https://doi.org/10.61090/aksujaeerd.2024.001 ISSN: 2736-0040 (Online)
ISSN: 2695-1975 (Print)
AKSUJAEERD 7 (1): 1 – 11, 2024 AKSU Journal of Agricultural Economics, Extension and Rural Development.

TECHNICAL EFFICIENCY OF LAYER FARMERS IN AKWA IBOM STATE, NIGERIA

Bassey, Iniobong Ibanga[1], Okon, Ubokudom Etim[1] & Akpan, Sunday Brownson[1]
[1]Department of Agricultural Economics and Extension, Akwa Ibom State University, Obio Akpa Campus
*Corresponding Author: inibas56@gmail.com

Abstract
This study analyzed the technical efficiency of layer farmers in Akwa Ibom State, Nigeria. A multistage random sampling technique was employed to select a total of 100-layer farmers across three agricultural zones in Akwa Ibom State. Relevant data was collected with the aid of a questionnaire. Data collated from the field was analyzed using descriptive statistics, stochastic production frontier, and maximum likelihood estimates. The result showed that most of the farmers were female, with mean age of 36.68 years for layer farmers. The production function estimate showed that hired labour, feeds, capital depreciation, pen size, and saw dust use positively influenced output of layer birds, while family labour and medication had a negative impact on output. The technical efficiency distribution showed a mean efficiency of 66%. The determinants of technical inefficiency showed that education, family size, market share, farming experience, extension visits, trainings, farm size and membership in social groups had negative influence of technical inefficiency of layer production, and farmers age and access to credit had a positive effect on the technical inefficiency of layer production. The study recommends the government and relevant stakeholders should make efforts to subsidize the cost of essential poultry inputs, and develop a workable system to enable poultry farmers access credit. Also, extension training should be intensified as it is shown to improve the technical efficiency of layer farmers.
Keywords: *stochastic production frontier, poultry farmers, production function*

Introduction
Poultry farms, which are a subset of the livestock industry, rear chickens (including layers, broilers, and cockerels), ducks, turkeys, and other birds for the production of meat and eggs (Adegbite and Alawode 2020, Chege 2014). Historically, poultry farming involved raising chickens primarily on agricultural farms or in backyard settings for daily egg production and family consumption. However, modern poultry farming has evolved into a significant enterprise comprising various operations such as hatcheries, poultry services, veterinary services, suppliers of inputs, and farms specializing in raising pullets for meat and egg production (Adegbite and Alawode 2020; Fadeyi 2018). The poultry industry in Nigeria is currently comprised of approximately 180 million birds, with layers representing 30% and broilers 70% of the total (FAOSTAT 2020). The nation boasts the second-largest chicken population in Africa, following South Africa (SAHEL, 2015). Nigeria produced 640,000 tons of chicken eggs and 239, 947 tons of Chicken meat in 2019 (FAOSTAT, 2020). Available statistics showed that, about 80 million, 60 million, and 40 million chickens are raised using extensive systems, semi-intensive systems, and intensive systems respectively (African Sustainable Livestock, 2018).

The poultry industry is a fast-growing private driven sector which currently worth over ₦10 trillion and contributing over 25% to Agricultural Gross Domestic Product (GDP) of the National Economy (African Sustainable Livestock, 2018). The sector has provided families in Nigeria with cheap source of protein and over 20 million direct and indirect employments (ASL, 2018). Hartwich et al. (2010) and Adeyemi (2011) noted that commercial farming has emerged recently due to market opportunities resulting from shifts in government policies affecting grain, starch, animal feed, poultry, fish, fruits, vegetables, and other sectors. They also highlighted that many medium to large-scale agricultural ventures are

not initiated by traditional sector entrepreneurs but represent investment strategies of established business owners from other sectors aiming to provide local substitutes and ensure raw material quality and quantity through vertical integration (Adeyemi, 2011). Conversely, poultry farming has evolved significantly from traditional free-range methods to modern intensive commercial practices. The country's prohibition on poultry product imports, evolving consumer preferences, and rising incomes have propelled this sub-sector forward, although the high cost of feed remains a major challenge (Owoade, 2019).

According to the FAO (2022), the trend in egg production expressed in tons is shown in Figure 1.1. The graph revealed undulating production histories with conspicuous multi-peaks and troughs. The graph showed a relatively steady rise in egg production from the 1960's to the close of the 1980's, falling a little short of 300,000 tons in production. Production declined briefly and rose to about 420,000 tons in the 1990's and then suffered a steep drop from the mid 90's to the end of the decade, reaching a low point of about 280,000 tons. The industry started showing signs of recovery in the early 2000's to above 400,000 tons in production. The graph then showed a progressive increasing trend to 2010 with production rate above 600,000 tons, with an undulating trend till 2020. This connotes that, egg production has not been consistent across the years.

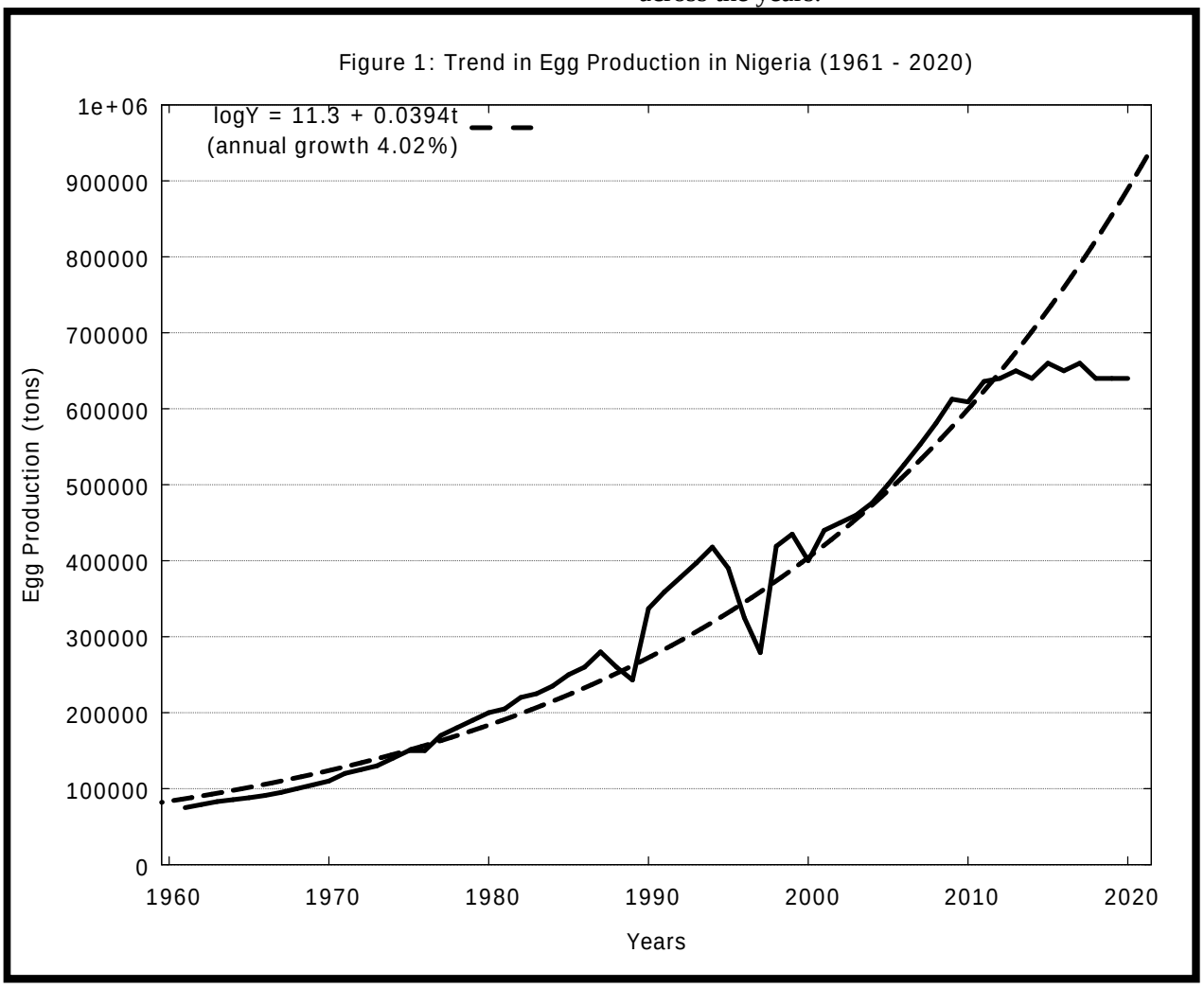

Figure 1.1: Trend in egg production in Nigeria (1961-2020). Data from FAO (2022).

Though the poultry business being a very lucrative and fast-growing business in this part of the world, farmers are still struggling on gaining footing as a result of lack of technical know-how, risk analysis, poor managerial skills, little or no counsel/guidance from experts, and high cost of inputs which has limited their ability to maximize their profits and technical efficiencies leading to loss and quitting from the business (Ohajiaya *et al.*, 2013). Most measures adopted by farmers and even government are geared towards increasing production without considering the efficiency and productivity of the sector, (Oyinbo *et al.*, 2015).

There is however little or no information on the technical efficiency of layer farmers in the Akwa Ibom State. The few information available need to be updated following major shake-up of the economy system. Therefore, this study seeks to bridge that gap by analyzing the technical efficiency of layer farmers in Akwa Ibom State. This will bring fresh insight to the efficiency levels of layer farmers in the South-south zone of Nigeria and also contribute to existing studies.

Conceptual Framework

The study delves into assessing farms' technical efficiency derived from the production frontier, as outlined by Farrell (1957). Technical efficiency denotes a farm's capacity to achieve maximum output with a given input mix. A farm is deemed technically efficient when it operates on the production frontier, while a technically inefficient one operates below this frontier. The positioning of individual farms concerning the efficiency frontier is influenced by diverse factors, including farmers' socio-economic features, climatic conditions, and edaphic factors (Sail, 1997, Hoppe et al., 2001, Akpan et al., 2019). The production frontier concept assumes that the production function's boundary is defined by "best practice" farms, indicating the utmost potential output for a specific input set. The disparity between observed and potential output typically arises from a blend of inefficiency and random error. Mathematically, Farrell's production frontier function commences by considering stochastic production with a multiplicative disturbance term as follows:

$$Yj = f(Xj;\beta)eE \quad \text{……..……..(1)}$$

Where $Y\ j\ is$ output; $Xj$is a vector of input, β is a vector of the parameter, e = error term while E is stochastic disturbance term consisting of two independent elements "V" and "U".

Hence, $E = U + V$ ……(2)

Following the definition in equation 2, equation 1 can be written as:

$$Yj = f(\ Xj;\ \beta)exp(V\ j + Uj)\text{…….(3)}$$

Where Vj represents the stochastic error term and Uj the one-sided error depicting the technical inefficiency of firm j. Technical efficiency (TE) of a firm using SPF is given as

$$TE = \frac{Y_i}{Y_i^*} = \frac{Observed\ output}{Frontier\ output} = \frac{f(X_j - \beta)exp(V_j - U_j)}{f(X_j - \beta)exp(V_j)} = exp(-U_j)\text{……..4}$$

Random variations in output ascribed to causes outside the farmer's control are taken into consideration by the variable V. Technical inefficiency is indicated by a one-sided component $U \geq 0$. Consequently, the farm's production is placed on the efficiency frontier (i.e., 100% technical efficiency) when U = 0, which denotes zero technical inefficiency for the farm. On the other hand, if U > 0, the farm's output is below the efficient frontier. It is assumed that V and U have zero means and constant variances, and that they are both independent and normally distributed. Given the prices of variable inputs and the amount of fixed production elements, the technical efficiency of a particular farmer is thus defined as the ratio of observed output to corresponding frontier output.

Materials/Methods

Study Area

This study was carried out in Akwa Ibom State located in the Niger Delta region of Nigeria. With a population of 5,482,177 (National Population Commission, 2016) and a land area of 6,900 km^2, it lies between latitudes 4^{0}32'N and5^{0}33'N and longitudes 7^{0}25'E and 8^{0}25'E. The climate is categorised as tropical, with

heavy rains falling on most months and a brief dry season. A mean annual temperature is 25.7 °C. The area receives about 3033 mm of rainfall annually (Climate Data, 2021). The Atlantic Ocean borders it on the south, Rivers State and Abia State on the west, and Cross River State on the east. It is currently the largest oil-producing state in Nigeria (NBS, 2017). The vegetation is characterized by three easily distinguishable types namely, the saline water swamp forest, the freshwater swamp and the rainforest. Agricultural practice is predominant, supporting about 75% of the rural households' income. The various agricultural products available in the State includes oil palm, cassava, yam, plantain, cocoyam, maize, rice, rubber, sea foods such as varieties of fish, shrimps, crayfish, oysters, poultry eggs and meats, pork and lately snailery among others.

Study Population, Sampling Technique, Sample Size and Instrument of Data Collection

The research utilized cross-sectional data collected from layer farmers in Akwa Ibom State, Nigeria. A two-stage sampling approach was employed for the study. Initially, three Local Government Areas (LGAs) were purposively selected from Akwa Ibom State's three senatorial districts—Uyo, Ikot Ekpene, and Eket—due to their significant involvement in poultry production. Subsequently, following the formula proposed by Yamane (1967), the sample size required for the study was determined using the equation presented in equation 3.1 as follows:

$$n = \frac{N}{1 + N(e)^2} \ldots\ldots\ldots\ldots\ldots (3.1)$$

Where,
n = sample size
N = finite population size
e = level of precision defined at 10% significant level (i.e. 90% confidence interval)
From the three (3) selected local government areas, the total sample or sample frame population is given as 1000poultry farmers. A total of one hundred (100) layer farmers was obtained; 45 farmers from Uyo, 42 farmers from Abak and 13 farmers from Mkpat Enin. Structured questionnaires were distributed to respondents, and these were supplemented with personal interviews to guarantee the coherence and precision of the collected data.

Analytical Techniques

Descriptive statistics were employed to analyze the socio-economic characteristics of the layer farmers. Additionally, the stochastic production frontier method was utilized to calculate the technical efficiency indices of the layer farmers. The frontier 4.1 software was used to estimate the production function and the determinants of the technical inefficiency simultaneously.

Explicitly, the Cobb-Douglas production function is specified as thus:

LAY=f (PEN, HHL, HIL, FED, VAS, CAP, SAD)……. (3.2)

Note that the variables are expressed in logarithms.

Implicitly, it is shown as thus:

$$/LogLAY = \delta_0 + \delta_1 LogPEN + \delta_2 LogHHL + \delta_3 LogHIL + \delta_4 LogFED + \delta_5 LogVAS + \delta_6 LogCAP + \delta_7 LogSAD + (V_1 - U_1) \ldots\ldots (3.3)$$

Where,
LAY = Quantity of egg measured in (kg)
PEN = Pen size as a proxy of land measured in meter squared (m^2)
HHL = Household labour used throughout the production cycle (man-days)
HIL = Hired labour used throughout the production cycle (man-days)
FED = Quantity of Feed used throughout the production cycle (Kg)
VAS = Quantity of drugs used throughout the production cycle (litres)
CAP = Depreciation value of farm asset as a proxy of farm capital (Naira)
SAD = Quantity of sawdust used throughout the production cycle (kg)
(Vi –Ui) = Composite error term
The model defining determinants of technical efficiency of layer farmers in the study area is implicitly specified as thus:

$$TIE = \beta_0 + \beta_1 AGE + \beta_2 EDU + \beta_3 GEN + \beta_4 EXP + \beta_5 HHS + \beta_6 FAS + \beta_7 SOC + \beta_8 TRA + \beta_9 EXT + \beta_{10} CRE + \beta_3 MAS + u_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

Where,
TIE = Technical inefficiency of layer birds production
AGE = Age of the poultry farmers (years)
EDU = Education level of the poultry farmer in years
GEN = Gender of the poultry farmer (dummy 1 for female farmers and 0 for male farmers)
EXP = Farming experience of the poultry farmer (years)
HHS = Household size of the poultry farmer (Number)
FAS = Poultry farmer farm size (Number of birds)
SOC = Membership in a social organization (Number of years)
TRA = Number of training attended by the poultry farmers (number)
EXT = Access to extension services (number of times)
CRE = Volume of credit accessed by the poultry farmer (naira)
MAS = Market share of the poultry farmer (defined as the number of stock sold divided by the total stock of the farm for broiler enterprise; For layer enterprises, market share represent the total number of egg sold divided by the total produced)

Results and Discussion

Socio-economic characteristics of layer farmers in Akwa Ibom State

The socio-economic characteristics of layer farmers in the study area are presented in Table 1a and Table 1b.

Table 1a: Socio-economic Characteristics of Layer Farmers in Akwa Ibom State

Variables	Frequency	Percentage	Mean
Gender (Number)			
Male	46	46	
Female	54	54	Dummy
Total	100	100	
Age Distribution (Years)			
25-40	71	71	
41-55	23	23	36.68
56-above	6	6	
Total	100	100	
Marital Status (Number)			
Married	57	57	
Single	43	43	Dummy
Others	0	0	
Total	100	100	
Farm Size (Hectares)			
0.1-0.499	74	74	
0.5-above	26	26	0.289
Total	100	100	
Farming Experience (Years)			
0-5	71	71	
6-10	21	21	
11-above	8	8	4.73
Total	100	100	

Source: estimated by author. Data from field survey, 2023

The result showed that the majority (54%) of layer farmers are females. The predominance of women in poultry production in the study area may be as a result of the scale at which the production is carried out, that is small-scale production. The distribution of the layer farmers age ranged between 25-40years with mean age of 36.68years. Most (54%) of the layer farmers in the study were married with an average experience of 4.73years. The finding suggests

that layer production is a more of a transition business than a permanent agro-business enterprise.

The results also showed that majority (96%) of the layer farmers went through formal schooling with a mean of 14.93years.

Table 1b: Socio-economic Characteristics of Layer Farmers in Akwa Ibom State

Variables	Frequency	Percentage	Mean
Educational Qualification (Years)			
No Schooling	4	4	
Primary	3	3	
Secondary	7	7	14.93
Tertiary	86	86	
Total	100	100	
Membership of Social Organisation (Years)			
0-5	93	93	
6-10	3	3	
11-above	4	4	1.36
Total	100	100	
Training (Number)			
0-5	91	91	
6-10	9	9	
11-above	-	-	2.08
Total	100	100	
Extension Visit (Number)			
0-5	82	82	
6-10	18	18	
11-above	-	-	2.8
Total	100	100	
Family Size of (Number)			
0-5	64	64	
6-10	35	35	
11-above	1	1	4.81
Total	100	100	
Farm Income per Year (Naira)			
0-10,000	33	33	
10001-50000	2	2	
50001-100000	8	8	
1000001-500000	35	35	392,604
500001-above	22	22	
Total	100	100	

Source: Field survey, 2023.

The finding implies that the majority of poultry farmers can read, write and also have access to information, adopt new innovations and are vested with good managerial potentials. Participation of layer farmers in social organization was an average of 1.36years which shows that the social capital formation among poultry farmers is low perhaps due to the transient nature of the business. In addition, the majority (91.00%) of the farmers had little or no training on poultry production. Also, an extension agent visits to layer farmers averaged at 2.80 times per year respectively. This clearly indicates that most poultry farmers do not have access to new and improved innovations and information as regards poultry production in the study area. Average household size layer farmers in the study area was 5.00 members respectively. This explains the importance of family labour in poultry production in the study area. Furthermore, the study estimated the mean annual farm income of layer farmers ₦392, 604 respectively. This shows that the business has a sustainability character in the study area.

Estimation of the Cobb Douglas Production Function of Layer Farmers in Akwa Ibom State

Table 2 presents the estimates for the Cobb-Douglas Production Function applied to layer farmers in Akwa Ibom State. The coefficient of sigma squared (0.6168) is statistically significant at the 1% probability level, suggesting a robust fit and the validity of the specified distribution assumption for the composite error (VI-UI) in the model.

Table 2: Estimates of Stochastic Production Function

Variable	Parameters	Coeff.	Std. error	t-value
Constant	δ_0	4.3488	1.2042	3.611***
Pen Size	δ_1	0.2566	0.1230	2.086**
Family labour	δ_2	-0.0604	0.0139	-4.342***
Hired labour	δ_3	0.0315	0.0179	1.759*
Feeds	δ_4	0.0448	0.0095	4.716***
Medication	δ_5	-0.0345	0.0419	-0.823
Capital dep.	δ_6	0.0477	0.0169	2.822***
Sawdust	δ_7	0.1489	0.0523	2.847***
Sigma squared		0.6168	0.1466	4.207***
Gamma		0.2443	0.0271	9.02***
Log likelihood		-98.5975		
LR test		20.7954(0.000)***		
Wald chi2 (7)		17.560 (0.014)**		

Source: estimated by author. Data from field survey, 2023. Asterisks *, **, and *** represent significance level at 10%, 5% and 1% respectively.

The variance ratio was estimated to be 0.2443 (24.43%) significant at 1% probability level, implying that about 24.43% of the disturbance in the system is due to the technical inefficiency of the layer farmers while 75.57% is as a result of the normal stochastic error. The generalized log likelihood function is -98.5975 which implies that the Cobb-Douglas model utilized in the estimation provides a suitable representation of the data. The results above show that pen size, hired labour, feed, capital depreciation and sawdust have a positive relationship with the output of egg produced implying that increased use of these factors will lead to an increase in egg production. Family labour and medication negatively influenced egg production in the study area.

Estimation of the Technical Efficiency Indices of Layer Farmers in Akwa Ibom State

The distribution of the layer farmers in the study area is presented in Table 3 below. The finding revealed that only 1% of the farmers had technical efficiency less than 30%. Majority (99%) of the farmers had technical efficiency ranging within 31% - 90%. No respondent had technical efficiency above 90%. The maximum technical efficiency of the farmers was 86.74% with a minimum of 15.34%. The mean technical efficiency obtained stood at 66%. This suggests that, with the current production technology, an average layer farmer in the study area has the potential to increase their egg production by approximately 34%.

Table 3: Distribution of Technical Efficiency Indices of Layer Farmers in Akwa Ibom State

Category of technical efficiency	Frequency	Percentage (%)
0.0001 – 0.3000	1	1.00
0.3001 – 0.6000	24	24.00
0.6001 – 0.9000	75	75.00
0.9001 – 1.0000	0	0.00
Total	**100**	**100.00**
Minimum	0.153372	
Maximum	0.867357	
Mean	0.655562	

Source: estimated by author. Data from field survey, 2023.

Determinants of Technical Inefficiency among Layer farmer in Akwa Ibom State

As presented in Table 4, the coefficients of technical inefficiency for layer production showed that farmer education (0.0254, $p<0.05$), family size (0.917, $p<0.05$), market share (0.0176, $p<0.05$), farming experience (0.7414, $p<0.01$), number of extension visits (0.177, $p<0.1$), membership in social group (0.207, $p<0.01$), trainings (0.209, $p<0.05$), and farm size (0.0004, $p<0.01$) have negative significant effects on the level of technical inefficiency. The negative signs imply that an increase in these variables will decrease the inefficiency level of the farmer and rather increase the technical efficiency level of poultry farms. On the contrary, farmers' age (0.2024, $p<0.05$) and access to credit (6.4E-06, $p<0.1$) have positive effect on the technical inefficiency of layer production. This implies that, increase in these variables increases farm level technical inefficiency. By implication increasing these variables reduces farm level of technical efficiency.

Table 4: Determinants of Technical Inefficiency of Layer Farmers in the Study Area

Variables	Parameters	Coefficient	Std. Error	t-value
Constant	β_0	-2.4181	2.323722	-1.041
Age	β_1	0.2024	0.0809	2.502**
Education	β_2	-0.0254	0.012990	-1.955**
Gender	β_3	-0.6849	0.631021	-1.085
Experience	β_4	-0.7414	0.1041	-7.123***
Household size	β_5	-0.9172	0.352392	-2.603**
Farm size	β_6	-4.43E-04	0.000106	-4.173***
Social group	β_7	-0.2071	0.077563	-2.670***
Trainings	β_8	-0.2092	0.102813	-2.035**
Extension visits	β_9	-0.17697	0.103060	-1.717*
Access to credit	β_{10}	6.4E-06	3.65E-06	1.753*
Market share	β_{11}	-0.0176	0.0086	-2.049**

Source: estimated by author. Data from field survey, 2023. Asterisks *, **, and *** represent significance level at 10%, 5% and 1% respectively.

The increase in years of education of poultry farmers is associated with improved innovation adoption and good access to information among others. This factor is negatively significant for layer farmers. This indicates that farmers with higher levels of education may exhibit lower levels of risk aversion and be more inclined to adopt new innovations and practices that could

reduce their technical inefficiency. Education plays a critical role in identifying and seizing investment opportunities. This aligns with expectations, as it is anticipated that technical efficiency increases with higher levels of schooling. Osinowo and Tolorunji (2019) came to similar conclusions. Family size had a negative effect on technical inefficiency for layer, indicating that increase in family size leads to an increase in technical efficiency. Family members can provide labour source for the farm, thus reducing the cost or need of hiring labour. This can allow resources to be allocated to other inputs that will help the farmer reduce technical inefficiency or increase the efficiency of resource use. This means that farmers with larger family size can increase their level of technical efficiency than farmers with smaller family size. Aboki *et al.,* (2013) came to similar conclusion.

Increase in the number of years of farming will lead to increase in the level of technical efficiency. This factor meets *a priori* expectation at 1% significant level for layer production. The finding implies that farm level technical efficiency increases with an increase in years of farming experience for a layer farmer in the study area. This finding is supported by the fact that an increase in layer production experience is positively associated with the adoption of new and improved production technologies, innovations, and techniques. This means that the more experienced the farmers are, the more they can adopt better production practices and efficiently allocate resources to reduce their level of inefficiency. This finding contradicts the findings of Osinowo and Tolorunji (2019) and is supported by Umar and Dezi (2020).

The rate of extension visits had a negative effect on technical inefficiency of layer farmers. This means that farmers who had more extension contact are more likely to increase their level of technical efficiency and decrease technical inefficiency than farmers with less extension contact. Access to extension can expose farmers to new and improved production practices that they may erstwhile not aware of. Also, extension teaching and training can better position farmers to be less risk averse, thus allowing them to adopt best farm practices and techniques that can result in a decrease in the level of technical inefficiency. The coefficient of age was positive on the technical inefficiency of layer production. This means that the technical inefficiency of the farmers increases as they get older. Increase in age may not necessarily connotes increase in poultry production experience, but could refer to older or aged people engaging in layer production. Moreover, older farmers often exhibit more risk aversion compared to younger farmers and may be less inclined to swiftly adopt new techniques and production practices that could assist in reducing technical inefficiency. This is in contrast with the findings of Osinowo and Tolorunji (2019), Aboki *et al.*, (2013) and Okon, *et al*., (2009).

Conclusion

This study analyzed the technical efficiency of layer farmers in Akwa Ibom State. The results of the study showed that the technical efficiency level of layer farmers was above 50.00% but not up to the frontier level, indicating that poultry farmers still have opportunities to increase the efficiency gap by 34.00%. The study discovered a positive influence of educational level, farming experience, gender, household size, farm size, trainings, extension visit, market share and involvement in social groups on layer farmer technical efficiency. This suggests that the technical efficiency of poultry farmers in the study area can still be increase if poultry farmers adopt the best technique of production. This is important as the study showed that many of the farmers are young entrants with little experience in poultry production and few extension visits. This is evidenced by the fact that the inefficiency model has shown that increasing education levels, extension visits, farming experience and training reduces technical inefficiency. The market share, farm size and social group also increase the technical efficiency of the poultry farmer. This suggests that increasing these factors is required to achieve greater technical efficiency.

Recommendations

- Efforts should be made into training layer farmers as the study showed that training increase the technical efficiency of poultry farmers.
- There is need for the Akwa Ibom State Agricultural Development Programme to increase the level of extension visits to layer farmers in the study area since the level of extension visit increases poultry farmers' technical efficiency.
- Social capital formation among layer farmers should be encouraged at all levels as it positively influences their technical efficiency.
- Layer farmers should gear efforts in the training of household labour to increase the improve the contribution of family labour to the productivity of the enterprise.

References

Aboki, E., Jongur, A.A.U., anbd Onu, J. I. (2013). Productivity and technical efficiency of family poultry production in Kurmi Local Government Area of Taraba State, Nigeria. *Journal of Agriculture and Sustainability.* 4(1): 52 – 66.

Adegbie, F.F. and Alawode, O.P. (2020). Financial Management Practices and Performance of Small and Medium Scale Poultry Industry in Ogun State, Nigeria. *Journal of Finance and Accounting*,8(2): 90-106.

Adeyemi, I.A., (2011). *The role of primary agriculture in processing and nutrition in urban food security in developing countries: the Nigerian experience*. In Adeyemo, R.A. (Ed) Urban agriculture, cities and climate change 12-21

African Sustainable Livestock 2050, (2018). *Livestock production systems spotlight Nigeria.* FAO, Rome, Italy.

Akpan, S.B. and John, D.N. (2020). Technical efficiency of small-scale cassava-based processors (cassava graters operators) in Eket Agricultural Zone of Akwa Ibom State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment. 16(3): 137-149*

Chege, L. M. (2014). *Factors Influencing Quail Farming in Nyeri Central Constituency, Nyeri County, Kenya* (Doctoral dissertation, University of Nairobi).

Climate Data (2021). Retrieved from https://en.climate-data.org/africa/nigeria/akwa-ibom-345/

Fadeyi, O. (2018). Smallholder agricultural finance in Nigeria: The research gap. *Journal of Development and Agricultural Economics*, *10*(11), 367-376. Retrieved from http://www.ijntr.org.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*, Series A.120(3).

Food and Agricultural Organization Statistics (2020). Food and Agricultural Organization of the United Nations. www.fao.org/faostat

Hartwich, F., Kormawa, P., Bisallah, I.D., Odufote, B.O., Polycarp, I.M. (2010) *Unleashing agricultural development in Nigeria through value chain financing*. A draft report prepared for Federal Government of Nigeria with the assistance of UNIDO, Bank of Industry and Central Bank of Nigeria

Hoppe, R.A, J. Tames, J.E. Perry, K. Penni, E.J. and J. Momke., 2001 Structural and Financial Characteristics of US Farms, Family farm Report. ERS, USDA, AIB No. 768.

National Bureau of Statistics (NBS). (2017). Selected Petroleum Statistics: Oil and Gas Production, Drilling and Development (2012 – 2016). August 2017. Pp. 1 – 21.

Ohajianya, D. O., Mgbada,J. U., Onu, P. N., Enyia, C. O., Henri-Ukoha, A., Ben-Chendo, N. G. and Godson-Ibeji, C. C. (2013). Technical and Economic Efficiencies in Poultry Production in Imo State, Nigeria. *American Journal of Experimental Agriculture 3(4): 927-938, 2013*

Okon, U. E., Enete, A. A. and Bassey, N. E. (2010): Technical Efficiency and its Determinants in Garden egg (Solanum -Spp) Production in Uyo Metropolis, AkwaIbom State, Nigeria. *Field Actions Science Report*.

Osinowo, O. H., Tolorunju, E. T. (2019). Technical efficiency of poultry egg production in Ogun State, Nigeria. *Journal of Agribusiness and Rural Development*. 1(51): 51–58.

Owoade, O. A. (2019). Sustaining Agricultural Transformation in Nigeria: Challenges, Issues and Strategies. *Intl. Journal of Innovative Agriculture and Biology Research.*7(4):13 – 22.

Oyinbo, O., Adah, I. D. and Rekwot, G. Z. (2015). Technical Efficiency-Food Security Nexus in Kaduna State, Nigeria: A Case Study of Poultry Egg Farmers. *Consilience. 14(2): Pp. 244-259*

SAHEL. 2015. An Assessment of the Nigerian Poultry Sector. http://sahelcp.com/anassessment-of-the-nigerian-poultry-sector/. SAHEL 11: 1-3.

Sall, S. 1997. A Characteristic – Approach to Adoption: The Case of improved Rice varieties in southern Senegal. Ph.D Dissertation, Department of Agricultural Economics, Manhattan Ks, pp. 20 – 30.

Umar, T. Y. and Dezi, N. (2020). Profitability and technical efficiency of chicken production in Kaduna State, Nigeria. *Islamic University Multidisciplinary Journal*. 7(8): 103 – 113.