UMYU Scientifica, Vol. 1 NO. 1, September 2022, Pp 254 – 260
https://doi.org/10.56919/usci.1122.032
ISSN: 2955 – 1145 (print); 2955 – 1153 (online)
A periodical of the Faculty of Natural and Applied Sciences, UMYU, Katsina

ORIGINAL RESEARCH ARTICLE

Firm Efficiency and Return to Scale in Layer Production Among Smallholders in Jos-North, Nigeria

Onuwa, C. Godfrey[1]*, Vihi, K. Samuel[1], Binuyo, Ganiyu[1], Adedire, Oludare[2], Owa, T. Grace[1], Wuyep, Gloria[1], and Dalla, Alexandar[1]
[1]Department of Agricultural Extension and Management, Federal College of Forestry, Jos, Nigeria.
[2]Department of Statistics, Federal College of Forestry, Jos, Nigeria.

ABSTRACT
Layer production depends on many factors, and it is an excellent source of nutritious animal protein (meat and eggs). Empirical knowledge of the determinants of firm efficiency improves productivity in poultry-egg production systems. Therefore, this study analysed firm efficiency and return to scale in layer production among smallholders in Jos-North, Plateau State, Nigeria. Primary data collected via two-stage cluster sampling were evaluated using descriptive statistics, regression, and elasticity of production analysis. The results revealed that average flock size, feed quantity per cycle, medication cost, labour and capital requirement was 105 birds, 2,750kg, N 17,250, 1095 person-days and ₦330,750, respectively. The coefficient of determination (R^2) is 0.768, indicating that variables in the regression model explain 77% of the variation in layer production. Moreover, the coefficient of variables including flock size (-0.446), feed quantity (0.791), medication cost (0.165), labour (0.275) and capital (-0.131) were significant determinants of layer production. The estimate of return to scale was 0.654($\sum\varrho<1$), indicating decreasing returns. In addition, the major constraints of layer production include the high cost of feeds (91.3%), inadequate capital (80%), disease outbreaks (70.8%) and high medication and equipment costs (61.3%). This study recommends improved input supply and subsidies; access to farm capital, commodity markets and farm cooperatives; adoption of modern technology, practices and provision of technical support to enhance firm efficiency and optimize productivity.

ARTICLE HISTORY
Received September 2, 2022
Accepted September 27, 2022
Published September 30, 2022

KEYWORDS
Constraints, determinants, poultry layers, production elasticity, smallholders

© The authors. This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 License (http://creativecommons.org/licenses/by/4.0)

INTRODUCTION

Livestock farming also serves as a subsidiary occupation to supplement the income of small and marginal farm households; livestock production involves the selection, breeding, management and marketing of animal products and by products. Success in raising livestock depends on several factors (Chiekezie *et al.*, 2021). Among livestock-based enterprises, poultry takes center stage due to its enormous potential for rapid economic development (Zakari *et al.*, 2018). Poultry production has a shorter cycle and is much more prolific than larger livestock, apart from the fact that poultry production is being conceived to be a technically easy venture (Chiekezie *et al.*, 2021). Poultry is the largest livestock herd, consisting of chickens, quail, ducks and turkeys, and together with poultry products (eggs and meat) accounting for about 30% of the animal protein consumed worldwide (Onuwa, 2022; Peterman, 2003). In developing countries, many people in rural areas keep small flocks of scavenger chickens. These birds play an important role in poverty alleviation and food security, providing meat and eggs for family consumption and sale to generate additional income or fulfill social obligations. Poultry birds also provide fertiliser and are active in pest control (Tauson, 2005). In addition, the poultry industry plays an important role in rural socio-economic development. It provides employment opportunities to the population and thus acts as a source of income. It is also an excellent source of nutritious animal protein (meat and eggs) (USDA, 2015). Poultry meat and eggs are delicious and generally accepted, with little to no cultural and religious boundaries in Nigeria (Emokaro and Erhabor, 2014). Eggs are a good source of iron, zinc and vitamin A; all of these are essential for health, growth and well-being (Australian Center for International Agricultural Research (ACIAR), 2009; Food and Agriculture Organization (FAO), 2012). Meat and egg production from layers should be enhanced as protein needs must be met from domestic sources (Chiekezie *et al.*, 2021).

Correspondence: Onuwa, G. C. Department of Agricultural Extension and Management, Federal College of Forestry, Jos, Nigeria. ✉ onuwag@gmail.com ; Phone: 08035606473
How to cite: Onuwa, G. C., Vihi, S. K ., Binuyo, G ., Adedire, O ., Owa, G.T., Wuyep, G., and Dalla, A. (2022). Firm Efficiency and Return to Scale in Layer Production Among Smallholders in Jos-North, Nigeria. UMYU Scientifica, 1(1), 254 – 260. https://doi.org/10.56919/usci.1122.032

Efficiency in available resource utilisation and improved technology adoption is critical to agricultural production (Alabi and Aruna, 2005). According to FAO's Food Insecurity Report (2012), 799 million people in 98 developing countries do not have enough food to lead a normal, healthy and active life. The supply of agricultural products and the resources used in their production is of great importance (Binuomote *et al.*, 2008).

Most developing countries, including Nigeria, face problems of inadequate food production and protein deficiencies. Inadequate animal protein remains in the diet of a large portion of the population, especially in rural areas, where more than 70% of Nigeria's population is located, persists (Onuwa, 2022). Nigerian agriculture is characterised by multitude of smallholder farmers, rudimentary farming systems and tools, low capital endowments, and low yields per hectare (Binuomote *et al.*, 2008). The Central Bank of Nigeria (CBN) (2010) confirms that while food production increased at a rate of 2.5%, food demand increased at a rate of over 3.5% due to high population growth (2.83%), leading to marginal food deficit. The current level of food insecurity requires well-defined approaches to mitigating this trend. Increasing productivity and efficiency in agriculture and especially in small-scale production systems, requires empirical knowledge on the determinants of returns to scale in layer production. Despite the development of the egg production industry, domestic demand has not been matched by local supply in Nigeria (Tijani *et al.*, 2006). Rapid population growth leads to increased demand for poultry products (meat and eggs); as such, demand for poultry products by the growing Nigerian population has continued to outstrip supply (National Bureau of Statistics (NBS), 2012). The ongoing challenges facing the poultry industry and especially layer production make it difficult for existing farms to expand while new farms are reluctant to enter the business. Such limitations include high feed costs, unprofitable egg and bird prices, low quality feed and feed ingredients, poor management systems, inadequate disease control facilities, marketing issues and production costs (Onuwa, 2022). The situation has forced many poultry farms to close and those that are still viable produce at very high costs and also face severe input constraints (Adepoju, 2008). The barriers of poultry egg production in Nigeria include poor sustainability, low productivity, inefficient resource allocation and utilization (Chiekezie *et al.*, 2021). The need to allocate productive resources cannot be overstated (Onuwa, 2022; Ashagidigbi *et al.*, 2011). Poultry production in Nigeria still has a long way to go to fulfill its role as a valuable tool of socio-economic improvement of the rural population (Chiekezie *et al.*, 2021). Despite growth in the poultry production industry in Nigeria, local demand has not been matched by local supply; and as such resulting in the increase of poultry product prices (Onuwa, 2022). The results of this study will therefore help identify the most effective ways to maximise poultry egg production in the area. Based on the foregoing, this study analysed firm efficiency among smallholders; and specifically estimated the determinants of and returns to scale in layer production; it also identified the constraints associated with layer production in the study area.

MATERIALS AND METHODS

Study area

This research was conducted in the Jos North Local Government Area (LGA) of Plateau State, Nigeria; with coordinates between longitude 8°40'N and 9°50'E and latitude 9°40'N and 10°45'E (NBS, 2012). The average temperature ranges from 18°C to 30°C and annual precipitation is between 1,400mm to 2,000mm per annum (NBS, 2012). It covers an area of 8600 km² and bounded by escarpments. The LGA has an average altitude of 1,280m.

Method of data collection

Data was collected using a structured questionnaire designed according to the study objectives by the authors in English language and administered to the respondents with the assistance of local enumerators and extension agents, who also served as translators of the questions to some of the poultry farmers in their local languages (, e.g. Hausa, Jarawa, etc.). They questionnaire provided information on the socioeconomic characteristics of the respondents (, e.g. age, gender, marital status, etc.), the factors of poultry egg production (, e.g. flock size, feed, labour, etc.) and barriers associated with layer production among the smallholders (, e.g. feed cost, inadequate capital, disease outbreaks, etc.).

Validation of the research instrument

Content validity was used to measure the adequacy of the instrument items in this study. Content validity in this context sought to determine the relevance and adequacy of items included in the instruments. Using the Jury Method (Kerlinger, 1973), the entire instrument was subjected to the scrutiny of relevant experts. Each of the experts was requested to independently give his expert opinion on the relevance and adequacy of the items with respect to the objectives of the study. Various questions of the data collection instrument were scrutinized in terms of how relevant they are to the specific objectives of the study as well as how the prepared questions exhaustively cover the specific objectives of the study. Furthermore, the data collection instrument was examined against the background of its adequacy in regard to the accomplishment of the objectives of the study.

Instrument reliability test

An instrument is considered reliable when it consistently produces the same result when applied to the same sample many times (Osuala, 2005). The test-retest method of affirming instrument reliability was employed for this study. It was computed by calculating the correlation coefficient between two distributions of test scores obtained at two different times on the same respondents. The instrument was trial tested on 20 respondents drawn from two wards in the Local Government Area viz: Naraguta B. and Salisu Adamu. The information obtained from the responses to the instrument was analysed using product-moment correlation analysis. High value of mean product-moment correlation coefficient of 0.723 indicated high reliability of the instrument.

Sampling procedure

The respondent farmers for the study were chosen using a two-stage cluster sampling technique. In the first stage, four districts (Naraguta B, Salisu Adamu, Ali Kazure and Garba Daho) from the 14 districts in the study area were purposively selected because poultry farmers are prevalent in these areas. In the second stage, at constant proportionality of 0.13 (13%); which is the constant ratio or fraction of variable quantity to another to which it is proportional, eighty (80) respondents were randomly selected for the purpose of this study from a sample frame of 804 poultry (layer) farmers compiled by local enumerators and extension agents from the Agricultural unit at the LGA secretariat; and validated using raosoft sample size calculator at 90% confidence level and 10% margin error as adapted from Onuwa *et al.*, (2022). Also, in selecting the sample size from the sample frame the Slovin formula was used; a total of 105 poultry farmers were methodically identified based on their participation in layer production, however, only 80 questionnaires were retrieved and used for the purpose of this study. The Slovin formula is specified in Equation (1), as adapted from Onuwa *et al.* (2021);

$n = N / 1+ Z^2$ (1)

n = Sample size.

N = Sample frame.

Z^2 = Z-score / error margin (confidence level at 95%); confidence level at 95% = 2.58

Hence;

n = 804 ÷ 7.656 = 105.02

The sample frame and size are presented in Table 1; however, for the purpose of this study only 80 questionnaires were retrieved; due to distorted values and mutilation of the rejected questionnaires.

Table 1: Sample frame and size

District	Selected communities	Sample Frame	Sample Size (0.13)
Gwong	Naraguta B,	298	21
	Salisu Adamu	183	66
	Ali Kazure	171	26
	Garba Daho	152	13
Total:		804	105

Source: Field Survey, 2016

Analytical technique

Descriptive and inferential statistics were used for the analysis of the collected primary data. Regression analysis was used to evaluate the factors affecting layer production in the study area. The return to scale in layer production was estimated using the elasticity of production factors.

Regression Analysis

A multiple regression analysis was used to estimate the input/output ratio in layer production and to determine the factors influencing layer production in the study area, a structural relationship was specified, and it showed a relationship between dependent variable (Y) and independent variables (X_i). Four functional forms (linear, semi-log, double-log, and exponential) were specified and fitted to the data. The double log function was the best fit and was chosen as the main equation. The selection of the production function depends on the sign and magnitude of the coefficients, the number of significant variables, the multiple determination coefficient, the economic rationale, and the significance of the coefficients and the overall performance of the model. The model in explicit form is given by equation (2) as adapted from Onuwa *et al.*, (2020):

$$Log\ Y = \beta_0 + \beta_1 logX_1 + \beta_2 logX_2 + \beta_3 logX_3 + \beta_4 logX_4 + \beta_5 logX_5 + e_i \ldots\ldots \quad (2)$$

Where:

Y = Total farm output (number of eggs); β_0 = intercept; $\beta_1 - \beta_5$= estimated coefficients (Regression coefficients of $X_1 – X_5$); X_1 = Flock size (number of chicks); X_2 = Feed (kg), X_3 = Medication cost (₦); X_4 = Labour (man-days); and X_5 = capital (₦); and e_i = Error term.

Return to scale

This refers to the change in output due to a certain proportional change in all factors of production simultaneously. It is a long term concept because all the variables are different. Returns to scale increase, remain constant, or decrease, depending on whether a proportional increase in inputs leads to a greater, equal, or lesser proportional increase in output. The elasticity of production is used to estimate returns to scale and is given by equation (3):

$$\text{Elasticity of production } (\sum\rho) = \frac{\%\text{change in output } (\%\Delta Y)}{\%\text{change in input } (\%\Delta\chi)} \ldots\ldots (3)$$

It can also be estimated from the relationship between the marginal physical product (MPP) and the average physical product (APP), expressed in equations (4), (5), (6) and (7):

$\sum \rho = \frac{\Delta \Upsilon}{\Upsilon} \div \frac{\Delta \chi}{\chi}$.. (4)

Written as;

$\sum \rho = \frac{\Delta \Upsilon}{\Delta \chi} \div \frac{\chi}{\Upsilon}$ .... (5)

Given that;

$\frac{\Delta \Upsilon}{\Delta \chi} = MPP$; and $\frac{\chi}{\Upsilon} = 1/\ APP$ .... (6)

Therefore;

$\sum \rho = MPP\ /\ APP$ .... (7)

However, in the production function, the return to scale obtained is equal to the sum of the elasticity's of the independent variables (Reddy *et al.*, 2004) and expressed in equation (8):

$\sum \varrho^k = RTS^k$…… (8)

Where: $\sum$=Summation sign; $\sum \rho^k$= Elastic modulus of k variables; RTS=Returns to scale

Decision Rule:

If$\sum \rho^k > 1$; denotes increasing returns to scale.

If$\sum \rho^k = 1$; denotes constant returns to scale.

If$\sum \rho^k = < 1$; denotes decreasing returns to scale.

RESULTS AND DISCUSSION

Production factors

Table 2 revealed that the mean flock size was 105 birds; this flock size indicates a predominance of smallholder farmers in the area; thus, layer production among the respondents was at subsistent levels; and as such lower farm productivity and profitability. This corroborates with Onuwa (2022) who reported similar outcomes. Average feed quantity utilized per production cycle (72 weeks) was 2,750kg; suggesting that poultry feed was a critical production input; and as such an important component in layer production. This corroborates with Chiekezie *et al.* (2021) and Zakari *et al.* (2018) who reported similar outcomes in their respective studies on layer production. Also, estimated average medication cost was ₦ 17,250. Administration of poultry medication was critical in raising healthy birds and mitigating disease outbreaks; and as such, medication is a vital cost component in layer production (Onuwa, 2022; Wale *et al.* 2020). The average quantity of labour per production cycle (72 weeks) was 1,095 man-days; implying that layer production is relatively labour-intensive and requires strict adherence to modern management practices. This corroborates with Onuwa (2022) who reported a similar outcome in a study on broiler productivity. Additionally, the estimated mean capital required per production cycle for an average flock size of 105 birds was ₦330,750. This implies that layer production has relatively high capital requirements in the study area. This was attributable to the high cost of production inputs such as poultry feed, day old chicks, etc. These results confirm Chiekezie *et al.* (2021); Zakari *et al.* (2018); Emokaro and Erhabor (2014); and Polycarp *et al.* (2004), who reported similar outcomes in their respective studies on economics of layer production.

Table 2: Summary statistics of production factors per cycle

Factors	Mean	S.D
Flock size (number of chicks)	105	±7.07
Feed (kg)	2,750	±353.6
Medication cost (₦)	17,250	±1061
Labour (man-days)	1,095	±134.4
Capital (₦)	330,750	±97970

Source: Field Survey (2016)

Regression analysis

The regression analysis presented in Table 3 revealed the determinants of layer production in the study area. The estimated coefficient of determination (R^2) is 0.768, which means that 77% of the variation in layer production is explained by the independent variables in the regression model, while the remaining 23% are exogenous to the system, i.e. unexplained and attributable to the random stochastic error term (e_i); thus, the null hypothesis is rejected. Further, the F-ratio (5.91) is significant at $p< 0.05$ (5%) level, implying that the variables (x_i) in the regression model accurately predict the outcome variable (Y_i). Therefore, the regression model fits the dataset well. It shows a significant and linear relationship between variables. These results corroborate with Chiekezie *et al.* (2021) and Zakari *et al.* (2018) who reported similar outcomes in their respective studies on economics of layer production. The coefficient of flock size (-0.446) was negative and statistically significant 5% level. This implies that high stocking density, relative to smallholder production systems, results in reduced output as the space occupied by each bird per m^2 is diminished. Cannibalism becomes frequent, and the struggle for feed increases, resulting in high mortality rates and a decline in output. These results corroborate with Chiekezie *et al.* (2021) who reported a similar outcome in their study on economics of layer production. In addition, the quantity of feed coefficient (0.791) is positive and statistically significant at 5% level. This implies that adequate poultry feed improves egg production; and as such, it is very important in layer production. Feed is a critical component in poultry production (Onuwa, 2022). In addition, the coefficient of medication cost (0.165) was positive and statistically significant at a 5% level. It could be deduced that the administration of the recommended medication to the birds enhances farm productivity (Onuwa, 2022; Wale *et al.* 2020). Thus, medication is an important cost component in layer production. In addition, the labour coefficient (0.275) is positive and statistically significant at a 1% probability level, showing that labour supply is an important component in layer production; it is a major requirement in carrying out various farm activities. This corroborates with Onuwa (2022) who reported a similar outcome in a study on broiler productivity. Additionally, the coefficient of capital (-0.131) was negative but statistically significant at a 5% level. This implies that layer production requires adequate money subject to the scale of production, and such as increase in stocking density results in higher capital requirements. These corroborate with Zakari *et al.* (2018); Yusuf and Malamo (2007); Oji and Chukwuma (2007) who reported similar results in their respective studies on economics and technical efficiency in layer production.

Table 3: Factors affecting layer production

Variable	Coefficients	Standard Error	T-value
Constant	4.071**	1.6	2.51
Flock size (X_1)	-0.446**	0.173	-2.578
Feed (X_2)	0.791**	0.316	2.503
Medication cost (X_3)	0.165**	0.056	2.946
Labour (X_4)	0.275***	0.065	4.23
Capital (X_5)	-0.131**	0.049	-2.673
R^2	0.768		
F-ratio	5.91		

Source: Field Survey (2016); *** & **= Significant at 1% (p<0.01) and 5% (p<0.05) Level

Elasticity of production

Table 4 shows the values of elasticity of production ($\sum\varrho^k$). The estimated value of returns to scale is 0.654; thus, $\sum\rho < 1$ which indicates a decreasing return to scale. Diminishing returns to scale are due to the operation of economies of scale, i.e. the reduced technical efficiency of fixed and variable factors. Variable factors are abundant compared to fixed elements. The additional yield of the variable factors becomes negative, so an increase in the use of the variable resources will produce less additional output. Thus, adding successive units of variable factors to fixed factors in the layer production process adds less to the gross farm output (eggs) produced. This value represents stage III of the production function, which is regarded as an irrational (supra-optimal) production stage. This stage allows for the reorganisation of fixed and variable resources and also correlates with the Law of Negative marginal returns. These results support Wale *et al.* (2020); Olaniyi *et al.* (2008); and Ojo (2003) who reported similar outcomes in their respective studies on economics and technical efficiency of layer production systems.

Table 4: Factors of elasticity and economies of scale

Factors of Production	Elasticity of production ($\sum\varrho^k$)
Flock size (X1)	-0.446
Feed (X2)	0.791
Medication cost (X3)	0.165
Labour (X4)	0.275
Capital (X5)	-0.131
Returns To Scale	0.654

Source: Field Survey (2016)

Constraints of layer production

Table 5 shows that the most common limitations of layer production in the study area include the high cost of feeds (91.3%) due to the high cost of feed materials, inadequate capital (80%), attributable to lack of access to agricultural credit. Disease outbreaks (70.8%) result from adopting poor management practices and disease control measures; and high medication and equipment costs (61.3%). Others were unskilled labour (40%), poor market channels (31.3%), inadequate production technologies/inputs (28.8%), and pecking and cannibalism (21.3%). These results corroborate those of Chiekezie *et al.* (2021); Zakari *et al.* (2018); Charles (2006); and Hassan (2002) who reported similar outcomes in their respective studies on economics of layer production.

Table 5: Constraints of layer production among smallholders

Constraints	Frequency*	%
1. High cost of feed	73	91.3
2. Inadequate capital	64	80.0
3. Disease outbreak	56	70.8
4. High medication & equipment cost	49	61.3
5. Unskilled labour	32	40.0
6. Poor market channels for eggs	25	31.3
7. Inadequate production technologies/inputs	23	28.8
8. Pecking and Cannibalism	17	21.3

Source: Field Survey (2016); * = Multiple responses

CONCLUSION

This study analysed the factors affecting firm efficiency and return to scale in layer production among smallholder farmers. The factors of production were revealed to influence the respondents' agricultural productivity. In addition, the variables in the regression model are significant determinants of layer production in the study area. The estimated elasticity of layer production shows diminishing returns to scale, i.e. the technical efficiency of fixed and variable resources decreases. All constraints identified by farmers as economically important and significantly affect layer production in the study area; and as such, efforts should be made to minimise these limitations. Poultry egg production in the study area is viable if the factors affecting farmers are minimised.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made for improvement of the performance of layer production for smallholder farmers:

i. Implement policies to subsidise the cost of poultry feeds, medication; poultry technology and equipment's.
ii. Provision of credit information and financing to farmers to avail them opportunities to capital required to expand their scale of production.
iii. Adherence to modern management practices and measures at optimum stocking density to mitigate disease outbreaks, pecking and cannibalism.
iv. Provision of technical support, agro-services centers and improved farm cooperatives to facilitate sustainable layer production among smallholders.
v. Improved market channels and linkages for poultry products (eggs, meat and poultry manure) that enhances efficiency and profitability.
vi. Implement policies to improve farmers' access to improved breeds of chicks, poultry technology and inputs.
vii. Adoption of modern management practices that improves firm efficiency and optimizes productivity.

REFERENCES

Adepoju, A.A. (2008). Technical efficiency of egg production in Osun State. *International Journal of Agricultural Economics and Rural Development*, 1(1):7-14.

Alabi, R.A., and Aruna, M.B. (2005). Technical Efficiency of Family Poultry Production in Niger Delta, Nigeria. *Journal of Central European Agriculture, .6(4)*:531-538.

Ashagidigbi, W.M., Sulaimon, S.A. and Adesiyan, A. (2011). Technical efficiency of egg production in Osun State. *International Journal of Poultry Science*, 6 (2):62-69. [**Crossref**]

Australian Centre for International Agricultural Research (ACIAR). (2009). Improving village chicken production: A manual field workers and trainers, ACIAR monograph series (Online) (139): 151-154.

Binuomote, S.O., Ajetomobi, J.O., and Ajao, A.O. (2008). Technical Efficiency of Poultry Egg Producers in Oyo State, Nigeria. *International Journal of Poultry Science, 7(12):1227-1231.* [**Crossref**]

Central Bank of Nigeria (CBN) (2010), CBN Statistical Bulletin. *CBN Publication*:

Charles, D.N. (2006). Efficiency Analysis of Local Chicks Multiplication and Production System (CMPS) in Plateau State, Nigeria. *Unpublished M.Sc. Thesis*, Ahmadu Bello University, Zaria, Nigeria: 34-51pp.

Chiekezie, N.R., Ozor, M.U., and Isibor, C.A. (2021). Economic analysis of layers poultry production in Anambra State, Nigeria. *International Journal of Agricultural Policy and Research*, 9 (5): 129-137.

Emokaro, C.O and Erhabor, P.O. (2014). Comparative Analysis of Profitability of Layers Production in Esan North East and Ovia North East Local Government Areas of Edo State, Nigeria. *J. Appl. Sci. Environ. Management,* 18 (1): 121-126. [**Crossref**]

Food and Agricultural Organization (FAO). (2012). Animal production and health guidelines, paper no. 11. *FAO Publication*, Rome, Italy.

Hassan, A.A. (2002). Economic Analysis of Egg Production in Three L.G.As o Kaduna State. *Unpublished M.Sc. Thesis*, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria.

Kerlinger, N.F. (1973). *Foundations of Behavioral Research (2nd Ed.)*. New York, Holt Rinehart and Winston Inc.

National Bureau of Statistics (NBS) (2012). *Socio-economic Survey on Nigeria*. First Quarter Report, NBS, Abuja.

Oji, U.O., and Chukwuma, A.A. (2007). Technical Efficiency of Small Scale Poultry-Egg Production in Nigeria: Empirical Study of poultry producers in Imo State, Nigeria. *Research Journal of poultry Sciences*, 1 (3): 16-21.

Ojo, S. O. (2003). Productivity and Technical Efficiency of Poultry Egg Production in Nigeria. *International Journal of Poultry Science,* 2(6):459-464. [**Crossref**]

Olaniyi, O.A., Adesiyan, I.O and Ayoade, R.A. (2008). Constraints of Utilization of Poultry Production Technology among Farmers in Oyo State, Nigeria. *Journal Humanity and Ecology,* 24(4):305-309. [**Crossref**]

Onuwa, G.C. (2022). Empirical Analysis of Productivity among Broiler Farmers. *Turkish Journal of Agriculture Food Science and Technology*, 10(8): 1377-1381. [**Crossref**]

Onuwa GC, Mailumo SS, Chizea CI, Onemayin JJ, Idris RS, Abalaka EA, Ebong AC. (2022). Technical Efficiency in Cowpea (*Vigna Unguiculata*)

Prodction in Kanke, Plateau State, Nigeria. *FUDMA Journal of Agriculture and Agricultural Technology,* 8 (1): *372-382.* **[Crossref]**

Onuwa,G.C., Adepoju, A.O.,and Mailumo, S.S (*2021*). Analysis of Arable Farmers' Agroforestry Practices in Bokkos Local Government Area, Plateau State, Nigeria. *Journal of Forests*, 8 (2): 161-170. **[Crossref]**

Onuwa, C. G., Mailumo, S. S., and Muhammed, S. Y. (2020). Profitability Analysis and Determinants of Groundnut (*Arachis Hypogea*) Production in Dambatta Local Government Area of Kano State, Nigeria. *Open Journal of Agricultural Science (ISSN: 2734-214X)*, *1*(1), 31-39. **[Crossref]**

Onuwa, G.C., Vihi, S.K., Binuyo, G., Adedire, O., Owa, G.T., Wuyep, G., and Dalla, A. (2016). *Field Survey Report*, Federal College of Forestry, Jos, Nigeria

Osuala, E.C. (2005). *Introduction to Research Methodology (3rd Edition).* Onitsha, Nigeria: African First Publishers Ltd., 307pp. ISBN: 9781754311.

Peterman, S. (2003). Laying hens in alternative housing systems practical experiences. *Dtsch. Tierarztl.wochenschr*, 110 (5): 220-224.

Polycarp, I.M., Mshelia, S.I., and Gabdo, B.H. (2004). Production Function Analysis of Small-Scale Poultry Production in Jos South L.G.A of Plateau State, Nigeria. *Global Journal of Pure and Applied Sciences,* 10(3): 369-371. **[Crossref]**

Reddy, S., Ram, P.R., Sastry, T.V., Devi, I.B., (2004). *Agricultural Economics*. 201pp. Oxford & IBH Publishing Co.Pvt

.

Tauson, R. (2005). Management and Housing systems for layers-effects on welfares on egg quality characteristics in cages and in a litter housing system. *Worlds Poultry Science Journal*, 61 (3): 477-490. **[Crossref]**

Tijani, A.A., Alimi, T., and Adesiyan, A.T. (2006). Profit Efficiency among Nigerian Poultry Egg Farmers: A Case Study of Aiyedoto Farm Settlement, Nigeria. *Research Journal of Agricultural Biological Sciences,* 2(6):256-261.

United States Department of Agriculture (USDA). (2015). *International Egg and Poultry Review*. Annual Report, 18 (16):1-3.

Wale, A., Babatunde, O.A., Olasunkanmi, M.B. (2020). Comparative Economic Analysis of Poultry Egg Production under Two Feed Management Regimes in Ogun State, Nigeria. *International Journal of Research and Scientific Innovation (IJRSI),* 7(8):107-115.

Yusuf, S.A and Malamo, O. (2007). Technical Efficiency of Poultry Egg Production in Osun State: A Data Envelopment Analysis (DEA) Approach. *International Journal of Poultry Science,* 6(9):622-629. **[Crossref]**

Zakari, H.U., Bashir, M.B., Abubakar, R.U., Lawan, U.A., and Mohammed, U.S. (2018). Economic Analysis of Layer Production in Jalingo Local Government Area of Taraba State, Nigeria, *International Journal of Agricultural Research and Food Production,* 3 (3): 41-49.