FUTOJNLS 2019 VOLUME- 5, ISSUE- 1. PP- 42 - 56

Futo Journal Series (FUTOJNLS)
e-ISSN : 2476-8456 p-ISSN : 2467-8325
Volume-5, Issue-1, pp- 42 - 56
www.futojnls.org

Research Paper July 2019

Comparative Analysis of Technical Efficiency and Profitability of Broiler and Layer Production Enterprises in Aba Agricultural Zone, Abia State, Nigeria

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Abstract
The study examined the profitability and technical efficiency of broiler and egg production enterprises in Aba agricultural zone of Abia State, Nigeria during the 2017 production season. Farm level data were collected from 90 broiler and 90 layer farmers in the State using a well-structured questionnaire. Multi-stage random sampling technique was used to elicit primary data from 180 respondents. Farm budgeting technique (cost and return analysis) was used to estimate the profit levels of the two enterprises while the stochastic frontier production function was used to examine the technical efficiencies of broiler and layer farms. Both broiler and layer enterprises were found to be profitable at 22% and 18% respectively. Both broiler and layer farmers are not fully technically efficient. The mean technical efficiencies of broiler and egg enterprises wre 0.52 and 0.75 respectively implying a wide scope for increasing farm profit by reallocating the existing resources more optimally. Access to credit was found to increase technical efficiency of broiler enterprise (-0.1893) but decrease technical efficiency in egg enterprise (0.4922). The result also shows that the coefficient of membership of cooperative (-0.4320) increases technical efficiency in egg production enterprise while household size (0.0661) reduces technical efficiency. Therefore, the study recommends that credit should be made available at terms and times convenient to farmers to enhance their level of efficiency. Farmers should also form cooperative societies to enable them have access to productive inputs to aid large scale operation. Extension services should be improved and intensified. This should include creating awareness for the women farmers to know the profit potentials of broiler and layer farming so that they could be encouraged to undertake the enterprises.
Keywords: profitability, production, stochastic frontier, technical efficiency

1. Introduction

Poultry is a collective term for all *Avian* species nutritionally and economically useful to man (Okoli, 2006). The most important poultry species remains the domestic fowl commonly called chicken, not only because of its universal availability but also because it provides important highly relished human foods. The other domestic *avian* species classed under poultry include turkey, duck, guinea fowl, goose and pigeon. According to Chukwuji *et al.* (2006), poultry production is attractive, because birds are able to adapt easily, have high

economic value, rapid generation time and high rate of productivity that can result in production of meat within eight weeks and first egg within 18 weeks of first chick being hatched. He further stressed that poultry is an important source of animal protein, income, employment, industrial raw materials, manure, financial security etc. Poultry production has indeed become a leader in the livestock industry both in advanced management and technology.

The poultry industry specifically, has been described as the fastest means of bridging the protein gap prevailing in Nigeria (Akpabio *et al.*, 2007). According to Ukoha and Augustine (2007) poultry industry goes a long way in providing animal protein for the populace because it provides meat and egg in very short time. The poultry industry has become a diverse industry with a variety of business interests such as egg production, broiler production, hatchery and poultry equipment business interest (Amos, 2006). Poultry production in the past was not counted as an important occupation; it has developed and occupies a place of pride among the livestock enterprise due to itsrapid monetary turnover (Amos, 2006). This singular reason, among others has made the enterprise attractive and popular among small, medium as well as large scale poultry farmers. Poultry production in Nigeria increased tremendously in the last two decades (Okoli, 2006). Over these periods, successive Governments encouraged the development of large scale modern poultry enterprise.

Effiong (2004) posited that it is important to emphasize that farm production which is an organization of resources to produce output involves different operations with varying technical and managerial requirements. Livestock production could be significantly boosted through improved efficiency of farms by utilizing resources as well as introducing improved technology. Efficiency is concerned with the relative performance of the processes used in transforming given inputs into outputs (Ohajianya and Onyenweaku, 2001). Production efficiency means attainment of production goal without waste (Ajibefun and Daramola, 2003). In essence, the efficient utilization of resources in the production process implies optimal productivity of resources. Economic theory identifies three types of production efficiency namely, allocative, technical and economic efficiencies. Farmers in Nigeria need to improve the efficiency in poultry production so that output could be raised to meet the growing demand, (Ojo, 2003). An increase in efficiency would lead to an improvement in the welfare of farmers and consequently, a reduction in their poverty level and food insecurity (Effiong, 2004). Researchers and other stakeholders in the livestock sub-sector concerned about increasing animal protein through efficient resource use and utilization should seek ways or solutions compatible or that will agree with the socio-cultural and economic make-up of the people. The poultry industry has become a diverse industry with a variety of business interests such as egg production, broiler production, hatchery and poultry equipment business (Amos, 2006).

The demand and supply gap for animal protein intake is high (Olagunju, 2007). The Food and Agricultural Organization (FAO) recommends that the minimum intake of protein by an average person should be 65gm per day, out of which 26g, (i.e. 40%) should come from animal sources. Nigeria is presently unable to meet this requirement. The animal protein consumption in Nigeria is less than 8gm per person per day, which is a far cry from the FAO minimum recommendation (FAO, 2016). Further lending credence to this, Gona (2009) affirmed that the internal supply of livestock products is in such insufficient quantities that importations are made officially and unofficially annually (Gona, 2009). In spite of these

importations however, the total supply of livestock products still fall short of the overall demand. In some cases, the domestic production and importations are together still not enough to meet more than 60% of the actual domestic demand (Mbanasor and Nwosu, 2000). However, the sub-sector is undergoing massive transformation fueled by high demand for meat, which is likely to double in the near future (Gona, 2009). The major forces behind this, is the combination of population growth, urbanization and income growth.
Poultry meat and egg offer considerable potential for bridging the nutritional gap in view of the fact that high yielding exotic poultry are easily adaptable to our environment and the technology of production is relatively simple with returns on investment appreciably high. Animal scientists, economists and policy makers are of the opinion that the development of the livestock industry is one of the options for bridging the generally known deficiency gap in Nigerians' diets (Mbanasor and Nwosu, 1998).

Against the back drop that there is dearth of information on the efficiency in resource use for the enterprises in the study area, also this study sought to compare the technical efficiency and profitability of broiler and layer production enterprises in the study area. The specific objectives were to examine the determinants of technical efficiency in broiler and layer production as well as compare the technical efficiencies and profitabilities of the two enterprises in the study area.

2. Methodology

2.1. Study area

The study was carried out in Aba Agricultural Zone of Abia State, Nigeria. Abia state is one of the 36 states in Nigeria. The state lies on the longitudes 7^0 00^1E and $8^0$$00^1$E and latitudes $4^0$$45^1$N and $6^0$$17^1$N of the Greenwich meridian. It is bounded by Imo state on the west, Ebonyi and Enugu states on East West, Cross River and Akwa Ibom states on the East West and Rivers state on the South. It is composed of three constituencies, namely: Abia North, Abia South and Abia Central with seventeen (17) Local Government Areas.

The Agricultural zones are divided into three; they are Umuahia, Ohafia and Aba zones. The climate is tropical and humid all the year. Annual rainfall ranges from 2000mm to 2500mm, temperature ranges within 22^0C and 31^0C (FOB, 1999) and occupies an area of 7620 square kilometer. The capital is Umuahia, and it is one of the nine constituent states of the Niger Delta. In Aba zone, there are seven L.G.As namely: Aba North, Aba South, Osisioma Ngwa, Obioma Ngwa North, Ukwa East, Ukwa West and Ugwunagbo

According to the National Population Commission (NPC, 2006), Abia State is populated by an average of 1,913,917 persons made up of 933,030 males and 971,878 females. With estimated annual population growth rate of 2.0 per cent. The major occupation of Abians include: trading, manufacturing, farming, civil service etc. The major business hub of Abia state is Aba which is known for its ingenuity of the peple in manufacturing of shoes, bags, clothes, paints and so many agribusiness firms are found in the zone (Oleka, 2014).

2.2. Sampling procedure/technique

A multi- stage random sampling technique was employed for this study

In stage one, two Local Government Areas namely: Osisioma, Aba North and Aba South, Local Government Areas were purposively selected due to prevalence of poultry producers.

In the second stage, 3 autonomous communities were randomly selected from the selected Local Government Areas making it 9 autonomous communities

In the third stage, 2 villages were selected from each autonomous community, making it 18 villages.

In the fourth stage, 10 poultry farmers (5 broiler producers and 5 layer producers) were randomly selected from the villages making it a total of 180 poultry farmers (90 broiler farmers and 90 layer farmers)

2.3. Data collection techniques

Primary data were used in this study. Primary data were generated with the aid of well-structured questionnaire, interviews and observations. Also, vital information were obtained from secondary sources like text books, magazines, seminar papers and reports for the completion of the work.

2.4. Analytical Techniques

Objective 1 was realized using descriptive statistics such as mean and percentage. Objective 2 was achieved using farm budgeting technique (cost and return analysis). Objective 3 was realized using z-test. Objective 4 was achieved using the Cobb- Douglas frontier production function analysis. Objective 5 was realized using a single stage maximum likelihood procedure. Objective 6 was achieved using z-test

2.5. Model Specification

2.5.1. Efficiency model:

The Cobb-Douglas stochastic production model is specified following Battese and Coelli, (1995).

$$LnY = \beta o + \beta_1 LnX_1 + \beta_2 Ln X_2 + \beta_3 Ln X_3 + \beta_4 Ln X_4 + \beta_5 Ln X_5 + \beta_6 Ln X_6 + (V_1 - U_1) \quad (1)$$

where,

Ln = represents the natural logarithm

Y = Number of broiler or crates of egg produced in a year

X_1 = Cost of feed (₦),

X_2 = Cost of day old chicks (₦),

X_3 = Cost of medications (₦),

X_4 = Depreciation of fixed assets (₦),

X_5 = Cost of family labour (₦),

X_6 = cost of hired labour

X_7 = Cost of capital inputs (₦)

X_8 = farm size

V_1 and U_1 = are assumed to be independently and identically distributed

U_1 = is a non-negative random variable associated with technical inefficiency in production.

V_1 = is a random error which is associated with random factors not under control of the farmers.

Following Battese and Coelli (1995), the mean of farm specific technical inefficiency U1 is defined as;

$$U_1 = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 \quad (2)$$

where U_i=Technical inefficiency effect of the i_{th} farm
Z_1=Education (years)

Z_2=farming experience (years)

Z_3= household size (numeric)

Z_4= Gender (dummy variable; 1=male, 0=female)

Z_5=Age (years)

Z_6= Extension contact (dummy variable; 1=yes, 0=no)

To examine if significant difference exist in the efficiency indices of broiler and egg production in the area, a Z-test was carried out. The formula is as stated in equation 3:

$$Z_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\delta_1^2}{n_1} + \frac{\delta_2^2}{n_2}}} \quad (3)$$

Where,

$\bar{x}_1$ = the mean economic efficiency indices of broiler production in the study area.
$\bar{x}_2$= the mean economic efficiency indices of layer production in the study area.
δ_1^2 = standard deviation of economic efficiency indices of broiler producing farmers.
δ_2^2= standard deviation of economic efficiency indices of egg producing farmers.
n_1 = the number of broiler farmers
n_2 = the number of egg farmers.

2.5.2. Net Margin (Budgeting Technique)

This is specified as in equation 4

$$NFI = \Sigma P_y - \Sigma P_x - \Sigma P_k \quad (4)$$

Where: NFI = Net Farm Income (N/bird)

P = Unit price in Naira?

y = Output (Number of Birds)

x = Input (Variable)

k = Input (fixed)

The fixed cost is the depreciation for farm tools used by the farmer (feeding trough, watering trough, water pumping machine, and poultry house). The straight line method of depreciation was used to calculate the rate of depreciation of the fixed assets as follows;

Or: NFI (π) = GFI – TVC – TFC (5)

Where NFI (π) = Net Firm Income

GFI = Gross Firm Income

TVC = Total Variable Cost

TFC = Total Fixed Cost

3. Results and Discussion

3.1. Socio-economic characteristics

Table 1. Socio-economic characteristics of bird farmers

Socioeconomic characteristics	Broiler farmers Frequency	Percentage	Layer (egg) farmers Frequency	Percentage
Gender				
Male	79	87.78	71	78.89
Female	11	12.22	19	21.11
Age				
≤ 20	0	0.00	0	0.00
21 – 30	12	13.33	16	17.78
31 – 40	15	16.67	32	35.56
41 – 50	33	36.67	24	26.66
> 50	30	16.67	18	20.00
Mean	42.59		41.19	
Year of experience				
1 –10	17	18.89	21	23.23
11 –20	30	33.33	24	26.67
21 –30	30	33.33	27	30.00
31 –40	11	12.22	12	13.33
>40	2	2.22	6	6.67
Mean	22.12		21.99	
Marital Status				
Single	28	31.11	30	33.33
Married	59	65.56	57	63.33
Widowed	2	2.22	3	3.33
Divorced	1	1.11	0	0.00
Level of education				
No formal Education	27	30.0	30	33.33
Primary school	25	27.78	29	32.22
Secondary school	21	23.33	19	21.11
Tertiary	17	18.89	12	17.34
Household size				
1-3	3	3.33	7	7.78
4-6	7	3.89	7	7.78
7-9	18	20.00	21	23.33
10-12	24	26.67	28	31.11
>12	38	42.22	27	30.00
Mean:	**9**		**7**	

Source: field Survey Data, 2018

Result in Table1 shows that there is a gender inequality involvement of poultry farmers in the study area, with male and female scoring 87.78% and 12.22% respectively for broiler enterprise whereas in egg (layer) production, 78.89% and 21.11% of male and female farmers were respectively involved. Also majority of the broiler farmers fell within the age limits of 41 -50 years while the layer (egg) farmers fell within the age limits of 31-40 years. The greater percentage of both the broiler and layer (egg) farmers (70.55%) fell within the age limits of 31-50 years. The mean age of the broiler farmers was 42.59 years while that of the layer hen farmers was 41.19 years. By implication, most of the poultry farmers were within the middle age groups, energetic, productive and rational decision makers within the community (Ogundari*et al.*, 2007). The mean age indicates that the poultry farmers were

middle-aged farmers who according to Onyenweaku (1991), are at their productive age in life and are likely to adopt innovation faster. This is true because age, as a proxy for experience, can enhance business initiatives and efficient use of scarce resources.

With respect to production experience, majority of the broiler and layer (egg) farmers had between 2-30 years of farming experiences. This is a clear indication that both the broiler and layer (egg) farmers had enough farming experiences that could improve poultry production in the study area. The mean years of farming experience for broiler farmers was 22.12 years while that of the layer (egg) farmers was 21.99 years. Okoye *et al.* (2009) stated that the more experienced a farmer is, the more efficient he/she will be in decision-making processes and he/she would be willing to take risks associated with the adoption of innovations. Similarly, Ezeh et al (2012) stated that the greater the years of farming experiences, the greater the farmers' ability to manage general and specific factors that affect the farm business. However, 65.56% of the broiler farmers and 63.33% of the layer farmers were married. The result implies that majority of the poultry farm households were stable.

On literacy status, the distribution is skewed in favour of those who had one form of formal education or the other. In other words, greater percentage of the broiler farmers (70.00%) and layer (egg) farmers (66.67%) were literate. The literacy status of the broiler and layer (egg) farmers was encouraging and this facilitates access and utilization of modern poultry farm inputs. This is possible because Anthony (2007) stated that education does not only create a favorable mental atmosphere for the acceptance of new ideas but positively changes the overall attitude of the individual towards change. The author further added that education has been known to be a powerful instrument that helps to shape life and make the essence of living meaningful even at adult stage. Nwaru (2004) also added that education enhances farmers' ability to make accurate and meaningful management decisions.

The distribution of the household size shows that majority of the broiler farmers had more than 8 persons per household while layer farmers had between 7 and 8 persons per household. It is interesting to note that the greater percentage of the broiler farmers (72.78%) and layer (egg) farmers (60.55%) had household size greater than 6 persons. This is shown in Table 1. The mean household size for broiler farmers was approximately 9 persons while that of the layer (egg) farmers was 7 persons. The composition of the household plays a crucial role in agricultural production. In Nigeria, a large household (achieved through polygamy or the extended family) is a livelihood strategy that is adopted to ensure that sufficient labour is available to cover peak workloads (Bishop-Sambrook, 2005).

3.2. Cost and Return Analysis of Broiler and Layer (Egg) Production in Aba Agricultural Zone of Abia State

This is an attempt to show how profitable the broiler and layer (egg) enterprises were in the study area. This was achieved by considering the costs and returns associated with the production of the two enterprises in the study area. The results of the analysis is presented in Table 2.

Table 2: Cost and Return Analysis of Broiler and Layer (egg) Production in Aba agricultural Zone of Abia State (550 birds/enterprise/production period)

	Broiler farmers			Layer (egg) farmers		
Item	Unit cost/₦	Qty(amt used)	Value (₦)	Unit cost	Qty(amt used)	Value (₦)
INCOME						
Culled birds(broiler)	1500	435	652500.0	-	-	-
Eggs (crates)	-	-		950	711 crates	675450.0
Droppings	100	25	2500	100	26	2600
A:GROSS INCOME			655000.0			678050.0
Variable cost						
Feed	3512.2	80 bags	280976 (55.2%)	3541.7	88 bags	311669.9 (56.2%)
Day old chick	250	550 birds	137500.0 (27.0%)	250	550 birds	137500.0 (24.8%)
Labour (family & hired)	1800	12 man-day	21600.0 (4.2%)	1800	18 man-day	32400.0 (5.8%)
Vaccines and medications	59.6	550 birds	32780.0 (6.4%)	61.2	550 birds	33660.0 (6.1%)
Utilities (Electricity and water)	1.5	550 birds	825.0 (0.2%)	2.2	550 birds	1210.0 (0.21%)
Transportation	1	550 birds	550 (0.1%)	1.2	550 birds	660 (0.1%)
Saw dust	3.8	550 birds	2092.8 (0.4%)	3.8	550 birds	2092.8 (0.4%)
B:TOTALVARIABLE COSTS			476323.8 (93.6%)			519192.7 (93.6%)
Fixed Cost						
Depreciation on fixed assets	58.8	550 birds	32356.8 (6.4%)	64.4	550 birds	35447.3 (6.4%)
C: TOTAL FIXED COST			32356.8 (6.4%)			35447.3 (6.4%)
D: TOTAL COST= (B+C)	924.9	550 birds	508680.6 (100.0%)	1008.4	550 birds	554640 (100.0%)
E: Net Farm Income =(A-D)			146319.4			123410.0
F: Farm Financial Ratios						
Operating ratio = B/D	0.94					0.94
Income/expenses ratio = (A/D)	1.29					1.22
Profitability index = F/A	0.22					0.18

Source: Field Survey Data, 2018

Table 2 shows that the variable costs constituted the highest share of costs of production (N476,323.8 per respondent) representing 93.6% of the total costs of broiler production while fixed cost was (N32,356.8 per respondent) representing only 6.4%. Variable cost also constituted the highest share (93.6%) of cost in layer (egg) production. Cost of feed accounted for the highest share (55.2%) of total cost for broiler production and 56.2% for layer (egg) production. This means that feed is the largest cost item in poultry production. This finding is in agreement with those of Okezie and Bime (2006), Mgbakor and Chinonso (2013), in their various studies also found that cost of feed constituted the highest share of total cost of broiler production in Cross River and Anambra States of Nigeria. Cost of day old chicks accounted for the second largest variable cost constituting 27.0% and 24.8% of the total cost of broiler and layer (egg) production respectively. The average gross income and net farm income were N655,000.0 and N146,319.4 respectively for a broiler farmer and N678,050.0 and N123,410.0 respectively for an average layer (egg) farmer.

Further cost and return analysis shows that the operating ratios for broiler farmer and layer (egg) farmer was 0.94 apiece meaning that 94% of the gross income was used to pay for the variable costs. The decision rule is that the lower the value of the operating ratio, the better the financial position of the farm. An operating ratio of 1 implies that the gross income can scarcely cover the expenses on the variable. The income/expenses ratio for broiler and layer (egg) production were 1.29 and 1.22 respectively implying that the broiler and layer (egg) enterprises generated 1.29 and 1.22 times more income than expenses incurred or total cost of production respectively. Income/expenses of large magnitude suggest that the enterprise is in a healthy financial position. In this case it indicates that both enterprises were profitable. The Profitability Index (PI) was 0.22 for broiler production which means that for every naira earned as revenue, 22 kobo was returned to the broiler farmer as net income. In the same vein, the Profitability Index (PI) was 0.18 for layer (egg) production which means that for every naira earned as revenue, 18 kobo was returned to the layer (egg) farmer as net income; as PI is the level of returns per unit gross income. The decision rule is that for a farm to be profitable, the PI should be greater than zero. However, if the PI is negative it implies that the farm is running at a loss.

The results in Table 2 shows that both enterprises were profitable and lucrative in the study area but broiler enterprise was more profitable given the higher profitability index, The implication of the findings is that when efficiently, effectively and carefully managed, poultry production is capable of producing good output/yield as well as reasonable net return over time to any agribusiness entrepreneur.

3.3. Test of Difference in the Profitability of Broiler and Layer Farmers

The result of the test of difference in profit is presented in Table 3

Table 3: Summary of z-test analysis of the significant difference between profitability of broiler and layer producers

Samples	Mean	Standard Deviation	Std. Error Mean	Df	z-cal	z-tab	Prob	Decision
profit of broiler farmers	**146319.4**	0.59822	0.30427	88	1.961	0.840	0.001	Significant
profit layer farmers	**123410.0**	0.22613	0.12581					Accepted
[a] Paired difference	22909.4							

Table 3 shows observed significant level (P) of 0.001 which is less than (α) = 0.05. The z –calculated of 1.961 is greater than the z –critical of 0.840 at 88 degrees of freedom (df). Since the z-calculated is greater than z-tabulated, we reject the null hypothesis which states that there is no significant difference between profitability of broiler and layer production and accept the alternative that there is a statistically significant difference between the profitability of the two groups of poultry farmers.

3.4. Technical Efficiency of Broiler and Layer Enterprises

The maximum likelihood estimates of the parameters of the stochastic frontier production function for the measurement of technical efficiency of broiler and layer production are presented in Table 4.

Table 4: Maximum Likelihood Estimates of parameters of the stochastic frontier production function for the measurement of technical efficiency of broiler and layer (egg) enterprises

		Broiler		Egg	
Production factors	Parameters	Coefficient	t-ratio	Coefficient	t-ratio
Constant	β_0	-0.5268	-0.6878	-1.2255	-2.3825
Cost of family labour	β_1	-0.0223	-0.3546	0.1206	3.0205***
Cost of hired labour	β_2	0.0264(4.	3655)***	0.1158	2.7377***
Cost of feeds	β_3	-0.0702	-0.6936	0.1207	2.1115**
Cost of medication	β_4	-0.1885	-1.5448	0.0343	0.6841
Cost of capital inputs	β_5	0.2394	2.4180**	0.2265	2.6301***
Cost of day old chicks	β_6	0.3127	2.0837**	0.2222	3.8060***
Farm size	β_7	0.0860	0.5975	0.5360	6.1293***
Annual depreciation	β_8	00.1728	2.3310**	-0.1549	-1.8209*
Inefficiency factors					
Constant	Z_0	0.7105	2.0563**	0.2576	1.4617
Age of farmer	Z_1	0.0213	0.1160	-0.0369	-7.5488***
Level of education	Z_2	0.0416	1.9746**	0.0007	0.1031
Farming experience	Z_3	0.0136	2.2115**	-0.0089	-1.2813
Household size	Z_4	0.0101	0.7786	0.0661	9.1893***
Extension contact	Z_5	-0.0747	-0.8703	0.0247	1.0388
Credit status	Z_6	-0.1893	-1.8197*	0.4922	6.1584***
Membership of coop	Z_7	-0.5354	-0.9654	-0.4320	-5.0640***
Gender	Z_8	0.0176	0.9979	-0.1040	1.1829
Diagnostic statistics					
Log-likelihood function		-182.3379		-34.9286	
Sigma squared (σ^2)		4.6060(21.3082)**		1.1254(4.3723)***	
Gamma (γ)		0.9999(2819)***		0.9866(122.9109)***	
L-R test		12.3898		74.1825	

Source: Field Survey Data, 2018/ computed from Frontier 6.1 version
Note: ***, **, and * imply statistical significance at the 0.01, 0.05 and 0.10 probability levels respectively.

Table 4 shows the results of stochastic frontier production function for the technical efficiency of broiler and egg production enterprises respectively. The estimates of sigma-squared (σ^2) for broiler and layer functions are 4.6060 and 1.1254 respectively. They are significant at the 0.01 probability levels indicating that they are significantly different from zero. It assures us of the goodness-of-fit as well as the correctness of the specified distributional assumptions of the composite error term. The value of the gamma (γ) for broiler and layer is as high as 0.9999 and 0.9866 respectively and show that the unexplained variation in output of broiler and layer birds is the major source of random errors. It also indicates that about 90 percent of the variation in output of broiler and layer is caused by inefficiency of the producers. This result confirms the presence of the one-sided error-component in the model and hence makes the use of Ordinary Least Square (OLS) inadequate in estimating the production function.

The result indicates that in broiler enterprise, the MLE estimate of cost of family labour is -0.0223 and statistically insignificant, while that of egg farmers is 0.1206 and significant at 1% level. This implies that a 1% increase in the use of family labour will result in a 0.1206% increase in the level of output. The MLE estimate of the cost of hired labour of broiler enterprise is 0.0264 and is significant at the 0.01 probability level. In egg enterprise, the value is 0.1158 and is also significant at the 0.01 probability level. This implies that if labour employment is increase by 1% output will increase by 0.0264% in broiler and by 0.1158% in

layer enterprises holding other variables constant. The coefficient of cost of feeds in egg enterprise is 0.1207 and significant at 5% level. This implies that if feed is increased by 1%, output will increase by 0.1207% holding other variables constant. The MLE estimate for cost of capital inputs in broiler is 0.2394 and statistically significant at the 5% level. This shows that increased capital investment by 1% could lead to an increase in the level of output by 0.2394% holding other variables constant. For the egg enterprise, the value of the coefficient is 0.2265 and is significant at the 1% level. It implies that if the use of capital inputs is increased by 1%, output will increase by 0.2265% holding other variables constant. The cost of foundation stock is 0.3127 and statistically significant at the 5% level. This implies that a 1% increase in stock of birds will lead to 0.3127% increase in output holding other variables constant. In the case of layer enterprise, the estimate for the stock of birds was 0.2222 and significant at 1% level implying that output will increase by 0.2222% if the stock of birds is increased by 1% holding other variables constant. The coefficient of farm size is positive in both enterprises but significant only for the layer enterprise. A coefficient of 0.5360 and significant at the 1% level implies that if farm size is increased by 1%, output will increase by 0.5360 holding other variables constant. In broiler, the coefficient of annual depreciation on durable capital items is 0.1728 and significant at the 5% level. This implies that a 1% increase in the purchase and use of durable capital items will result in 0.1728% increase in outputs in broiler enterprise in the study area holding other variables constant. For layer enterprise, the coefficient of -0.1549 and significant at 10% level implies that a 1% increase in the use of durable capital items will lead to a decrease in profit by 0.1549% for the egg enterprise holding other variables constant.

3.5. Determinants of Technical Efficiency of Broiler and Layer Production

The result of the determinants of technical efficiency is also presented in Table 4. The results indicated that in broiler enterprise, level of education (Z_2) is positive and statistically significant at the 5% level. This implies that as the number of years spent in school increases, technical inefficiency in broiler business reduces. Credit status (Z_6) was found to be negative and significant at the 0.10 probability level in broiler enterprise but positive and significant at the 0.01 probability level for the layer enterprise. This indicates that access to credit, reduced technical inefficiency in broiler, but increased technical inefficiency in egg production enterprises respectively. This could be suggestive of the fact that egg producers might have diverted the credit to other farming activities other than layer (egg) enterprise Age of farmer (Z_1) was found to be negative and significant in egg production enterprise. This implies that as the age of farmer increases technical inefficiency in egg production increases. Household size (Z_4) was found to be positive in both broiler and egg production enterprises but significant only in egg production enterprise at the 1% level. This signifies that the higher the household size, the lower the technical inefficiency of the layer production enterprise. Membership of cooperative society (Z_7) is negative in both broiler and egg production enterprises but insignificant in broiler. The coefficient is significant in layer production enterprise at the 1% level. This implies that membership of broiler organization increases the technical inefficiency of the egg farmer in the study area.

Distribution of technical Efficiency

Table 5: Frequency distribution of the range of economic efficiency

	Broilers		Egg	
Range	Number	Percentage	Number	Percentage

0.01-0.20	59	49.17	4	3.33
0.21-0.40	22	18.33	7	5.83
0.41-0.60	15	12.50	14	11.67
0.61-0.80	11	9.17	41	34.17
0.81-1.00	13	10.83	54	45.00
Total	120	100.00	120	100.00
Mean	0.52		0.75	
Minimum	0.01		0.04	
Maximum	0.99		0.96	
Mean of worst 10	0.05		0.24	
Mean of best 10	0.93		0.94	

Source: Field Survey Data, 2018

The distribution of respondents according to their technical efficiency in production is shown in Table 5. The results indicate that the technical efficiency range of broiler farmers is between 0.01-0.99. The table shows the mean technical efficiency of broiler farmers to be at 52%, the minimum technical efficiency of 0.01 and the maximum of 0.99 were obtained. The means for the best 10 and worst 10 broiler farmers are 0.05 and 0.93 respectively. This suggests that if a typical farmer in the sample is to achieve technical efficiency he/she would require a 48% cost saving [i.e., 1-(0.52/0.99)*100]. The worst technically inefficient farmer needs a cost saving of 95% [i.e., 1-(0.05/0.99)*100]. This means that a typical broiler farmer can increase technical efficiency by 48%. The mean technical efficiency of egg production enterprise is 75%. This average value implies that the average egg farmer could increase technical efficiency by up to 25% by improving their technical and allocative efficiency. The technical efficiency of egg farmers ranged from 0.01-0.96. Egg farmers have the minimum technical efficiency of 0.04 and the maximum of 0.96. The means for the best 10 and worst 10 egg producers are 0.24 and 0.94 respectively. This means for an average farmer in the sample to achieve the technical efficiency of its efficient counterpart, the typical farmer could realize about 25% cost saving [i.e., 1-(0.75/0.96)*100]. The worst technically inefficient layer farmer needs a cost saving of 79% [i.e., 1-(0.24/0.96)*100]. This means that egg producers can increase their efficiency of production by up to 14% if productive inputs are optimally utilized. If this increase is achieved by these farmers, they will be operating on the production frontiers. Thus, there is still need for improvement on the productivity of farmers and income through increased efficiency in the use of existing resources.

The best technically efficient farmers operated almost on the frontier, as depicted by the maximum technical efficiencies of 0.99 and 0.96 for broiler and layer enterprises respectively. However, there exist a gap between technical efficiency levels of best ten and worst ten farmers. To bridge this gap, the average best farmer needs to save 48% and 25% costs to climb to the frontier for broiler and layer enterprises respectively. This is in contrast with the findings of Tijani *et al*. (2006) who found the mean technical efficiency of egg farmers to be 84.34% and affirmed that about 15.66% of the profit is lost due to technical inefficiency.

3.6. Test of Difference in the Technical Efficiency of Broiler and Layer Farmers

The result of the test of difference in technical efficiency is presented in Table 6

Table 6: Summary of z-test analysis of the significant difference between technical efficiency of broiler and layer production

Samples	Mean	Standard Deviation	Std. Error Mean	Df	z-cal	z-tab	Prob	Decision
Technical efficiency of broiler producers	**0.52**	0.59822	0.30427	88	17.086	1.950	0.001	Significant
Technical efficiency of layer producers	**0.75**	0.22613	0.12581					Reject
[a] Paired difference	0.23	0.37209	0.17846					

The results in Table 6 show a Z-cal value of 17.086 which is greater than the Z-critical value of 1.950 at the 0.05 probability level and 88 degrees of freedom. We hereby reject the hypothesis that the mean technical efficiency of broiler and layer farmers is the same. The two groups of farmers are not therefore operating at the same levels of technical efficiency

4. Conclusion and Recommendations

Based on the findings of this research, it is concluded that poultry farming in Aba agricultural zone, Abia state, Nigeria is of the small scale type considering the number of birds raised by broiler and egg farmers. Efforts geared towards increasing the farm size should be intensified. Low participation of women is an indication of limited access of women to inputs needed in poultry production and/or their lack of awareness on the profit potentials of poultry production, among other reasons. High literacy level among the respondents is an indication that poultry farmers' attitude to the adoption of technologies and skill acquisition will be positive. Both enterprises were profitable and lucrative in the study area but broiler enterprise was more profitable given the higher profitability index. Poultry farmers are not technically efficient in their use of productive resources. The varied technical efficiency of broiler and layer farmers is due to the presence of inefficiency effects. The mean efficiency result showed that layer farmers are more efficient than the broiler farmers

Technical efficiency is negatively influenced by level of education and positively influenced by credit status of broiler farmers. For egg farmers, age of farmers and membership of cooperative contributes positively to technical efficiency while credit status reduced technical inefficiency.

The implication of the findings is that when efficiently, effectively and carefully managed, poultry production is capable of producing good output/yield as well as reasonable net return over time to any agribusiness entrepreneur. Years of experience was found to reduce inefficiency and invariably increase profit. This is because, it enables the farmer set realistic targets and broadens the planning horizon thereby exposing them to better production techniques which farm advisory services, training and workshops can provide

This study recommends that to expand broiler farmers' scale of operation, farmers in Abia State should form cooperative societies so as to enable them have access to productive inputs that will enable them expand their resource base and consequently their scale of operation. Extension education was found to have significantly affected their levels of technical inefficiency. Extension services should therefore be improved upon and intensified to impart technical and economic knowledge to the farmers. Given the low levels of participation by the women folk, there is need to create awareness for the women farmers to know the profit potentials of broiler production so that they could be encouraged to undertake the enterprises.

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