# MEASURING EFFICIENCY OF BROILER BREEDING PROJECTS USING STOCHASTIC COST LIMIT IN IRAQ (BAGHDAD GOVERNORATE)

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**ABSTRACT**

**The study aimed to estimate the cost efficiency and to know the most important social and economic factors affecting the production of broiler chickens in the Baghdad governorate. Using the random parametric analysis (SFA) based on the greatest possibility (ML) method. To determine the factors affecting the cost inefficiency function. The study relied on primary data from its field sources according to a questionnaire prepared for this purpose in Baghdad Governorate for one production year (2022). Data were collected randomly from (64) projects out of a total of (546) projects, with a rate of (11.72%). The results indicated that all the explanatory variables confirmed a prior prediction of the economic theory, as all the coefficients estimated for the cost of fodder, chicks, medicines, vaccines, and chicken meat production gave positive parameters indicating agreement with the assumption that the cost function increases directly with the input prices. The average cost of broiler breeding projects in the sample area was estimated at 1.04, which is about 4% more than the minimum cost set by the limits. Breeders can achieve an additional profit of up to 12.2% if the optimum efficiency is reached, so breeders must develop their agricultural skills in managing the use of inputs to achieve the lowest possible cost efficiency.**

**Keywords: cost efficiency, Poultry project management, maximum likelihood**



## قياس كفاءة مشاريع تربية فروج الدجاج باستخدام التكلفة الحدودية العشوائية في العراق (محافظة بغداد)

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**المستخلص**

**هدفت الدراسة الى تقدير كفاءة التكلفة ومعرفة اهم العوامل الاجتماعية والاقتصادية التي تؤثر على إنتاج فروج اللحم في محافظة بغداد. استخدام التحليل الحدودي العشوائي (SFA) اعتمادا على طريقة الامكان الاعظم (ML). ولتحديد العوامل التي تؤثر على دالة عدم كفاءة التكلفة. اعتمدت الدراسة على البيانات الأولية من مصادرها الميدانية وفق استمارة استبانة أعدت لهذا الغرض في محافظة بغداد لسنة إنتاجية واحدة (2022). جمعت البيانات عشوائيا من (64) مشروعًا من إجمالي (546) مشروعًا بنسبة (11.72٪). أشارت النتائج إلى أن جميع المتغيرات التوضيحية تؤكد توقعًا مسبقا لنظرية الاقتصادية، أذ أن جميع المعلمات المقدرة لتكلفة الأعلاف والصيصيان والأدوية واللقاحات وانتاج لحم الدجاج أعطت معلمات موجبة تشير إلى التوافق مع افتراض أن دالة التكلفة تزيد بشكل طردي مع أسعار المدخلات. تم تقدير متوسط التكلفة لمشاريع تربية دجاج اللحم في منطقة العينة اذ بلغت 1.04، وهي تكلفة تزيد بنحو 4٪ عن الحد الأدنى الذي حددته الحدود. يمكن للمربين تحقيق ربح إضافي يصل الى 12.2٪ حال الوصول إلى الكفاءة المثلى، لذلك يجب على المربين تطوير مهاراتهم الزراعية في إدارة استخدام المدخلات لتحقيق أقل كفاءة تكلفة ممكنة.**

**الكلمات المفتاحية: كفاءة الكلفة، إدارة مشاريع الدواجن، الامكان الاعظم.**

**Received:22/7/2024, Accepted:18/1/2025**

## INTRODUCTION

Poultry farming is an important business with a significant impact on the national economy when compared to the costs of meat and other animal derivatives. It also plays a critical role in ensuring animal protein from meat and eggs with high nutritional value. The economic importance of poultry is because it has a high nutritional value and is rich in essential amino acids compared to red meat because it contains a high percentage of protein with a low percentage of fat, as wellas being easy to digest, due to the tow fat content (5%) It is characterized by the speed of the production cycle and the cheapness of poultry products compared to livestock products (6). The development of this sector and the increase in its products provide the possibility to meet the local demand for its products and then to reduce the importing from abroad. This saves a large amount of foreign currency to be available for use in other areas that help in achieving economic development. Local, Arab, and international studies focused on dealing with the economic efficiency of chicken meat production projects (3, 4, 5) and the random border cost function (1, 9, 10, 11, 13, 14, 16). Despite the obvious increase in meat production projects in Baghdad governorate, it still suffers from high production costs because of inefficient use of available resources as well as fluctuating prices. Therefore, the present study aims to use the boundary cost model to estimate the cost efficiency of broiler breeding projects, determine the importance of each factor and discover whether there is an inefficiency in the cost of chicken meat production. By determining the extent to which breeder efficiency can be raised with the current resource and available technology to address food shortage problems in the study area, this study will assist in introducing a new perspective to breeder policymakers on how to increase chicken meat production. The research is predicated on the premise that the breeders of broiler breeding projects in the research sample have efficiency in the cost of production and that the state's policies, namely the low level of support for meat production projects, are to blame for the lack of self-sufficiency,

## MATERIALS AND METHODS

### Data collection

The study relied on primary data from field sources based on a questionnaire prepared for this purpose and through direct interviews with broiler breeders in the Baghdad governorate for one production year (2022). Data were collected randomly from (64) projects out of a total of (546) projects in the Baghdad governorate That is, (11.72%) of the total projects.

### Data analysis

Stochastic Frontier analysis (SFA) with Maximum Likelihood Estimation (MLE) was used to estimate a stochastic frontier cost function and to determine the factors affecting cost inefficiency.

### The stochastic frontier cost function

This method depends on regression techniques to estimate the function of total costs as a dependent variable while output levels and input prices are independent variables. The expected total cost constitutes the limit that represents the best application. The project is described as efficient when the current cost is higher than expected. The stochastic production frontier was first introduced separately by (2, 20). Further, these models develop by (12, 17, 18). The general formula for the stochastic frontier cost function is:

$$TC_i = C(Y_i, P_i\ ;\ \beta) + \varepsilon_i \dots\dots (1)$$

Where:== $TC_i$: Total Costs

$P_i$: Prices of input

$Y_i$: Output

This function represents the relationship between the lowest cost and a certain level of production in light of the given prices. According to economic theory, the cost function in equation (1) is a function related to the first and second partial derivatives. Furthermore, it is not decreasing and homogeneous of the first degree and can be rewritten in the following logarithmic form: (20)

$$LnTC_i = Ln\ C(Y_i, P_i\ ;\ \beta) + \varepsilon_i \dots\dots (2)$$

$LnTC_i$ : It is the function of logarithmic costs as the process of reducing the total cost to a minimum, and therefore the actual total cost cannot be less than the planned cost, as the difference between them represents the limit of random disturbance.

$$\varepsilon_i = V_i + U_i$$

Where:

$U_i$: represents the lack of efficiency in costs and expresses the amount of deviation in the actual cost of the firm from its optimum level and that it follows the semi-normal distribution.

$V_i$: represents the random error and is subjected to a normal distribution.= To estimate equation (1), it is necessary to formulate the appropriate cost equation for broiler farming projects, as follows:

$$Ln\ C_i = \alpha_o + \alpha_1 LnP_{1i} + \alpha_2 LnP_{2i} + \alpha_3 LnP_{3i} + \alpha_4 LnP_{4i} + \alpha_5 LnY_i + (V_i + U_i) \dots\dots\dots (3)$$

Where: Ci :The total production costs of broiler breeding projects in Baghdad governorate (Thousand dinars).

$P_1$: feed price (Thousand dinars).

$P_2$: The chick's price (Thousand dinars). $P_3$: The price of Medicines and vaccines (Thousand dinars).

$P_4$: The work price includes permanent and rented work (one thousand dinars).

$Y_i$: The output of broiler breeding projects(ton).

The inefficiency model (Ui) is defined as:

$$U_i = \delta_O + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} \dots\dots. (4)$$

Where $Z_1$, $Z_2$, and $Z_3$, represent the age of breeders (year), experience (year), and education (year), respectively the socio-economic variables are included in the model to indicate their possible influence on the cost efficiency of the broiler chicken breeding projects.

## RESULTS AND DISCUSSION

The specification of the variables for this frontier estimation is presented in Table 1. They include the sample mean and the standard deviation for each variable. The costs of producing chicken meat breeding projects in the Baghdad governorate for the year 2022 were calculated. The total variable cost amounted to 3650847 (Thousand dinars) to produce 2522.78 tons of chicken meat, with a standard deviation of 32451.23. The large size of the standard deviation conforms to the fact that most farms operate at different scales of operation. The relative importance of feed costs came first accounting for 78.86% of the total variable costs. This indicates the high price of feed to produce chicken meat breeding projects. This is partly because breeders depend on feed imported from the private sector because of the disabling of local feed projects and the absence of government support. The costs of Medicines and vaccines came next with a percentage of 9.96% of the relative importance of the total variable costs, which confirms the paramount importance of breeders to importing quality-high, disease-resistant, and productive chicks. The relative importance of drugs, vaccines, and rented labor expenses was 7.44% and 3.73% of the total variable costs, respectively. Table 1 also shows the socioeconomic factors for breeders which involve their age, experience, and educational years. The mean breeders' age was 32.5 years with a standard deviation of 8.12 years. The mean experience years was 12.7 years with a standard deviation of 3.15 years. For the education years, the mean and standard deviation were 10.4 and 3.20 years, respectively.

**Table 1. Specification statistics of the variables in the stochastic frontier model**

| Variables | Mean | Average Kilogram of meat /Dinar | Standard Deviation | % of TC |
|---|---|---|---|---|
| **Feed costs (Thousand dinars)** | **2879133** | **1141.25** | **23542.45** | **78.86** |
| **Chicks' costs (Thousand dinars)** | **363792** | **144.20** | **13523.22** | **9.96** |
| **Medicines and vaccines (Thousand dinars)** | **271600** | **107.66** | **2254.65** | **7.44** |
| **Labor cost (Thousand dinars)** | **136322** | **54.04** | **5412.78** | **3.73** |
| **The total variable cost of production (Thousand dinars)** | **3650847** | **1447.15** | **32451.23** | |
| **Chicken meat output (ton)** | **2522.78** | | | |
| **age of breeders (year)** | **32.50** | | **8.12** | |
| **Experience years** | **12.7** | | **3.15** | |
| **Education level (number of schooling years)** | **10.4** | | **3.20** | |

**Source: Estimate using Eviews.12**

**Parametric stochastic cost function analysis and cost-effectiveness:** The computer program frontier 4.1 was used to obtain the maximum-likelihood (ML) estimations of the parameters of the stochastic cost frontier models. Table 2 displays these outcomes. Most

of the estimated transactions of the cost of feed, chicks, medications, vaccines, and chicken meat output gave positive coefficients, indicating conformity with the assumption that the cost function monotonically increases with input prices. The result showed that all independent variables confirm a prior expectation, except labor, which makes up a smaller portion of the total cost of producing chicken meat, this scenario illustrates how sensitive the breeding system of the chicken meat project in the research region is to changes in the production and the price of these inputs. The percentage increase in total output is based on the interpretation of the Cobb-Douglas function's coefficient as the production elasticity because the cost function is a function of all input prices (7). In this instance, the production's cost elasticity is represented by the cost function coefficients. Therefore, a 1% increase in chicken meat production will result in a 0.855% rise in overall production costs. The feeding cost increases the overall production cost by about 0.544%, while the chick cost increases the overall production cost by about 0.324%, the cost of medicines and vaccines increases the overall production cost by about 0.045%, and the cost of labor will increase the overall production cost by about 0.012%. The analysis of the inefficiency model is shown in Table 2. The model shows that the signs and significance of the estimated coefficients in the inefficiency model have important effects on the cost-efficiency of chicken meat breeding projects in the study area. The positive coefficient of the age of the breeders of those projects indicates that the older breeders tend to be less cost-efficient, that is, the decline in cost-efficiency tends to increase with the age of the breeders. This is consistent with the assumption that younger breeders have greater access to extension services and has better knowledge of production costs because they are relatively more educated than older breeder. The negative coefficient of the education of breeders implies that the higher the number of years of study, the lower the cost of inefficient poultry breeding projects. The positive relationship indicates that educators who have obtained more years of education have greater economic efficiency, as education is positively related to the adoption of techniques and the enhancement of knowledge and skill with more reliance on technology (8) Moreover, The negative coefficient for years of experience led to a decrease in the cost of the inefficiency of chicken breeding projects, which amounted to (-0.213), as the increase in years of experience becomes more cost-effective for breeders in resource allocation in terms of introducing the appropriate number of chicks at the appropriate time for breeding and providing the chicks need of electricity, water, and appropriate breeding conditions, thus reducing the risks of production. The result of the presence of economies of scale (Es) among chicken breeders computed as the inverse coefficient of cost elasticities concerning the chicken meat breeding projects in tons as the only output in the analysis shows that (Es) prevails among the sampled breeders, judging by the fact that Es computed is greater than one (19), that is Es =1.075 It is a positive value, which means that the achieved (Es) is positive and consistent with the nature of chicken meat breeding projects in Baghdad province. This result further confirms Schultz’s poor-but-efficient hypothesis that breeders in a traditional setting are efficient in their resource allocation behavior given their operating circumstances.

**Table 2. Estimates coefficients of cost frontier for Broiler chicken breeding projects in Baghdad Governorate.**

| Variables | Coefficient | Estimated coefficient values | Standard-Error | t-ratio |
|---|---|---|---|---|
| **General Model** | | | | |
| **Constant** | $\beta_0$ | **1.386** | **0.172** | **8.058*** ** |
| **Chicken meat output** | $\beta_1$ | **0.855** | **0.358** | **2.387**** |
| **Feed costs** | $\beta_2$ | **0.544** | **0.155** | **3.506**** |
| **Chicks cost** | $\beta_3$ | **0.324** | **0.144** | **2.253**** |
| **Medicines and vaccines cost** | $\beta_4$ | **0.045** | **0.020** | **2.250**** |
| **Labor cost** | $\beta_5$ | **0.012** | **0.007** | **1.714** |
| **Inefficiency Model** | | | | |
| **Constant** | $\delta_0$ | **-0.049** | **0.098** | **-0.502** |
| **age** | $\delta_1$ | **0.015** | **0.005** | **2.820**** |
| **Experience** | $\delta_2$ | **-0.213** | **0.067** | **-3.243*** ** |
| **Education** | $\delta_3$ | **-0.007** | **0.028** | **-0.250** |
| **Variance parameter** | | | | |
| **Sigma-squared($\sigma^2$)** | **$(\sigma^2) = \sigma^2v + \sigma^2u$** | **0.045** | **0.007** | **6.429*** ** |
| **Gamma ($\gamma$)** | **$\gamma = \sigma^2u / \sigma^2v + \sigma^2u$** | **0.942** | **0.0003** | |
| **Log-likelihood** | | **83.521** | | |
| **LR test** | | **12.442** | | |

***** Significant level of significance 1%, ** Significant level of significance 5%.**

**Source: Calculated using frontier version 4.1**

The core aim of this model is to examine the cost efficiency of the broiler chicken breeding projects in the study area. Thus, the model is presumed to be the depiction of the data for considering its highly significant chi-square value as well as the Log Likelihood function under the half-normal distribution based on maximum likelihood techniques (15). According to Table 2, the parameter has a value of 0.942 and is significant at the level of 1%. This indicates that the cost efficiencies accounted for almost 45% of the variance in overall production costs. According to this statistical finding, the cost efficiency variance explains that there is a difference between the real cost and the cost frontier. The observation of LR likewise yields results greater than those of the supplied LR (12.442 > 2 = 3,841), indicating that the claim that all breeding for broiler chickens in the Baghdad Governorate is 100 percent effective is unsubstantiated. An overview of the cost-efficiency ratings for the broiler chicken breeding initiatives in the research area can be seen in Table 3. The formula for cost-effectiveness is CEE=Exp (U i). The average cost of breeders to produce chicken in the sample area is around 4% above the minimum set by the frontier, according to estimates of the breeders' mean cost efficiency, which was estimated at 1.04. To put it another way, in comparison to the best-practices chicken breeding produces the same product, and, dealing with the same technology, 4% of costs are squandered. with a minimum and maximum efficiency of 1.01 and 1.15, respectively. If inefficient breeders (minimum efficiency) could achieve maximum efficiency, the additional profit they can earn is 12.2% $\left(1 - \frac{1.01}{1.15}\right)$ , Besides the minimum efficient breeders, the average efficient breeders can earn an additional profit of up to 12.2% if they can achieve maximum efficiency. Therefore, breeders should improve their farming skills in managing the use of input to achieve minimum cost efficiency.

**Table 3. Cost Efficiency Distribution of Broiler chicken breeding projects in the Baghdad Governorate**

| Efficiency range | Cost Efficiency (CE) Frequency Relative | Frequency (%) | Efficiency Level Statistical Descriptive | Frequency |
|---|---|---|---|---|
| **1.01-1.09** | **62** | **96.88** | **Mean** | **1.09** |
| **1.10-1.16** | **2** | **3.12** | **Minimum** | **1.01** |
| | | | **Maximum** | **1.15** |
| | | | **Standard deviation** | **0.02** |
| **Total** | **64** | **100** | | |

**Source: Prepared by the researchers, based on the questionnaire**

## CONCLUSIONS AND RECOMMENDATIONS

Considering the present findings, all independent variables confirm a previous expectation as all the estimated coefficients for the cost of feed, chicks, medicines, vaccines, and chicken meat output gave positive coefficients. Breeders with more years of education are more economically efficient. Younger breeders are more efficient than older breeders. The more years of experience, the more cost-effective it is for educators to allocate resources. The average cost of breeders to produce chickens in the sample area is about 1.09% above the minimum set by the limits. In other words, 4% of their costs are wasted, compared to raising better-practiced chickens that produce the same output and experience the same technology. Medium-efficient breeders can also earn an additional 12.2% profit if they can achieve maximum efficiency. Therefore, breeders should improve their agricultural skills in managing the use of inputs to achieve minimum cost efficiency. The study suggests providing subsidies for fodder and chicks as well as controlling their high prices. It also suggests providing incentives to feed factories and hatcheries, as this can help reduce the high prices of fodder and chicks. and supporting younger breeders with a relatively high level of education to enable them to adopt the best breeding practices.

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