as high FCR performance.

Within the scope of the study, the X10 coefficient was the production cycle coefficient. Accordingly, 1 unit increase in the production cycle caused - 0.001 TL decrease in the profit. Yalçın and Cevger (2003) determined this ratio as -0.005. Thus, we see that it has a small but clear effect in reducing profit in the production cycle.

CONCLUSION

As a result of the study, the changes in dependent variable, “profit level", caused by 10 independent variables [feed price, yield, labor, veterinarian, medicine and vaccine costs, electricity-water expenses, mortality rate, chick cost, other costs, feed conversion rate (FCR) production cycle] were modeled. Accordingly, through the regression model in question; ($Y = 3.255 - 0.035X_1 + 1.036X_2 - 1.033X_3 - 0.983X_4 - 1.093\mathrm{X}_5 - 0.413\mathrm{X}_6 - 1.015\mathrm{X}_7 - 0.860\mathrm{X}_8 - 1.928\mathrm{X}_9 - 0.001(\mathrm{devX}_{10})^2$.
Considering the the effects of independent variables on profit, the order of the independent variables from the most effective to the least effective were determined as x9: Feed conversion ratio (FCR), x5: Electricity-water expense, x2: Revenue, x3: labor, x7: Chick cost, x4: Veterinarian, Medicine, and vaccine costs, x8: Other costs, x6: Mortality, x1: Feed cost and x10: Production cycle. The results of this study have shown that broiler enterprises operating in Turkey and consultancy services as well as entrepreneurs who are considering entering a new sector institution, can use the model as a favorable decision support tool for assessing the investment risk under varying conditions. The compatibility of the model estimates with the field will provide the opportunity to determine consistent strategies in pre-feasibility studies to be made before the investment.

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AUTHOR CONTRIBUTIONS

Author Contributions ST planned and designed the study, methods, and manuscript preparation. EK analyzed. EK and ST interpreted the data.

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