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Short Communication / *Kısa Bilimsel Çalışma*

A study on determination of factors affecting profits with quantitative models in commercial egg production*

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Summary: In present study, it was aimed to demonstrate the use of profit function regression model as a decision support tool in commercial egg production. According to the estimated model results; all independent variables in the equation have important effects on the profit (Y) per kg eggs ($p<0.05$). It was concluded that a 1 TL increase in pullet, feed, labour, veterinary medicine and other cost as well as 1 unit increase in feed conversion rate (FCR) and mortality decreased the profit per egg. On the other hand, a 1 TL increase in egg sale price and 1 unit increase in egg yield increased the profit per unit. Production period had no effect on profit per egg. In this context, in addition to the estimation of the expected results of profit function regression model in commercial egg production, it was determined that this function could be used as a decision support tool in conditions where a change seen in price and costs.

Key words: Decision support tool, egg production, profit function, regression model

Ticari yumurta tavukçuluğu işletmelerinde karlılığı etkileyen faktörlerin kantitatif yöntemlerle belirlenmesi üzerine bir araştırma

Özet: Bu araştırmada, ticari yumurta üretiminde kar fonksiyonunu oluşturarak, kara etkisi olduğu düşünülen faktörlerin regresyon modeli yardımıyla belirlenmesi amaçlanmıştır. Model tahmin sonuçlarına göre, analize dahil edilen tüm bağımsız değişkenlerin istatistik açıdan kg yumurta başına kar (Y) üzerindeki etkisi önemli ($p<0.05$) bulunmuştur. Buna göre, işletmelerde yarka, yem, işgücü, veteriner-sağlık ve diğer giderlerde 1 TL'lik; yemden yararlanma (FCR) ve ölüm oranlarındaki 1 birimlik artışın kg yumurta başına elde edilen karı azalttığı sonucuna varılmıştır. Diğer taraftan yumurta satış fiyatındaki 1 TL'lik; yumurta randımanındaki 1 birimlik artış ise birim karı artırmaktadır. Üretim süresinin ise yumurta başına kar üzerinde bir artışa neden olmadığı tespit edilmiştir. Bu çerçevede araştırmada kurulan kar fonksiyonu regresyon modelinin ticari yumurta üretiminde de sonuçların tahmini yanında, fiyatların ve maliyet unsurlarının değişebileceği durumlarda karar destekleme aracı olarak kullanılabileceği belirlenmiştir.

Anahtar sözcükler: Kar fonksiyonu, karar destekleme aracı, regresyon modeli, yumurta üretimi.

Econometric models have been utilized as decision support tools and tools for progressive planning of the enterprises in livestock sector. Researchers have made some analysis with econometric models and techniques. Oğuz et al. (9), Tijani et al. (16) and Yusuf and Malomo (18), have established profit function models and determined the marginal impact factor of the independent variable. Profit function has been utilized as a selection criterion in dairy cattle breeding (4, 15, 17) and in broiler production systems (5, 12). Heady et al. (7) have used quadratic and Cobb-Douglas type production model to determine marginal effects of the corn and soybean on body weight gain in broilers.

Oğuz et al. (9) have observed that optimal production period is approximately 44th week with econometric model in chicken farming enterprises in Turkey. Sakarya (13) has investigated productivity analysis and determined return of scale in broiler production after estimating Cobb-Douglas type production function. Cevger and Yalcin (3) have used regression model to determine factors affecting profit in broiler production. Cevger (2) found no effect of fattening period, capacity usage, number of animals and other current expense items on profit via constructed profit function regression model in lambs.

The aim of this study was to use the profit function model to estimate factors affecting profit per kg egg in

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laying period and evaluate whether the established model could be used as a practical decision support tool in the field by the producers.

For this purpose, data from 82 egg production enterprises which operate and use randomly sampling method (11) in Afyonkarahisar were used as the research materials. Data regarding a whole production period were obtained from a face to face questionnaire from the producers in May 2005.

According to the obtained data, total cost, total revenue and total profits of the enterprises and profit per kg egg have been calculated in order to determine the factors affect profits (13). 16 eggs are registered to be 1 kg in the study (1).

The multiple regression models have been used to estimate the side and quantity of relationship between profit per kg egg and variables affecting profit (11). The constructed regression model is,

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

Y : Profit (Turkish Lira-TL) per kg eggs
X_1 : Price of purchased or breeding pullet (TL/hen)
X_2 : Feed price (TL/kg)
X_3 : Cost of labour (TL/per kg eggs)
X_4 : Cost of veterinary service and medicine (TL/per kg eggs)
X_5 : Other costs including building and machinery depreciation, repairs and maintenance and miscellaneous costs (TL/per kg eggs)
X_6 : Length of production cycle (day)
X_7 : Feed conversion rate - FCR (kg feed consumed per kg eggs)
X_8 : Mortality rate (%)
X_9 : Egg sale price (TL/kg)
X_{10}: Laying percentage (%)

The relationship between dependent (Y) and each independent variable (X_i) in the established model was examined in scatter diagrams and all the independent variables were found to have a linear relationship.

The estimated regression model results and related statistical tests are presented in Table 1. Independent variables included in model at 99 % have showed the variations on profit per kg eggs in enterprises (R^2=0.997). The beta (β) values depicted in Table 1 are the estimated coefficient values. Each coefficient demonstrates what the percentage of change will be in dependent variable against each 1 unit change on X.

Table 1. Estimation of regression model regarding profit per kg eggs (TL) and several factors affecting profitability
Tablo 1. Yumurta başına kar ile karı etkileyen bazı faktörlere ilişkin regresyon model tahmini

Variables	β (X ± Sx)	t	Sig t*	R^2	Durbin-Watson	F	Sig F**
(Constant)	0.706±0.046	15.260	0.000	0.997	2.152	2451.782	0.000
X_1	-0.052±0.001	-42.989	0.000				
X_2	-2.354±0.026	-90.326	0.000				
X_3	-1.049±0.055	-19.147	0.000				
X_4	-1.018±0.205	-4.972	0.000				
X_5	-0.944±0.056	-16.899	0.000				
X_6	0.000±0.000	16.494	0.000				
X_7	-0.449±0.014	-33.230	0.000				
X_8	-0.001±0.000	-2.190	0.032				
X_9	1.030±0.013	80.434	0.000				
X_{10}	0.003±0.000	12.658	0.000				

Y= Profit (TL/kg Lay) *p<0.05 **p<0.001 N: 82

Table 2. Correlation matrix of the variables involved in the regression model
Tablo 2. Regresyon modeline dahil edilen değişkenlerin korelasyon matrisi

Variables	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
Y	1										
X_1	-0.290	1									
X_2	-0.424	-0.075	1								
X_3	-0.646	0.233	0.023	1							
X_4	-0.375	-0.397	0.118	0.325	1						
X_5	-0.444	0.165	0.291	0.457	0.167	1					
X_6	0.076	0.264	-0.077	-0.022	-0.385	0.065	1				
X_7	-0.407	0.400	-0.283	0.549	-0.083	0.211	0.207	1			
X_8	-0.287	0.211	-0.001	0.404	0.203	0.192	0.324	0.276	1		
X_9	0.379	0.188	0.364	-0.134	-0.357	0.180	0.062	-0.090	-0.042	1	
X_{10}	0.274	0.189	-0.089	-0.287	-0.419	-0.146	-0.090	-0.098	-0.224	0.106	1

The existence of any violation of the assumptions made in the least square estimation have been tested with VIF (Variance Inflation Factor) (11) and DW statistics obtained from SPSS 16.0 results and correlation matrix (Table 2 and Figure 1). According to the statistical tests, it has been understood that there is no serious autocorrelation, multicollinearity and heteroscedasticity problems.

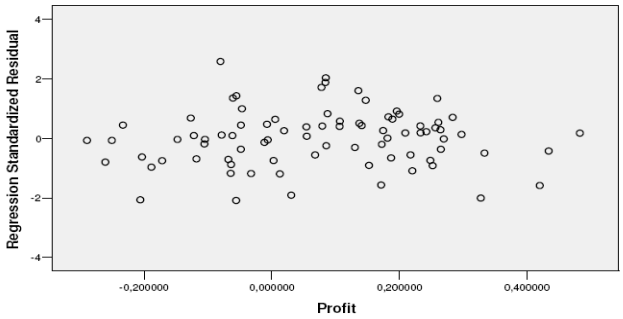

Figure 1. Relationships between dependent variable (Y) and standardized residuals
Şekil 1. Bağımlı değişken (Y) ile standartlaştırılmış artıklar arasındaki ilişkiler

As a result of the multiple regression analysis (Table 1); the effect of all independent variables on Y has been found to be statistically important ($p<0.001$ and $p<0.05$). In the light of multiple regression analysis result, it is possible to predict that the coefficient values that rise in 1 TL in feed price/per kg (X_2) and per pullet price/number (X_1) will cause a decrease on Y as 2.354 and 0.052 TL in percentage points. The rises in X_3 (labour cost), X_4 (veterinary-medicine expenditures) and X_5 (other costs) will lead to decrease on profit per kg egg as 1.049; 1.018 and 0.944 respectively. An increase of 1 kg in feed (X_7) will lead to decrease on profit/per kg eggs as 0.449 TL and 1 % increase in mortality rate (X_8). This will also lead to decrease per kg egg profit as 0.001 TL. A 1 TL increase in egg sale price (X_9) will lead to increase in Y as 1.030 TL. While 1 % increase in the laying percentage (X_{10}) had a slight positive effect on Y (as 0.003 TL), lengthening the production period (X_6) for one more day had no effect on Y (0.000 TL).

As seen in multiple regression model, the most important factors affecting profit are the economic items such as feed prices (X_2), labour costs (X_3), vet-med expenditures, (X_4), other costs (X_5) and egg sale prices (X_9). While egg price has a positive effect on profit, the mentioned costs have negative sides.

Some technical factors such as FCR (X_7), mortality rate (X_8) and laying percentage (X_{10}) have a negligible effect on profit.

The effectiveness of feed price on profit shows the importance of feed usage in rational production. Beside the importance of feed in production, the rapid increase in concentrated feed prices compared to egg price increases the influence of feed on profitability (14).

Moreover; it has been reported that higher egg production cost and less FCR value depends on poor quality feed usage in production. It is also reported that 0.5-1 kg more feed has been used for 1 kg egg production in Turkey than that of the other countries (8).

According to the results of this study, labour cost, veterinary and medicine expenditures and other costs affected profit per egg/kg ($p<0.05$). Some researchers have reported that these factors have primarily effect on the profitability in egg production (6, 10).

The slight negative effect of pullet price on profit per eggs/kg is because of the fact that the enterprises grow pullets themselves. Only six enterprises have stated that they purchased the pullet from other enterprises.

Considering the expenditures for each production day, it didn't seem to worth to lengthen the production period for one more day, because production period statistically had important effect on profit per eggs/kg, but no significant effect (0.000 TL) in value. This showed that each additional time increased the degree of the cost effects on "Y".

Cevger and Yalcin (3) have reported that feed price, veterinary and medicine expenditures and other costs have negative effects on profit per kg live weight in the broiler production with the values -2.021; -1.233 and -1.089 TL respectively and also reported that the effect of labour cost on profit per kg live weight is unimportant.

It was concluded that the estimated results were close to the actual values in practice. Therefore it was understood that the regression model could be used as a decision support tool both in micro (breeders and investors who will deal with laying hen production) and macro (decision of the governmental policies on egg industry) levels. Owing to this, the effect of expected risks and uncertain issues during the production process in enterprise profitability, could be better evaluated particularly while making the enterprise planning using the model results.

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