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Economic efficiency in table-egg enterprise in Abia state, Nigeria

[*1]Onu, D. O., [2]Okoronkwo, F. C., and [3]Onyenweaku, C. E.
Department of Agricultural Economics, College of Agricultural Economics, Rural Sociology and Extension, Michael Okpara University of Agriculture, Umudike, P.M.B 7267 Umuahia Abia State, Nigeria
Email: dononu@yahoo.com

ABSTRACT
The study examined the economic efficiency of egg production in Abia State, Nigeria during the 2018 production season. Farm level data were collected from 240 layer farmers in the State using a well-structured questionnaire. Multi-stage random sampling technique was used to elicit primary data from the respondents. The stochastic frontier profit function was used to examine the economic efficiency of the layer farms. The enterprise is not fully economically efficient. The mean economic efficiency of layer is 0.75. This implies that farm profit could still be increased by reallocating the existing resources more optimally. Access to credit was found to decrease economic efficiency of egg enterprise (0.4922). The result also shows that the coefficient of membership of cooperative (-0.4320) increased economic efficiency while household size (0.0661) reduced economic efficiency. Therefore the study recommends that credit should be made available at terms and times convenient to farmers to enhance their level of economic efficiency. Farmers should also form cooperative societies to enable them have access to productive inputs to aid large scale operation. There is need to create awareness for the women farmers to know the profit potentials of layer production so that they could be encouraged to undertake the enterprise.
Key words: stochastic frontier, normalized profit, economic efficiency profitability, efficiency.

Introduction
Agribusiness enterprises in developing economies face the challenges of limited resources, low technology and inelastic demand for its products. Since producers have more control over inputs rather than output levels, cost reduction in input usage becomes a better means of increasing profitability and productivity than output growth (Adepoju, 2008). Economic Efficiency is therefore described as a major driver of productivity growth and competitiveness. Efficiency of agribusiness enterprises is considered essential in achieving sustainable economic growth and significant level of food security. The gaps in growth resulting from inefficiency are usually bridged through policy interventions and relevant programmes to enable entrepreneurs attain maximum outputs with available inputs with a view to maximizing profit (Adepoju, 2008).

The livestock sector, with the poultry subsector being a major contributor is vital to the socio-economic development of Nigeria. The sector contributes about 9-10% of agricultural GDP (FAO, 2006). The business of poultry farming comprises chickens, turkeys, geese, ducks, quail and guinea fowls. The major poultry products are eggs and meat. Ohajianya and Onyeweaku, (2001) asserted that poultry has a shorter life cycle and therefore more prolific than other livestock. Also it provides quick employment opportunities, reduces poverty through income generation while products from this sub-sector provide direct cash and other sources of livelihood as well as a source of organic manure. In recognition of the importance of poultry industry and table egg in particular, successive governments in Nigeria have sought to rejuvenate the subsector since the late 1990s by investing in research and development projects.
Livestock industry in Nigeria falls short of its aim of self-sufficiency in animal protein consumption which is put at 5gm/caput per day which is far cry from F.A.O recommended level

of 35gm/caput per day (Ojo, 2005). This has been attributed largely to high cost of feeds which constitutes about 50 per cent of total production cost (Ojo and Ajibefun, 2000; Udom, 2003).

Poultry is a collective term for all *Avian* species nutritionally and economically useful to man (Tijani *et al.*, 2006). The most important poultry species remains the domestic fowl commonly called chickens, 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.

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 (Onu *et al*, 2017). 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 makeup 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).

More so, Okike (2009) observed that the potential for egg consumption was enormous in the country but most people eat less than 40 eggs in a year. He argued that if the farmers can produce at affordable prices, the consumption rate will rise and called on the government to rise to create the enabling environment that would help the farmers reduce their production cost. Ebong (2007) and Uchendu (2008) identified the problem of low or inadequate skills, knowledge, and non-scientific approaches to agricultural production as major impediments to agricultural productivity in Nigeria. They attributed the persistent low productivity to inefficient use of resources and poor managerial skills despite efforts by Nigerian Agricultural Research Institutes to make available improved crop varieties and breeds of livestock and technologies to farmers who find it difficult to understand, patronize and apply the technological innovations.

Many authors have also reported that farmers in developing countries fail to explore the full potential of technology and make allocative errors (Simonyan and Onu, 2018, Onu and Echebiri 2017, IWMI, 2002; and IRRI, 2010). According to the Resources Inventory and Management Limited (RIM, 1992), the inability of Nigeria to meet production targets to the fact that Livestock industry is dominated by poor-resource farmers who have very low level of education, poor capital base and inability to manage resources efficiently. Afolabi, (2012) and Adepoju (2008) reported that poultry industry has performed below expectation in recent times. They attributed this development to inefficiency in resource use. They also described the business environment of egg producing enterprises as hostile due to: high cost of feed, poor management, diseases and pests, poor extension and training facilities, marketing problems, lack of credit facilities, poor logistics and lack of regulatory institutions to ensure that farmers comply with established rules for quality, products safety and standard

Abia State has a comparative advantage in poultry production and exports poultry products especially table egg to neighboring States like Enugu, Imo, Akwa Ibom and Cross River. (Abia State State Year Book, 2001). However, there is dearth of information on the economic efficiency in table egg agribusiness enterprises in the State, yet, information on this is very critical to achieving a highly efficient and competitive table egg business in the State, hence the need for this research. The broad objective of this study was to analyze the economic efficiency in table-egg agribusiness enterprises in Abia State. The specific objectives were to: 1. describe the socioeconomic characteristics of table egg entrepreneurs in Abia State, 2. analyze the level of economic efficiency in table-egg production and 3.examine the determinants of economic efficiency in table egg production in the State.

Theoretical Framework on Stochastic Frontier Production and Profit Functions

Economic efficiency is concerned with the relative performance of the process used in transforming inputs into output. The concept of efficiency goes back to the pioneering work of (Farell, 1957) who distinguishes between three types of efficiencies: (i) Technical efficiency (TE), (ii) Allocative or price efficiency (AE); and (iii) Economic efficiency (EE). Technical efficiency in production is the physical ratio of product output to the factor input, the greater the ratio, the greater the magnitude of technical efficiency. The overall measure of technical efficiency can be desegregated into three components: (1) pure technical efficiency (PTE) due to production within an isoquant frontier; (2) congestion due to over-utilization of inputs, and (3) scale efficiency, due to deviations from constant returns to scale (Worthington. and Dollery, 2000). Allocative efficiency is concerned with choosing optimal sets of inputs. A firm is allocatively efficient when production occurs at a point where the marginal value product is equal to the marginal factor cost. Economic efficiency is a situation where there are both technical and allocative efficiencies (Coelli, 1996).

The stochastic production frontier models proposed by Aigner *et al*. (1977) were used in this study. Considering a farmer using inputs $X_1, X_2, ..., X_n$ to produce output Y, efficient transformation of inputs into output is characterized by the production function f(X) which shows the maximum output obtainable from various input vectors. This approach is favoured, because, it accounts for the presence of measurement error in the specification and estimation of the frontier production function, in that, the former consists of two error terms.

The stochastic frontier production function is defined as:

$Y_i = f(x_i, \beta) \exp(V_i - U_i)$, i =1, 2…n ……………………………………………………………….. (1)

Where; Y_i = production of the i^{th} farm

X_i = vector of input quantities of the i^{th} farm

β = vector of unknown parameters of the i^{th} farm

V_i = random errors associated with random factors not under the control of farmers e.g weather and diseases

U_i = inefficiency effects (one-sided error with $U \geq 0$) i.e. $U_{i's}$ are non- negative associated with technical

Inefficiency in production.

$V_i - U_i$ = composite error term

The model simultaneously estimates the individual technical efficiency of respondents as well as determinants of technical efficiency. The estimation of stochastic frontier production makes it possible to find out whether the deviation in technical efficiencies from the frontier output is due to firm specific factors or due to external random factors. It provides estimates for the technical efficiency by specifying composite error formulations to the conventional production functions (Coelli, 1995; Battesse and Coelli, 1995). In this context, technical efficiency of an individual farmer is defined as the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by the farmer. The technical efficiency of farmer (i) in the context of the stochastic production function in equation (1) is given as:

TE $= Yi/Yi^*$ ……………………….…………….………..(2)

$= f(X_i; \beta) \exp(V_i - U_i)/f(X_i; \beta) \exp(V_i)$…………………………………………………………..(3)

Where: Yi = Observed value of output, Yi* = Frontier output (or potential output and other variables are as previously defined.

Note that the value of technical efficiency lies between zero and one. The most efficient farm will have value of one whereas the less efficient farm will have their efficiencies lying between zero and one. The parameters of the stochastic frontier production function model were estimated by the method of maximum likelihood using the computer program Frontier version 4.1(Coelli, 1994). A profit function relates maximum profits to the prices of product(s) and input(s) as to other exogenous variables such as fixed inputs or agro-climatic and social variables. The parameters of profit function contain all the information about the underlying production functions. It is more convenient to start model building from the profit function side. More so, some of the independent variables may be so highly correlated as to cause multicolinearity when a production function approach is used but of least significant when profit function approach is employed. It is quite difficult to derive the input demand and product supply functions from the fitted production function. On the contrary, the use of Shepherd’s lemma, helps in obtaining such estimations with relative ease when a profit function approach is used, because, it is virtually difficult to mix up endogenous and exogenous variables compared to say the cost function approach. But under certain conditions, a profit or cost function corresponds uniquely to a given production function. Fraser and Graham (2005) emphasized that the duality theory contributes immensely in providing a richer specification of production relationships than the traditionally popular production functions. (e.g. the Cobb-Douglas and Constant Elasticity of Substitution (CES) functions).

Derivation of a Profit Function from a Production Function

Let there be a production function where m variable inputs, $X_1, X_2, \ldots, Xm$ and n fixed inputs. $Z_1, Z_2 \ldots Z_n$ are related to output Y. ie.

$$Y = f(X_1, X_2 \ldots Xm; Z_1, Z_2, \ldots Z_n) \quad \ldots\ldots (4)$$

In the short run, the opportunity cost of fixed inputs is zero. The producer needs only to maximize the returns to variable inputs called variable costs. In essence, the resulting returns or variable profits (π') to fixed inputs in respect of the production function in equation (4) can be written thus:

$$\pi' = P_y.f(X_1, X_2 \ldots X^*m; Z_1, Z_2 \ldots Zn) - \sum_{i=1}^{m} P_i X_i^* \quad \ldots\ldots (5)$$

Where:

P_y = output price, P_i = per unit price of the i^{th} variable input and i = 1,2,….m.

For maximization of profit (π') in the short run, we take the first partial derivative with respect to the variable inputs and equate them to zero each in turn. Thus, the partial derivative with respect to X_i, i=1, 2,...,m from equation(5) is given by:

$$\frac{\partial \pi'}{\partial X_i} = P_y fi = P_i \quad \ldots\ldots (6)$$

Where; fi denotes the first partial derivative with respect to the i^{th} input. Since from equation (5), $f(X_1, X_2, \ldots, Xm)$ is equal to Y, equation (6) can thus be written as:

$$Py \,.\, \partial y/\partial xi = Pi \text{ or } \partial y/\partial Xi = P^i/py, \; i=1,2,\ldots,m. \quad \ldots\ldots (7)$$

There would thus be "m" simultaneous equations in "m" unknowns which can be solved to obtain the optimum input quantities.

X_i^*, where i = 1,2, …………m given by:

$$X_i^* = X_i^* (Py, P_1, P_2, \ldots, Pm; Z_1, Z_2 \ldots, Zn) \quad \ldots\ldots (8)$$

Equation (8) thus gives the demand function for the i^{th} variable input. Substituting the demand function given by equation (8) in equation (7);

$$\pi'^* = Py.f(X_1^*, X_2^*, \ldots, X^*m; Z1, Z_2, \ldots, Z_n) - \sum_{i=1}^{m} P_1 X_1^* \quad \ldots\ldots (9)$$

Where:

X_1^*(i=1,2,…,m) = is the optimum quantity of the i^{th} variable input and π'^*= corresponds to the amount of maximum variable profits.

In essence, π'^* in equation (9) is expressed as a function of the prices of output and variable inputs and the fixed input quantities which is the profit function.

Thus:

$$\pi'^* = \pi'^* (Py, P_1, P_2 \ldots Pm; Z_1, Z_1 \ldots Zn) \quad \ldots\ldots (10)$$

In this study, a modified form of this function called the normalized profit function which has proved handier from the theoretical and econometric point of view as it reduces the number of explanatory variables to one and provides a wider choice of the functional form was adopted.

Normalized Profit Function

The normalized profit function is related to relative input prices unlike the profit function which is related to the actual prices of inputs and price of the output, thus, equation (4) is transformed into:

$$\pi / P_y = \pi' = f(X_1, X_2 \ldots, Xm; Z_1, Z_2 \ldots Z_n) - 1/P_y \sum_{i=1}^{m} P_i X_i \quad \ldots\ldots (11)$$

If r_i is substituted for P_i/P_y, $i=1,2,\ldots,m$, then (eqn. 11) can be written as:

$$\pi/Py = \pi' = f(X_1, X_2 \ldots Xm; Z_1, Z_2 \ldots Zn) - \sum_{i=1}^{m} r_i X_i \quad \ldots\ldots (12)$$

Note that profit (π') in equation (11) and (12) is the normalized profit which is related to input prices unlike the profit function which is related to the actual prices of inputs and the price of the output. We can as well obtain the variable factor demand equations from equation (11) where relative prices are used. Such demand equations when substituted in equation (11) results in the normalized profit function as follows;

$$\pi^* = \pi^* (r_1, r_2, \ldots rm, Z_1, Z_2, \ldots, Zn) \quad \ldots\ldots (13)$$

Materials and Methods

Study area

The study was carried out in Umuahia agricultural zone of Abia State. Umuahia agricultural zone is located in Abia state, Southeast of Nigeria. The zone is between longitudes 7^0 23′ and 8^0 02′ East of Greenwich meridian and latitudes 5^0 49′ and 6^0 92′ north of the Equator. The population of the zone is 1,913,917 (NPC 2006). The zone is made up of five local government areas namely; Isiala Ngwa north, Isiala Ngwa South, Umuahia North, Umuahia South and Ikwuano. The area has dense equatorial vegetation characterized by thick forest, the soil is subjected to erosion and leaching with annual temperature of between 20^0C - 30^0C and rainfall ranging from 200mm-300mm (Opara, 2004).

There are two distinct seasons; rainy season which starts in March and ends in October while dry season starts in November and ends in March. The major food and cash crops produced in the area includes cassava, maize, melon, banana, oil palm, orange, mango, cowpeas. The animals reared at both subsistence and commercial levels are goats, sheep, pig, poultry and sometimes cow.

The farmers of the zone also engage in other off-farm and non-farm activities like trading, civil service, welding, saloon business, baking, and transport business among others

Sampling Technique

The study was based on primary data elicited from respondents using structured questionnaire administered to egg producers. The multistage random sampling technique was used in the selection of respondents. The three agricultural zones of the state which reflect the demarcation structure were covered. In the first stage, two Local Government Areas (LGAs) were purposively selected based on the preponderance of poultry production activities from each of the zones. The second stage involves the choosing of 2 poultry producing villages, giving a total of 12 villages. In the third stage, twenty (20) layer producers were randomly selected from each of the 12 villages. This gave a total of 240 egg producers. Well trained enumerators as well as agricultural extension agents residing in each of the villages in the study area assisted the researcher in data collection.

Methods of Data Analysis

The stochastic frontier normalized profit function was used in the analysis of data. It was used to empirically determine the economic efficiency in resource utilization of the broiler and layer enterprises respectively.

Empirical Model for Economic Efficiency in Layer Enterprise

Following Effiong, (2004), the stochastic frontier normalized profit function model used is explicitly specified as:

$In\pi^*B = In\beta_o^* + \beta_1^* Inq_1 + \beta_2^* Inq_2 + \beta_3^* Inq_3 + \beta_4^* Inq_4 + \beta_5^* Inq_5 + \beta_6^* Inq_6 + \beta_7^* Inq_7 + \beta_8^* Inq_8 + V_i - U_i$ .... (14)

Where,

π^*_B = Normalized profit (in ₦ per broiler enterprise)

q_1 = Normalized price of family labour, (₦/manday)

q_2 = Normalized price of hired labour, (₦/manday)

q_3 = Normalized price of feed and feed supplements in (₦)

q_4 = Normalized price of veterinary and medical services (₦)

q_5 = Normalized price of capital inputs (₦)

q_6 = Normalized price of foundation stock (day old chicks purchase) (₦)

q_7 = Farm size (No. of birds)

q_8 = Annual depreciation on durable capital items (₦)

V_i = Normal random errors which are assumed to be independent and identically distributed having N $\{0,\delta^2\}$.

U_i = Non-negative random variables associated with the technical inefficiency of the entrepreneur. It is assumed that the technical efficiency effects are independently distributed and arise by truncation at (zero) of the normal distribution with mean U_i and variance δ^2, where U_i (for this and the subsequent models) is specified as:

$U_i = \delta_o + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} + \delta_6 Z_{6i} + \delta_7 Z_{7i} + \delta_8 Z_{8i}$ ………………………………..… (15)

Where;

U_i =Technical inefficiency of the i^{th} farmer

Z_1 = Age of farmer (years)

Z_2 = Level of education (No. of years spent in school)

Z_3 = Farming experience (years)

Z_4 = Household size (No.)

Z_5 = Extension contact (No.)

Z_6 = Credit status (Dummy variable, 1 for access, zero otherwise)

Z_7 = Membership of cooperative (1 for membership, zero otherwise)

Z_8 = Sex (binary variable, Male = 1, female = 2)

The above model was incorporated in the frontier model in determining the economic inefficiency of egg production enterprise. This was done with the belief that the variables have direct influence on the level of efficiency (Battesse *et al.* 1993 and Kalirajan and Shand, 1994).

RESULTS AND DISCUSSION

Socio-economic characteristics

Some selected socio-economic characteristics of layer farmers are presented in Table 1

Table 1. Socio-economic characteristics of layer farmers

Socioeconomic characteristics	Frequency	Percentage
Gender		
Male	172	71.66
Female	68	23.33
Age		
≤ 20	0	0.00
21 – 30	52	21.67
31 – 40	84	35.00
41 – 50	68	28.33
> 50	36	15.00
Mean	41.19	
Year of experience		
1 – 10	42	17.50
11 – 20	68	28.33
21 – 30	74	30.83
31 – 40	44	18.33
> 40	12	5.00
Mean	21.99	
Marital Status		
Single	90	37.50
Married	144	60.00
Widowed	6	2.50
Level of education		
No formal Education	40	16.67
Primary school	98	40.83
Secondary school	78	32.50
Tertiary	24	10.00
Household size		
1-3	14	5.83
4-6	54	22.50
7-9	62	25.83
10-12	56	23.33
> 8	54	22.50
Mean:	**7**	

Source: field Survey Data, 2018

Result in Table1 shows that there is a gender inequality involvement of layer farmers in the study area, with male and female scoring 71.66% and 23.33% respectively. Also majority of the layer (egg) farmers (35.00%) fell within the age limits of 31-40 years. The mean age of the farmers was 41.19 years. By implication, most of the farmers were within the middle age groups, energetic, productive and rational decision makers within the community. The mean age indicates that the poultry farmers were middle-aged farmers who according to Ohajianya and Onyenweaku (2001), 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 farmers (30.83%) had between 21-30 years of farming experiences. This is a clear indication that layer (egg) farmers had enough farming experiences that could improve poultry production in the study area. The mean years of farming experience for layer (egg) farmers was 21.99 years. Okoye *et al.* (2008) 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. However, 60.00% of the layer farmers were married. The result implies that majority of the layer 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 farmers (83.33%) were literate. The literacy status of the layer (egg) farmers was encouraging and this facilitates access and utilization of modern poultry farm inputs. This is possible because Echebiri (2004) 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 layer hen farmers had between 7 and 9 persons per household. The mean household size for layer (egg) farmers was 7 persons. The composition of the household plays a crucial role in agricultural production.

Summary Statistics of Production Factors

Production factors are statistically summarized and presented in Table 2

Table 2: Summary Statistics of Output and Inputs in Egg Production enterprise

Variable	Mean	Min	Max
Output	2637.17	344.00	14318.00
Hired Lab	89.13	0.00	341.00
Family Lab	162.27	0.00	379.00
Feeds	88.23	72.00	100.00
Vet Service	2508.92	9400.00	27800.00
Birds	105741.67	112500.00	270000.00
Transport	2995.50	0.00	16700.00
Capital	51954.86	30010.00	78450.00

Source: Field survey data, 2018

The summary statistics of input utilized and outputs realized are presented in Table 2. Results showed that a typical table egg farmer produced an average of 2,637.17 crates of egg utilizing 89.13 mandays of hired labour, 162.7 Mandays of family labour, 88.23kg of feeds, expended ₦25,208.92 on veterinary service and medication, ₦105,741.67 on purchase of foundation stock, ₦2,995.50 on transportation and ₦51,954.86 on capital inputs per production cycle. The results showed that for each of the inputs, the average used in production is more for the layer enterprise as compared to the broiler enterprise. This is due to the long production cycle in layer enterprise.

Empirical results of the economic efficiency for the production factors

The result of the Maximum Liklihood Estimates of economic efficiency of layer production is presented in Table 3

Table 3: Maximum Likelihood Estimates of parameters of the stochastic frontier production function for the measurement of economic efficiency

Variables	Parameters	Coefficient
Constant	β_0	-1.2255(-2.3825)
Normalized price of family labour	β_1	0.1206(3.0205)***
Normalized price of hired labour	β_2	0.1158(2.7377)***
Normalized price of feeds	β_3	0.1207(2.1115)**
Normalized price of medication	β_4	0.0343(0.6841)
Normalized price of capital inputs	β_5	0.2265(2.6301)***
Normalized price of stock	β_6	0.2222(3.8060)***
Farm size	β_7	0.5360(6.1293)***
Annual depreciation	β_8	-0.1549(-1.8209)*
Diagnostic statistics		
Log-likelihood function		-34.9286
Sigma squared (σ^2)		1.1254(4.3723)***
Gamma (γ)		0.9866(122.9109)***
L-R test		74.1825

Source: Field survey data, 2018

Note: ***, **, and * implies statistical significance at the 0.01, 0.05 and 0.10 probability levels respectively. Values in parenthesis are the t-ratio.

Table 3 shows the results of stochastic frontier normalized profit function for the economic efficiency of egg production enterprise The estimates of sigma-squared (σ^2) for layer functions is 4.3723 it is significant at the 0.01 probability levels indicating that it is 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) is high 0.9866 and showed that the unexplained variation in output layer birds is the major sources of random errors. It also indicates that about 99 percent of the variation in output of 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 the MLE estimate of normalized price of family labour 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 profit. The MLE estimate of the normalized price of hired labour of egg enterprise is 0.1158 and is also significant at the 0.01 probability level. This implies that if labour employment is increase by 1% profit will increase by 0.1158% in layer enterprises holding other variables constant. The coefficient of normalized price 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 normalized price of capital inputs in egg enterprise is 0.2265 and is significant at the 1% level. It implies that if the use of capital inputs is increased by 1%, profit will increase by 0.2265% holding other variables constant. The normalized price of foundation stock was 0.2222 and significant at 1% level implying that profit 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 and significant. A coefficient of 0.5360 and significant at the 1% level implies that if farm size is increased by 1%, profit will increase by 0.5360 holding other variables constant. In layer production, the coefficient of annual depreciation on durable capital items -0.1549 and significant at 10% level implies that a 1% increase in the use of durable capital items will lead to a decrease of in profit by 0.1549% holding other variables constant. Tijani *et al*. (2006) in the study of profit efficiency among poultry egg farmers in Nigeria reported the significance of labour and farm size on output. They however found that labour reduced profit.

Determinants of economic inefficiency

The result of the determinants of economic efficiency is presented in Table 4.

Table 4: Determinants of economic inefficiency for egg enterprises

Variables	**Parameters**	**Coefficient**	**t-ratio**
Constant	δ_0	0.2576	1.4617
Age of farmer	δ_1	-0.0369	-7.5488***
Level of education	δ_2	0.0007	0.1031
Farming experience	δ_3	-0.0089	-1.2813
Household size	δ_4	0.0661	9.1893***
Extension contact	δ_5	0.0247	1.0388
Credit status	δ_6	0.4922	6.1584***
Membership of coop	δ_7	-0.4320	-5.0640***
Gender	δ_8	-0.1040	1.1829

Source: Field survey data, 2018

Note: ***, **, and * implies statistical significance at the 0.01, 0.05 and 0.10 probability levels respectively.

The results in Table 4 indicated that Credit status (Z_6) was found to be positive and significant at the 0.01 probability level. This indicates that access to credit increased economic inefficiency in egg production enterprises. Age of farmer (Z_1) was found to be negative and significant. This implies that as the age of farmer increases economic inefficiency in egg production. Household size (Z_4) was found to be positive and significant at the 1% level. This signifies that the higher the household size, the lower the economic inefficiency of the layer production enterprise. Membership of cooperative society (Z_7) is negative and significant at 1% level. This implies that membership of cooperative organization increases the economic inefficiency of the egg farmer in the study area.

Distribution of Economic Efficiency

The distribution of respondents according to their economic efficiency in production is shown in Table 5.

Table 5: Frequency distribution of the range of economic efficiency

Range	Frequency	Percentage
0.01 – 0.20	8	3.33
0.21 – 0.40	14	5.83
0.41 – 0.60	28	11.67
0.61 – 0.80	82	34.17
0.81 – 1.00	108	45.00
Total	240	100.00
Mean	0.75	
Minimum	0.04	
Maximum	0.96	
Mean of worst 10	0.24	
Mean of best 10	0.94	

Source: Field survey data, 2018

The results indicated that the mean economic efficiency of egg production enterprise is 75%. This average value implies that the average egg farmer could increase economic efficiency by 25% by improving their technical and allocative efficiency. The economic efficiency of egg farmers ranged from 0.01-0.96. Egg farmers have the minimum economic efficiency of 0.04 and the maximum of 0.96. The means for the best 10 and worst 10 for the farmers are 0.24 and 0.94 respectively. This means that for an average farmer in the sample to achieve the economic efficiency of its efficient counterpart, the typical farmer could realize about 25% cost saving [i.e., 1-(0.75/0.96)*100]. The worst economically inefficient 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 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 economically efficient farmers operated almost on the frontier, as depicted by the maximum economic efficiency of 0.96. However, there exist a gap between economic efficiency levels of best ten and worst ten farmers. To bridge this gap, the average best farmer needs to save 25% costs to attain to the frontier for layer enterprise. This is in contrast with the findings of Tijani *et al*. (2006) who found the mean economic efficiency of egg farmers to be 84.34% and affirmed that about 15.66% of the profit is lost due to economic inefficiency.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this research, it is concluded that table egg farming in Abia state is of the small scale type considering the number of birds raised by the 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 table egg production and/or their lack of awareness on the profit potentials of layer production. The farmers are not fully economically efficient in their use of productive resources. The varied economic efficiency of egg farmer is due to the presence of inefficiency effects. The mean efficiency of layer farmers showed that they are fairly economically efficient.

However, an important conclusion stemming from the analysis is that overall economic efficiency of layer farms could could still be improved. Economic efficiency is negatively influenced by age of farmers and membership of cooperative while credit status reduced economic inefficiency.

This study recommends that to expand layer 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. 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 layer production so that they could be encouraged to undertake the enterprise.

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