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# Econometric analysis of profit efficiency of broiler farms in Ondo state, Nigeria

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## ABSTRACT

Researchers have recently focused their attention on the chicken producers' inability to produce in sufficient quantities and quality, which contributes to the high price of locally produced chickens. The study investigated the profit efficiency of broiler farms in Ondo state, Nigeria. In order to collect cross-sectional data from sixty owners of broiler poultry farms in the study area between October 2021 and January 2022 for the 2021 production year, a multistage survey technique was used. The data were analyzed using descriptive statistics, gross margin and Cobb-Douglas stochastic profit frontier model. Average stock size and mortality rate of farmers were 1826 birds and 3.3% respectively while *Ross* strain of birds was most preferred birds. The result indicated that broiler farming is a lucrative business with a profitability index of 45.5 %. The results reveal that the cost of feed, cost of labour used and day-old chicks were the variables that significantly explained the profit efficiency of broiler poultry farms while household size, years of experience and other income source were the profit inefficiency variables. The study recommends government supports to broiler farms in form of input subsidies to enhance efficiency.

*Keywords: Cross sectional data, Flock sizes, Profit inefficiency, Ross strain, Stochastic profit frontier.*

## INTRODUCTION

Livestock industry constitutes an essential part of the agricultural sector of Nigeria. It includes poultry, fishes, snails, pigs, rabbits and ruminants (Oladimeji *et al.,* 2017). The industry provides small and marginal farm families with extra sources of income. (Lal *et al.,* 2021). According to Netherlands Enterprise Agency (2020), the Nigerian poultry industry contributes approximately 25% to agricultural GDP in the country. The poultry industry is a large sector with a diverse range of corporate interests, including enterprises that produce eggs, meat,

chicken, broilers, hatcheries, and poultry equipment (Adeyonu *et al.,* 2021). Broiler production is the raising of heavy-meat breed birds for the goal of producing high-quality meat products (Mir *et al.,* 2017).

Poultry production is one of the most widespread ways of protein production. Its rapid multiplication due to its short incubation period of 21days further enhances interest of the Nigerian citizenry in poultry (Oladimeji *et al.,* 2017). This short production cycle can help the attainment of protein sufficiency in Africa as well as rapid economic growth to the continent Etuah *et al.,* 2021) and to Nigeria in particular (Ekunwe and Soniregun, 2017). Even though there is a greater demand for chicken due to increased urbanization and food supply shortages, there has also been a dump of imported poultry goods. When compared to local broiler meat, imported chicken is more popular with consumers due to its lower price and consumer-friendly packaging. (Egyir *et al.,* 2012; Tuffour and Oppong, 2014). Nigeria is struggling to meet the high consumption demand of meat, which are needed to close up on the prevalent protein deficiency gap in Nigeria (Alabi *et al.,* 2020) and also causing a loss of revenue due to high levels of poultry importation and the accompanying huge demands on foreign exchange as may be inferred from the studies by Egyir *et al.* (2012) and Tuffour and Oppong (2014).

The inability of the chicken producers to produce in sufficient quantities and quality which has translated to the rather high cost of locally produced chickens' meat in country and hence the over-dependence on cheap imported broiler meat to the extent that Nigeria has witnessed a dramatic switch in the trend of chicken meat supply from domestic supply base of 70% to the current situation where local supply is only 10% of consumer demand (Kughur *et al.,* 2019). Hence, the lack of ability of local production to meet domestic demand has led to several questions, one of which is whether producers are producing effectively (Yevu and Onumah, 2021). Considering the high cost of poultry production and in light of the COVID-19 experience in Nigeria and other countries, this position poses the question of how productive and profitable broiler producers are operating. Are poultry businesses profitable in light of the high cost of poultry operation? As a result, the study hypothesizes that broiler farms are profit-efficient. Efficiency measurement is still an important area of research in both developing and developed countries. This study is therefore motivated by the need to evaluate factors affecting the efficiency of poultry production in Nigeria.

## MATERIALS AND METHODS

The study area was in Ondo State, Nigeria. It is situated between longitudes 4 20' and 6 03'E and latitudes 5 45' and 7 52'N. It is bordered on the east by the states of Edo and Delta, on the west by the states of Ogun and Osun, on the north by the States of Ekiti and Kogi, and on the south by the Atlantic Ocean's Bight of Benin. According to the National Bureau of Statistics (2016), the state has an estimated population of 4,525,632 people and a land area of roughly 15,000 square kilometers'.

One of the state's eighteen (18) Local Government Areas is Akure, the state's capital and largest town. The people's primary source of income is agriculture. The petroleum sector dominates the state's economy, although other significant economic factors include the production of cocoa, asphalt mining, and businesses taking advantage of the state's long coastline. Ondo State was selected because it is one of the fastest developing States in Nigeria. The majority of the inhabitants in the state are farmers who produce food crops and livestock and market them. Poultry farming is more prevalent and commercialized in the state than in neighboring states (Olutumise *et al.,* 2023).

### Source of Data

For the purpose of this study, primary data were collected between October 2021 and January 2022 using structured questionnaires. Among the information collected are socioeconomic characteristics, broiler farm production variables,

inputs and output prices, and broiler production inputs and output.

**Sampling Procedure**

A two-stage sampling procedure was employed to obtain relevant information from poultry farmers in Ondo State. Three local government areas (LGAs) (Ilaje, Okitipupa and Odigbo) were purposively selected because of the predominance of poultry farmers in that area (Olutumise *et al.,* 2023). The list of poultry farmer in the state was obtained from Poultry Farmers Association of Nigeria, Ondo State branch from which 20 poultry farms were randomly selected from each of the LGAs based on the population of poultry producers in the Local Government Areas as reported in the list obtained from the Poultry Association of Nigeria. This constitutes the second stage of the sampling. In all, sixty (60) broiler farmers were interviewed and information from them was used for analysis.

**Analytical Tools**

This study employed a number of analytical tools based on the objectives of the study. The tools are:

Descriptive Statistics: Descriptive statistics such as tables, frequencies, mean and percentages were used for socio-economic characteristics of the farmers.

Gross Margin Analysis: This was used to estimate the costs and returns to poultry broiler production per farmer per bird over a production cycle. This was used to estimate the costs and returns to broiler production in the study area. It was given as (equation 1)

GM = TR − TVC

Where GM = Gross Margin, TR = Total Revenue and TVC = Total Variable Cost (cost incurred in the use of variable inputs).

The Stochastic Frontier Profit Function

Profit efficiency is the amount of money made while operating on the profit frontier while taking into account factors and pricing unique to each farm. With completely competitive input and output markets, a single output technology that is quasi-concave in the (n x 1) vector of variable inputs and the (m x 1) vector of fixed components, and a farm that maximizes profit, Z (Yevu and Onumah, 2021). The actual normalized profit function which is assumed to be well behaved could be derived as follows (equation 2):

$$(\pi) = \sum(TR - TFC) = \sum(PQ - WX_i)$$

To normalize the profit function, profit (n) was divided on both sides of equation 2 by P, which was the average market price of the broiler. That was (equation 3:

$$\frac{\pi}{P(p,z)} = \frac{\sum PQ - WX_i}{P} = Q - \frac{WX_i}{P} = f(X_i, Z) - \sum P_i X_i$$

Where: π represented Profit, TR represented total revenue, TC represented total fixed cost, P represented price of output (Q), *X* represented the quantity of optimized input used, *Z* represented price of fixed inputs used,

$$P_i = {}^{W}/_{P}$$

which represented normalized price of input $X_i$, while represented production function. The stochastic profit function model which ws assumed to be ‘‘well-behaved’’ and consistent with the stochastic frontier concept could be expressed as: (equation 4)

$$\pi_i = f(P_i, W_i).\exp \epsilon_i$$

Where i = 1….n was the number of sampled broiler farms, $\pi_i$ was the normalized profit of the farm, computed as gross revenue less variable cost, divided by farm-specific output price; $i^{th}$ was the vector of variable input prices of the farm divided by output price; $P_i$ was the vector of a fixed factor of the farm, ‘exp’ was an exponential function, and $\epsilon_1$ was an error term which was assumed to behave in a manner consistent with the frontier concept (Yevu and Onumah,

2021), thus specified as (equation 5),

$$\epsilon_i = v_i + u_i$$

Where $v_{i's}$ was a symmetric random error (noise error) term that was assumed to account for exogenous factors beyond the control of the broiler farmer and $u_{i's}$ was a non-negative random variable, associated with the inefficiency in production.

The explicit Cobb-Douglas functional form of the stochastic frontier profit-function for the broiler farmers in the study area was therefore specified as follows (equation 6):

$$In\pi = In\beta_0 + \beta_1 InP_1 + \beta_2 InP_2 + \beta_3 InP_3 + Z_{ij} + (V_i - U_i)$$

Where, $\pi_j$= restricted normalized profit i computed for $i^{th}$ farm defined as gross revenue less fixed costs divided by farm specific output price P (average price of matured broiler).

In = natural log

$P_{ij}$= price of variable inputs i normalized by average price of output for ith farm (average price of matured broiler)

Where (i=1.... 4) so that:

$P_1$= normalized price of feed (in naira/kg)

$P_2$= normalized price of labour (in naira/day)

$P_3$= normalized price of day old chicks (in naira/bird)

$Z_{ij}$ = the quantity of fixed inputs i for jth farm (i= 1… 2)

$Z_1$ $Z_1$ = Cost of farmhouse

$Z_2$ $Z_2$ = Cost of cage

$Z_3$ $Z_3$ = Cost of others (electricity, water, veterinary, sanitation)

$U_i$ = inefficiency variable (represents farmer specific characteristics related to profit efficiency).

The inefficiency model is specified as (equation 7):

$$U_i = \delta_0 + \sum_{d=1}^{4} \delta_d W_{di}$$

where $\delta_i$s the parameter to be estimated, U is a non-negative error term that captures profit inefficiency effects relative to the stochastic profit frontier, W is a vector of variables explaining inefficiency effects and $\delta_0$= is constant in the equation.

$\delta_0$ = constant term

$w_d$= variables explaining inefficiency effects and are defined as follows:

$w_1$= Age of famer

$w_2$= Household size

$w_3$= Education years

$w_4$= Poultry farming experience

$w_5$= Other income source.

## RESULTS AND DISCUSSION

### Farm-specific Variables of the Poultry Farms

Table 1 presents the farm-specific variables of the poultry farms in the research area. The result shows that 33.3% of the farmers had less than 500 birds in their farms while 35% and 31.7% kept between 500-1000 birds and greater than 1000 birds respectively. The average stock size in the study area was 1826 birds. The result reveals that majority of birds stocked by farmers were *Ross* strain (60%) while 38.3% and 1.7% of the broiler poultry farmers stocked *Arbo*r acre and *Agrited* respectively. This implies that Ross was preferred to the other strains of birds. The reason might be because Ross strain has the highest feed intake and final body weight compared to other strains (Ikusika *et al.*, 2020).

Average mortality rate of farmers was 3.3%. Deep litter housing is used by 75.0% of broiler farmers on average, while cage housing is used by 8.3%. Only 16.7% of broiler farmers housed their birds in both deep litter and cage housing. This could be because deep litter allows farmers to properly manage poultry waste materials and profit from the economic opportunities that come with them. The result shows that less than half (42.4%) of the broiler poultry farmers had contact with extension officers and the remaining without any throughout the production cycle. However, availability of extension services and information about technical aspects of poultry technologies play an important role in increasing farm level efficiency hence; the benefits of production practices needed by the farmers might have been denied resulting to lower

Table 1. Farm Specific Variable of the Poultry Farmers in the Study Area

| Number at stocking | Frequency | Percentage |
|---|---|---|
| Less than 500 | 20 | 33.3 |
| 500 – 1000 | 21 | 35.0 |
| Greater than 1000 | 19 | 31.7 |
| Total | 60 | 100.0 |
| Mean=1514, SD = 1626 | | |
| Housing Type | | |
| Deep Litter | 45 | 75.0 |
| Cage | 5 | 8.3 |
| Deep litter and cage | 10 | 16.7 |
| Total | 60 | 100.0 |
| Feed Technology | | |
| Self-Milling | 1 | 1.7 |
| Commercial Feeds | 57 | 95.0 |
| Self-Milling and Commercial | 2 | 3.3 |
| Total | 60 | 100.0 |
| Strains of birds | | |
| Arbor Acre | 23 | 38.3 |
| Ross | 36 | 60.0 |
| Agrited | 1 | 1.7 |
| Total | 60 | 100.0 |
| Mortality rate | | |
| 5% & below | 50 | 83.3 |
| 6 -10 | 3 | 5.0 |
| 11 – 15 | 3 | 5.0 |
| 16% & above | 4 | 6.7 |
| Total | 60 | 100.0 |
| Mean=5.766, SD= 8.86 | | |
| Rearing Period | | |
| 5 weeks | 6 | 10.0 |
| 6 weeks | 51 | 85.0 |
| 8 weeks | 3 | 5.0 |
| Total | 60 | 100.0 |
| Mean=6.0, SD= 0.55 | | |
| Source of Credit | | |
| Bank | 2 | 3.4 |
| Cooperatives | 32 | 51.7 |
| Personal saving | 26 | 43.3 |
| Total | 60 | 100.0 |

Source: Field Survey in 2022

income.

Furthermore, the majority (95%) of broiler poultry farmers purchased commercial feeds for their farms, while 1.7% and 3.3% used self-milling and a combination of self-milling and commercial feeds, respectively. This could imply that commercial feed is of greater quality than farmers' own prepared feed because commercial feed is made by specialists who are more knowledgeable about the ingredients to be utilized at each stage of feed production as well as their proportion in the overall feed. The result supports Wongnaa *et al.* (2023) claim that the decision of those who used commercial feed was informed by their lack of knowledge of feed preparation, milling machines, and necessary raw materials.

The table further shows that majority (85%) of broiler farmers reared their birds for 6 weeks, while 10% could only afford 5 weeks of rearing. The average broiler rearing period before culling or disposal was 6 weeks. This implies that the

Table 2. Average Cost and Return to Broiler Production per Farm per Production Cycle

| Cost of Items | Amount (Naira[a]) | % of TVC |
|---|---|---|
| 1826 Day-old chicks @ ₦430.60 | 785,908.33 | 25.69 |
| Feed cost | 2,040,735.73 | 66.70 |
| Medication cost | 71,473.92 | 2.34 |
| Transportation cost | 18,978.33 | 0.62 |
| Hired Labour cost | 68,013.33 | 2.22 |
| Family Labour cost | 32,856.67 | 1.07 |
| Fuel cost | 20,352.54 | 0.67 |
| Others cost | 21,436.67 | 0.70 |
| Total variable cost | 3,059,755.53 | 100.00 |
| Total Revenue (Revenue from matured broiler) | 4,452,861.02 | |
| Profit (Total Rev-TVC) | 1,393,105.49 | |

[a]Naira (₦) is Nigerian currency, 1₦ = US$0.002277.
Source: Field Survey in 2022

Table 3. Distribution of Technical Efficiency Levels of Broiler Poultry Farms

| Efficiency score | Frequency | Percentage |
|---|---|---|
| 0.10 - 0.50 | 26 | 43.3 |
| 0.51 - 0.60 | 4 | 6.7 |
| 0.61 - 0.70 | 7 | 11.7 |
| 0.71 - 0.80 | 3 | 5.0 |
| 0.81 - 0.90 | 14 | 23.3 |
| 0.91 & above | 6 | 10.0 |
| Total | 60 | 100.0 |
| Min = 0.008 | | |
| Max =0.956 | | |
| Mean = 0.607 | | |

Source: Field Survey in 2022

Table 4. The Maximum Likelihood Estimates (MLE) Of Cobb-Douglas Stochastic Frontier Profit Function

| Variables | Parameters | Coefficient | Standard Error | p>\|t\| | t- Ratio |
|---|---|---|---|---|---|
| Constant | $\beta_0$ | 7.376*** | 0.210 | 0.000 | 35.129 |
| Cost of feeds | $\beta_1$ | -9.935*** | 1.163 | 0.000 | -8.543 |
| Cost of labour | $\beta_2$ | 3.163*** | 0.283 | 0.000 | 11.175 |
| Cost of DOC | $\beta_3$ | 4.733*** | 0.983 | 0.000 | 4.814 |
| Cost of farmhouse | $Z_1Z_1$ | 0.163 | 0.983 | 0.874 | 0.166 |
| Cost of cages | $Z_2Z_2$ | 0.733 | 0.895 | 0.852 | 0.819 |
| Others | $Z_3Z_3$ | -0.018 | 0.059 | 0.809 | -0.305 |
| Inefficiency | | | | | |
| Constant | $\delta_0$ | 0.236 | 1.104 | 0.800 | 0.214 |
| Age of farmer | $\delta_1$ | -0.0718 | 0.0495 | 0.174 | -1.449 |
| Household size | $\delta_2$ | -0.690** | 0.250 | 0.008 | -2.767 |
| Education years | $\delta_3$ | 0.132* | 0.071 | 0.059 | 1.850 |
| Poultry experience | $\delta_4$ | 0.257*** | 0.049 | 0.000 | 5.271 |
| Other income source | $\delta_5$ | 1.192** | 0.427 | 0.006 | 2.795 |
| Sigma squared | $\Sigma$ | 0.668** | 0.266 | 0.013 | 2.506 |
| Gamma | $\gamma$' | 0.951*** | 0.036 | 0.000 | 26.191 |
| Log Likelihood | | -34.345 | | | |

***, **, and * denote statistically significant coefficients at 1%, 5%, and 10%, respectively.
Source: Field Survey in 2022.

optimal rearing period for broiler chickens is 6 weeks.

**Cost and Return on Broiler Production per Farm and Cycle**

Table 2 shows the average cost and return on broiler production per farm and cycle. According to the findings, the total cost of broiler production in the study area was N3,059,755.53 while the total revenue generated was N4,452,861.02. The average net profit of broiler poultry farms was N1,393,105.49. Feed cost accounted for the majority (approximately 66.7%) of total variable cost in the study area of broiler farms. Our findings support the findings of Adeyonu and Odozi (2022) and Arslan *et al.*, (2018), who stated that feed is the most expensive variable cost in broiler production. This was followed by the cost of day old birds (25.69%), with the remaining cost items (9%) being medication, transportation, hired and family labour, fuel cost, and other miscellaneous costs. The result further showed that the cost of producing a matured broiler bird was ₦1675.66, while ₦2521.44 was realized as income with profitability index of 45.53% implying that broiler farming is a profitable enterprise. The findings corroborate Khan and Afzal, (2018) and Adeyonu and Odozi's (2022) claims that livestock farms and other businesses can be successful, but at different rates depending on the farm.

**Distribution of Profit Efficiency Scores of Poultry Farms**

The distribution of profit efficiency of poultry farmers is presented in the Table 3. Profit efficiency ranges from 0.0080 to 0.9559, according to the results. Profit efficiency was estimated to be 0.607 on average. According to the efficiency distribution, 43.3% of poultry farmers scored between 10 and 50, while 23.3% scored between 0.81 and 0.90. The average efficiency score of broiler poultry farms was 60.7%, indicating that all farms operated at moderate levels of efficiency using the given production techniques. However, it indicates that the output realized can still be increased by 39.3% by implementing the most efficient farm techniques. The mean profit efficiency was 60.7% for the input prices and technology in use, which suggests that 39.3% of the border profit was lost due to economic inefficiency. The results show that by putting optimal farm practices into effect, producers may, on average, boost their profitability by enhancing their competitiveness in the short term.

**Estimates of the Profit Frontier Model of Poultry farms**

Table 4 shows the maximum likelihood estimates (MLE) of the Cobb-Douglas stochastic frontier profit function result. At the 1% level, the variance parameter for sigma square ($\sigma^2$) was 0.668 significant. The results show that the explanatory variables included in the model explained approximately 67% of the variation in broiler production profit. Due to the farms' poor economic performance, the gross profit deviated from the frontier profit. Research demonstrated that rather than random distribution of the deviations from the frontier profit, profit variability was mostly influenced by inefficiency effects. This sigma square value indicated that the data fit the stochastic model well. The estimated gamma coefficient (**γ'**) of 0.951 obtained was also highly significant at the 1% level of significance, indicating that the one-sided random inefficiency component strongly dominates the measurement error and other random disturbance, indicating that approximately 95% of the variation in actual profit from maximum profit (profit frontier) between farms was primarily due to differences in farmers' practices rather than random variability. All of the efficiency parameters' maximum likelihood estimates were significant.

The findings show that the cost of feed, cost of labour used, and cost of day old chicks were the variables that significantly explained the technical efficiency of broiler poultry farms, whereas household size, years of experience, and other income sources were the inefficiency variables. The estimated elasticity of feed, labour, and day-old chick costs as inputs to broiler pro-

ducers' gross profit indicates that only four independent variables are significant. The cost of feed has negative sign and significant at 5%, implying that, the higher the cost of feed, the lower the profit efficiency of broiler poultry farms.

The cost of labour has a positive sign and significant at 1% level. The implication is that if the cost labour increased by one naira, the profit efficiency increased by 3.16 units. This result is in line with those of Chowdhury (2016) and Yevu and Onumah (2021), who similarly discovered a favourable link with both hired labour and family and suggested that each is productive in their own right. With respect to the cost of day-old chicks, the variable has a positive coefficient and significant at 1% level. This demonstrated that the day-old chick's marginal value production was higher than its cost. A naira increase in the cost of a day-old chicks increased profit efficiency of broiler poultry farms by 47.3%. This finding is consistent with Tuffour and Oppong, (2014) that a rise in poultry output would follow an increase in the stock of birds. It's crucial to understand that with the inefficiency model, a positive coefficient signifies a rise in profit inefficiency, whereas a negative coefficient results in a fall in profit inefficiency or an increase in profit efficiency. Household size has a negative coefficient and is significant at 5% level. An additional member to the broiler poultry farmer household decreased profit inefficiency by 6.9%. The positive sign of the coefficient years of experience implies that the more number of years an individual is involved in broiler production, the less experienced he would likely be in the production activities of broiler birds. The years of experience of the farmer decreased the profit inefficiency of farmer by 25.7%. The result agrees with Tuffour and Oppong (2014) that more experienced farmers are better able to adopt best agricultural practices through a continual learning process, enabling output at the frontier using the least expensive mix of productive inputs available. The result also shows that broiler poultry farmers with other income sources increased profit inefficiency by 11.9%.

## CONCLUSION

The result of indicated that broiler production is a lucrative and profitable business. This serves as an eye-opener to farmers who may want to invest in broiler farming as there is every likelihood that their investment in the industry will not go down the drain. The results reveal that the cost of feed, cost of labour used and cost of day old chicks significantly explained the technical efficiency of broiler poultry farms while household size, years of experience and other income source were the inefficiency variables.

## RECOMMENDATION

This study recommends that major poultry farms in the study area might apply reverse integration by building feed mills where premium livestock feed can be produced and supplied to other farms. This would reduce feed costs in the production of broilers. The country's security should be improved by the government in order to protect the crops that farmers grow and make more inputs available for the manufacture of animal feed and lowering the feed's price. Also, farmers should be encouraged to increase their flock sizes by subsidizing some of their major inputs

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Nil

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