



ANALYSIS OF FACTORS AFFECTING TECHNICAL EFFICIENCY OF POULTRY EGG PRODUCTION IN OGUN STATE, NIGERIA

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ABSTRACT

Poultry farming is facing low capital base, diseases and reduced egg production in Nigeria. This study aimed at examining the factors influencing technical efficiency of poultry egg production in the study area. Data were obtained from 102 poultry egg farmers through purposive and snowball sampling technique using structured questionnaire. Data were analysed using descriptive statistics and stochastic production frontier mode. Estimates show that poultry egg production was dominated by small-scale farmers (53.9%), male (80.0%), married (56.7%) with average farming experience of 4.54 years. Mean efficiency was 0.729. Flock size (0.2881) and medication (0.0549) significantly increased egg production efficiency while feed (-0.4320) was inefficiently utilised. The socioeconomic factors that reduced production inefficiency were farming experience ($p < 0.10$), education ($p < 0.01$), extension visit ($p < 0.10$) and distance to farm ($p < 0.05$). Waste from 4.9% of the farms were utilised as organic manure while 95.1% disposed their waste into dung pit, bush, canal or used chemical treatment. However, extension service is required to complement the low experience of the farmers. Adequate inputs like drugs/ vaccines and feeds should be distributed at affordable prices to encourage increased egg production. Crop farmers should be enlightened about the use of poultry waste as organic fertilizer in order to reduce air pollution.

Keywords: Egg, Organic manure, Poultry, Technical efficiency, Waste disposal

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INTRODUCTION

Livestock rearing plays important roles in human food and nutritional security, livelihood and rural poverty alleviation [1]. Nigeria has the largest annual egg production and second largest chicken population in Africa. The poultry industry comprises about 180 million birds which contribute 9-10% to the nation's Agricultural gross domestic product (GDP) [2]. The rural poultry systems are generally of small-scale with insufficient hygiene management, little or no veterinary inputs and marketing problems due to lack of poor infrastructure [3]. Poultry is a major supplier of protein, lipids and vitamins to man but the industry is being confronted by economic and technological constraints [4]. Poultry egg is palatable and it plays important role in bridging the protein gap. A large yolk of poultry egg contains about 60 calories while its albumen contains 15 calories [5]. Thus, egg reduces health hazard resulting from protein malnutrition but its consumption is low in Nigeria. For example, the average intake of eggs per person/ annum in Nigeria was 70 pieces compared to 370 pieces in China [6]. Hence, egg importation has remained on the high side with about 500,000 dozens of egg from United States of America to Nigeria [7].

Domestic fowl is the commonest avian species raised for egg production in Nigeria among other poultry including ducks, guinea fowls, turkeys, pigeons and ostriches [8]. Busari and Okanlawon [9] classified poultry farms into small (< 1000 birds), medium (1000 to ≤ 5000 birds) and large scale (≥ 5000 birds) enterprises. The poultry enterprise has improved the employment opportunity in egg production and marketing in the country. But, most of the farmers lack the technical knowledge and managerial ability thereby incurring huge capital loss and discouragement [10]. Waste disposal is another area of great challenge. Because, the waste generated in form of faeces, offals, dead birds and broken eggs emit foul odour and constitute environmental nuisance that are harmful to both animal and human health [11]. Oyebanjo and Otunaiya [12] earlier reported that 76.4% of poultry farmers did not treat their farm waste to reduce air pollution while the wastes from 63.9% of farms were not utilized. Alabi *et al.* [13] confirmed that chicken droppings usually contaminate the litters and improper disposal lead to air and water pollution as well as breeding of flies.

Meanwhile, poultry manure should be used as a by-product for profitable crop production. Hossen *et al.* [14] stressed that the manure can provide valuable

organic and inorganic nutrients for growing crops. Are *et al.* [15] also affirmed that poultry waste can be utilized to increase soil microorganisms and improve water holding capacity of the soil for proper plant growth. However, the challenges to effective poultry waste management in Nigeria include ignorance, lack of technical knowledge, high management costs, low technology, and lack of enforcement of waste management policies [16].

Therefore, the study was set to investigate the factors affecting the technical efficiency of egg production in Ogun State being a predominant area of poultry production and egg marketing.

The specific objectives are to:

- Describe the socioeconomic characteristics of the poultry farmers and their farming system,
- Analyse the technical efficiency of egg production in the area,
- Examine the efficiency score and performance of specific farm characteristics in egg production, and
- Identify the waste management techniques and their implications on the environment.

MATERIALS AND METHODS

Study area

The study was conducted in Ogun State which is situated within the latitude of 60°N and 80°N and a longitude of 2.50°E and 50°E with a land mass of about 1.7 million hectares, i.e. 1.9% of the total land area in Nigeria. Ogun State is made up of twenty (20) Local Government Areas (LGAs) with estimated human population of 6,379,500 [17]. It is characterized by climate with rainfall between 1211 – 1264 mm and average temperature ranging from 18°-24°C during the rainy season and 30°-35°C during the dry season. These favour crop and livestock production including arable crops, poultry, fishery, forestry and wild life.

Ethical clearance

Ethical clearance was not required in this study.

Study data and sampling technique

Primary data were obtained from egg-based poultry farmers using well-structured questionnaire. A multistage sampling technique was adopted in the selection of the respondents. The first stage involved selection of two (2) LGAs in each of the four divisions of Ogun State as follows; Odogbolu and Ijebu North LGAs from Ijebu Division, Ikenne and Sagamu LGAs from Remo Division, Obafemi-Owode and Odeda LGAs from Egba Division, Yewa North and Yewa South LGAs from Yewa Division. In the second stage, 13-15 poultry farmers were randomly selected from each of the eight (8) LGAs. Subsequently, data from one hundred

and two (102) completed questionnaires were used in the analyses.

Method of data analysis

The socioeconomic data and farming system were analysed using measure of central tendency while stochastic production frontier was adapted to capture the technical efficiency of poultry egg production. A firm is technically efficient if it produces a level of output higher than another firm with the same level of input usage and technology [18]. The technical efficiency component is the use of stochastic frontier model which is extended to measure the inefficiency effect [19]. The stochastic frontier production model has the advantage of allowing simultaneous estimation of individual technical and allocative efficiencies of the farmers as well as the determinants of technical inefficiency [20]. The technical efficiency of an individual farm is defined as the ratio of observed output (Y_i) to the corresponding frontier output (Y_i^*) for the available technology [21]. This is specified as:

$$\begin{aligned} TE &= Y_i / Y_i^* \\ &= \ln \beta_0 + \sum \beta_j \ln x_{ij} + v_i - u_i \\ &= \ln \beta_0 + \sum \beta_j \ln x_{ij} + v_i \end{aligned}$$

so that; $0 \leq TE \leq 1$.

Y is the output in kg, x , denotes the input vector; β is the vector of production function u_i parameters. The frontier production function $F(X|\beta)$ measures the maximum potential output for any particular input vector x while v_i and u_i are the error terms that cause actual production to deviate from the frontier. The v_i is assumed to be independent and identically distributed with zero mean and constant variance ($0, \sigma^2 v$), and is independent of u_i which is a non-negative term representing the deviations from the frontier production and is attributed to controllable factors (technical inefficiency). It is half normal, identically and independently distributed with zero mean and constant variance: $N(0, \sigma^2 u)$.

The estimating equation of the stochastic frontier model is defined by:

$$\ln Y_i = \ln \beta_0 + \beta_1 \ln x_{1i} + \beta_2 \ln x_{2i} + \beta_3 \ln x_{3i} + \beta_4 \ln x_{4i} + \beta_5 \ln x_{5i} + v_i - u_i$$

Where;

Y = Quantity of eggs produced in crates

X_1 = Quantity of feed consumed by birds (kg)

X_2 = Flock size (number of birds)

X_3 = Hired labour (man-day)

X_4 = Drugs/ medication used by birds (ml)

X_5 = Agrochemicals used on farm (litre)

V_i = Random errors (uncontrollable factors)

U_i = Technical inefficiency effect (controllable factors)

The technical inefficiency effect U_i is defined as;

$$U_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \dots + \delta_7 Z_{7i} + e_i$$

Where;

δ_0 = constant term and δ_i = coefficient to be estimated

Z_1 = Age of the poultry farmer (years)

Z_2 = Experience in poultry farming (years)

Z_3 = Formal education (year of schooling)

Z_4 = Marital status (1, if married, 0, otherwise)

Z_5 = Household size (number)

Z_6 = Gender (1, if male, 0, otherwise)

Z_7 = Extension visit per year (number)

Z_8 = Distance to farm from home (km)

e_i = stochastic error term

RESULTS AND DISCUSSIONS

Socioeconomic characteristics of the poultry farmers and their farming system

The descriptive statistics of the poultry farmers in Table 1 reveals that an average poultry farmer was 41.3 years old, majority was male (80.0%), married (56.7%) while 43.3% were either single or once married. This implies that majority of the farmers were young and agile and they had access to family labour. This agrees with the results of [22] which revealed that 72.5% of the poultry egg producers were below 50 years of age. More than half (59.3%) of the poultry farmers were engaged in off-farm work as their primary occupation. This could lead to smallholding of poultry farm. An average poultry

farmer had 4.54 years of farming experience which is considerably low thereby indicating inadequate knowledge of poultry farming techniques. However, 83.3% of the farmers had a minimum of secondary education while only 5.3% had no formal education. This result conforms to [23] who found that majority (69.2%) of the poultry egg producers had tertiary education. This implies that the education will contribute significantly to their skills and decision making.

The result shows that the poultry farms were small-scale (53.9%) while 46.1% was medium-scale. Majority (61.8%) of the enterprises focused only on egg production while 38.2% combined egg production with rearing of broilers, cockerels and/ or turkey. An average poultry farm produced 30.6 crates of egg per day implying a small scale production. About 31.3% of the farm employed 1-3 workers while 68.7% employed up to 6 workers. More so, 60.0% of the farms had no contact with extension service which could disseminate innovation to enhance farm efficiency and productivity while 40.0% had about 3 contacts. Furthermore, 68.0% of the farmers did not subscribe to poultry farmers' association and this may limit their access to modern farm practices and support of government/ private stakeholders.

Table 1: Characteristics of the farmers and their farming system (n = 102)

Characteristics	Class	Number of farmers	%	Mean
Age of farmer (years)	<30	18	17.3	41.3
	30-<40	26	25.3	
	40-<50	35	34.0	
	≥ 50	24	23.3	
Gender	Male	82	80.0	
	Female	20	20.0	
Marital status	Single	40	39.3	
	Married	58	56.7	
	Divorced	3	2.7	
	Separated	1	1.3	
Primary occupation	Poultry farming	41	40.7	
	Other livelihood sources	61	59.3	
Experience of poultry farmer	<5 years	61	59.3	4.54
	5-<10	32	31.3	
	≥ 10	9	8.8	
Education of farmer (years)	None	5	5.3	
	Primary	12	11.3	
	Secondary	32	31.3	
	Tertiary	53	52.0	
Flock size (number of bird)	Small Scale (≤ 1000)	67	65.7	
	Medium Scale (1001- 5000)	35	34.3	
Poultry enterprise combination	Egg production only	63	61.8	

	Egg and Broiler/ cockerel/ turkey production	39	38.2	
Egg production per day (crates)	<25	58	56.9	
	25 - <50	23	22.5	30.6
	50 - <75	17	16.7	
	≥75	4	3.9	
Number of Farm worker	1-3	32	31.3	
	4-6	56	54.7	4.22
	≥6	14	14.0	
Extension visit (number)	None	61	60.0	
	1-2	22	21.3	
	≥ 3	19	18.7	
Membership of poultry farmers association	Member	33	32.0	
	Non-member	69	68.0	

Source: Results of Field Data, 2022

Technical efficiency of the poultry egg farms

The estimates of the stochastic frontier model in Table 2 show that the sigma square of the maximum likelihood estimate is significant at $p < 0.01$ indicating goodness of fit of the model to the data. The significant ($p < 0.01$) factors affecting egg production efficiency were feed (-0.4320), flock size (0.2881) and medication (0.0549). The coefficient of feed is negative implying reducing effect on production perhaps due to overutilization. This finding corroborates [24] who reported that labour and feed inputs were overutilized in poultry farming in Ogun State despite the high cost of feed. The flock size had a significant positive thereby contributing to increased egg production. This could be attributed to low mortality and good health conditions of the birds. Medication had a positive and significant indicating good effect of drugs

and veterinary services maybe as a result of proper administration.

The estimates of the inefficient model revealed that experience in poultry farming (-0.1844), year of schooling (-0.4529), extension visit (-0.0953) and distance to farm (-0.0533) were negative. Hence, they had significant effect in reducing inefficiency in egg production at $p < 0.10$, $p < 0.01$, $p < 0.10$ and $p < 0.05$ respectively. These may be attributed to higher level of knowledge and skills, adoption of modern practices through extension visit and close residence of the farmer to the farm for security purpose. This result contradicts [25] who found that formal education, age of farmers and farm location contributed to inefficient egg production.

Table 2: Maximum likelihood estimates of technical efficiency among the farms

Variables	OLS			MLE		
	Coefficient	S. Error	t-ratio	Coefficient	S. Error	t-ratio
Constant	2.073***	0.7052	2.939	3.4559***	0.6471	5.3405
Feed consumed (kg)	-0.2719*	0.1631	-1.6667	-0.4320***	0.1440	-2.9989
Flock size (number)	0.3077***	6.3656	4.8340	0.2881***	0.0455	6.3242
Hired labour (man/day)	0.0157	0.0343	0.4584	63.0438	2.7412	0.2299
Medication/ drug (ml)	0.0369	0.0382	0.9652	0.0549***	0.0195	2.6039
Agrochemical used (litre)	0.0537**	0.0227	2.3672	0.0381	0.0371	1.0273
Inefficiency model						
Age				0.8353	1.0190	0.8190
Experience in poultry				-0.1844*	0.0982	-1.8778
Formal education				-0.4529***	0.1731	-2.6156
Marital status				-0.0192	0.0306	-0.627
Household size				0.0253	0.0128	0.1969
Gender				-0.1117	0.2096	-0.5330
Extension visit				-0.0953*	0.0532	1.793
Distance to farm				-0.0533**	0.0226	2.352
Sigma squared				0.4796***	0.0624	7.6783
Gamma				0.0823	0.5369	0.1533

Log likelihood function	-83.35
Likelihood ratio test	13.1368

Source: Results of Field Data, 2022 ***significant 1%, **Significant 5%, *Significant 10%

Efficiency level of the poultry farms

Table 3 shows the distribution of technical efficiency scores among the farms. The estimates revealed that 24.5% of the farms performed below technical efficiency level of 0.50 while 75.5% were efficient between 0.51 and 0.96. The mean technical efficiency was 0.729 showing that the farmers were efficient in poultry egg production in spite of the low farming

technology. However, the farmers can improve their production efficiency by 27.1% through adoption of innovations, improved inputs and general modern farm practices. This result supports the finding of Dogan *et al.* [26] which revealed that the mean technical efficiency score of poultry egg farmers in Turkey was 0.99 and the enterprises were determined as technically efficient.

Table 3: Distribution of poultry farms by efficiency level

Range	Frequency	Percentage	Minimum	Mean	Maximum
0.10 – 0.20	0	-			
0.21 – 0.30	0	-			
0.31 – 0.40	5	4.9	0.323		
0.41 – 0.50	20	19.6			
0.51 – 0.60	18	17.6			
0.61 – 0.70	21	20.7			
0.71 – 0.80	23	22.5		0.729	
0.81 – 0.90	12	11.8			
0.91 – 1.00	3	2.9			0.961
Total	102	100.0			

Source: Results of Field Data, 2022

Farm characteristics and efficiency score

The efficiency scores were estimated for specific poultry production factors and characteristic as presented in Table 4. The result shows that the performance of small-scale poultry farm (0.6378) with less than 1000 birds was lower than the medium scale (0.7429) with more than 1,000 birds. The farmers who were engaged in poultry farming as secondary occupation (0.6446) performed lower than mean technical efficiency while the full-time farmers were above the mean efficiency level. Farmers with experience less than 5 years

performed relatively lower (0.6538) than their counterparts who had a minimum experience of 10 years (0.6918). The farmers who had no formal education (0.6282) performed lower than those that attended a minimum of secondary school (0.7013), though, both could not attain the mean efficiency level probably due to lack of technical know-how and extension services. However, poultry farms with 1-3 workers had a higher efficiency performance (0.7514) above the farms with 4-6 workers (0.7182) or more than 6 workers (0.6916) possibly due to over-utilisation of farm labour.

Table 4: Distribution of efficiency score by specific farm characteristics

Farm characteristics	Mean Score	Std. Error of Mean
Average farm	0.7290	0.0091
Flock size		
Small scale (≤ 1000)	0.6378	0.0028
Medium scale ($1001 - \leq 5000$)	0.7429	0.0053
Major occupation		
Poultry farming	0.7417	0.0083
Crop farming / Non-farm activities	0.6446	0.0274
Experience of poultry farmer		
< 5 years	0.6538	0.0122
5 - < 10	0.7557	0.0096
≥ 10	0.6918	0.0103

Formal education		
None	0.6282	0.0316
Primary	0.7673	0.0042
Secondary	0.7013	0.0156
Tertiary	0.7855	0.0427
Number of permanent worker		
1-3	0.7514	0.0509
4-6	0.7182	0.0346
≥6	0.6916	0.0087

Source: Results of Field Data, 2022

Waste disposal practices and implications on the environment

The method of waste disposal has implications on the environment in form of air and water pollution. The results in Table 5 revealed that 27.4% of the farmers bury their poultry wastes inside dung pit and spent an average of ₦22,500.61 on this method of disposal. This method could cause underground water pollution, air pollution and health hazards. About 12.8% of the farmers sun-dry or burn the waste particularly during dry season. So, the expense was minimal at 5 man-days and ₦334.20 probably to buy fuel and matches. Meanwhile, offensive odour and smoke are sources of air pollution which has negative effect on human health over a number of days since the dry matter burns gradually. However, waste from 4.9% poultry farms were collected free of charge and used by farmers as organic fertilizer for crop production. On the other hand, 15.7% of the respondents disposed their poultry waste into canal. In this case, the waste is eventually washed down by flood into streams, rivers and oceans leading to

water pollution with hazardous effect on aquatic animals and rural dwellers. This can lead to the spread of diseases and parasites from farm locations both rural and urban areas. An average farm expended ₦5,570.42 and 3.5 man-days of labour on this method of disposal.

Furthermore, 20.6% of the farmers throw their poultry waste into bush/ vegetation by average of 3 man-days of labour at a cost of ₦4,325.17. The air pollution emanating from this disposal method could be harmful to people that live close to the vegetation. This result corroborates the finding of [27] who reported that the major complaint of neighbours living around the poultry farms was odour (60.0%) that emanates from the poultry houses while 25.0% of the farmers also complained about no dumping site for the waste.

Finally, 18.6% of the poultry farmers treated their waste with chemical to suppress the offensive odour at average cost of ₦10,840.83 in addition to 7 man-days of labour. Though, this is a demonstration of modern technology but the waste is better utilized as organic manure to increase food production.

Table 5: Distribution of farm by waste disposal practices (n = 102)

Disposal Practices	Frequency	Percentage %	Cumulative frequency	Labour (man-day)	Cost of disposal (₦)
Buried in dung pit	28	27.4	27.4	12.5	22,500.61
Sun-drying/ burning	13	12.8	40.2	4.7	334.20
Utilized as manure/ compost	5	4.9	45.1	-	-
Thrown into canal/ river	16	15.7	60.8	3.5	5,570.42
Thrown into bushes	21	20.6	81.4	2.6	4,325.17
Chemical treatment	19	18.6	100.0	7.2	10,840.83

Source: Results of Field Data, 2022

Poultry egg production constraints

The constraints confronted by the poultry farmers were presented in Table 6. The result shows that high cost of feeds/ input was the major constraint confronting 74.5% of farmers followed by poor road network (69.6%) for

egg transportation/ marketing leading to post-harvest loss and inability to access agricultural loan (67.6%) for effective egg production. Other challenges include inadequate capital/ facilities (43.1%), high mortality rate (21.6%), theft/pilferage (14.7%) and lack of trained workers (12.7%). The solution suggested by farmers

include establishment of additional feed-mill centers by government and Poultry Farmers' Association, rehabilitation of rural roads, intensification of extension services among poultry farmers. This result agrees with

the finding of Osinowo and Tolorunju [25] who found that unbearable cost of feeding constituted the major problems (81.66%) confronting egg producers in Ogun State, Nigeria.

Table 6: Problems confronted by the poultry farmers

Constraints	Frequency	Percentage	Rank
Inadequate capital/ facilities	44	43.1	4 th
Lack of access to loan	69	67.6	3 rd
High cost of feeds/ input	76	74.5	1 st
Lack of committed/ trained workers	13	12.7	7 th
Poor road for egg distribution	71	69.6	2 nd
High mortality rate	22	21.6	5 th
Theft/ pilferage	15	14.7	6 th

Source: Results of Field Data, 2022

CONCLUSION AND RECOMMENDATIONS

The findings revealed that the poultry farmers achieved a mean technical efficiency level of 72.9%, though; the medium scale farmers had higher efficiency gains (74.3%) than the small-scale farmers (63.8%). On the average, the farmers have opportunity to increase their egg production efficiency by 27.1%. Farm size should be expanded by increasing flock size and proper medication which have significant increasing effects on technical efficiency. Hence, distribution of adequate production input such as drugs/ vaccines and quality feeds should be ensured by the stakeholders at affordable rate. Meanwhile, overutilization of feed should be avoided while extension services/ training should be intensified to compliment education and farming experience in order to reduce inefficiency in poultry egg production. More so, Awareness and training should be established among crop farmers to adopt organic farming through the use of poultry waste which is available than artificial fertilizer at low cost while such practice will reduce environmental pollution as well as promote food production. However, government should enforce farmers to comply with the policy of proper waste disposal and standard management practices.

REFERENCES

1. MINISTRY OF AGRICULTURE AND COOPERATIVES (MOAC, 2013). Economic Survey for Fiscal Year 2012/2013, Government of Nepal, Singha Durbar, Kathmandu, Nepal
2. FAO (2012). Food and Agricultural Organization statistic online issue. www.fao.org
3. HEISE, H., CRISAN, A. & THEUVSEN, L. (2015). The Poultry Market in Nigeria: Market Structures and Potential for Investment in the Market. *International Food and*
4. ZUBERU, D.K., OREO, L.D. & DANLANDI, F.B. (2015). Economic Appraisal of Small and Medium Scale Performance in Poultry Egg Production in Ogun State, Nigeria. *International Journal of Agricultural Economics and Extension*, 3(6): 158-161.
5. MEMON, I.N., NOONARI, S., ASIF, M., SHAH, S. T., PEERZADO, M.B., PANHWAR, G.M., SETHAR, A.A., KALWAR, G.Y., BHATTI, M.A. & JAMRO, A.S. (2015). Economic Analysis of Poultry Egg Production in Quetta District Balochistan. *Journal of Fisheries and Livestock Production*, 3(3): 137.
6. ODUNTA, A. (2015). National Importance of Poultry Industry in Nigeria. Paper Presentation at the World's Eggs Day, National Conference, October 14th, 2015, Abuja.
7. UNITED STATES DEPARTMENT OF AGRICULTURE (USDA, 2013). International Egg and Poultry Review Nigeria: Market Reports. Retrieved from www.thepoultrysite.com on 12th-12-2014.
8. AKANNI, K.A. & BENSON, O.B. (2014). Poultry Wastes Management Strategies and Environmental Implications on Human Health in Ogun State of Nigeria. *Advances in Economics and Business*, 2(4): 164-171.
9. BUSARI, A.O. & OKANLAWON, I.N. (2015). Economic Appraisal of Small and Medium Scale Poultry Egg Production in Ife and Ilesha Metropolis, Osun State, Nigeria. *Turkish Journal of Agriculture Food Science and Technology*, 3(7): 562-565.
10. NSE-NELSON, F.A., KURUMEH, J.C. & OSONDU, K.R. (2017). Evaluation of Poultry Egg Marketing in Ikwuano Local Government Area of Abia State, Nigeria.

Agribusiness Management Review, 18: 197-221.

- Agro-Science, 17 (1):1-6. DOI: <https://dx.doi.org/10.4314/as.v17i1.1>
11. ONU, D.O., OFFOR, E.I. & OKPARA, B.O. (2015). Poultry Wastes Management Strategies and Environmental Implications in Abia State, Nigeria. *International Research Journal of Agricultural Science and Soil Science*, **5**(6): 159-164.
 12. OYEBANJO, O. & OTUNAIYA, A.O. (2011). Profit Efficiency and Waste Management in Poultry Farming: The Case of Egba Division, Ogun State, Nigeria. *International Journal of Poultry Science*, **10**(2): 137-142.
 13. ALABI, A., AGHIMIEN, C.I., OSASOGIE, D.I. & ERIE, O.G. (2014). Environmental Effects of Poultry Production in Edo State, Nigeria. *American Journal of Experimental Agriculture*, **4**(12): 1773-1782.
 14. HOSSEN, M.S., HOQUE, Z. & NAHAR, B.S. (2015). Assessment of Poultry Waste Management in Trishalupazila, Mymensingh. *Research in Agriculture Livestock and Fisheries*, **2**(2): 293-300.
 15. ARE, K.S., ADELANA, A.O., FADEMI, I.O.O. & AINA, O.A. (2017). Improving Physical Properties of Degraded Soil: Potential of Poultry Manure and Biochar. *Agriculture and Natural Resources*, **51**(6): 454-462
 16. MCALLISTER, J. (2015). Factors Influencing Solid-Waste Management in the Developing World, All Graduate Plan B and other Reports 528, Utah State University, Logan, Utah, 20-75.
 17. NATIONAL POPULATION COMMISSION (2022). The Estimated Population of Nigeria, Abuja, Nigeria
 18. BAMIRO, O.M., PHILLIP, O.A. & MOMOH, S. (2006). Vertical Integration and Technical Efficiency in Poultry (Egg) Industry in Ogun and Oyo States, Nigeria. *International Journal of Poultry Science*, **5**(12): 1164–1171.
 19. RAHMAN, S. (2003). Profit Efficiency among Bangladeshi Rice Farmers. *Food Policy*, **28**: 487-503.
 20. BATTESE, G. & COELLI, T. (1995). A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data, *Empirical Economics*, **20**: 325-332.
 21. OJO, S.O. (2003). Productivity and Technical Efficiency of Poultry Egg production in Nigeria. *International Journal of Poultry Science*, **2**: 459-464.
 22. ODIMEGWE, F.E., BABATUNDE, O.W. OGBONSO, F. & AMBODE, S. (2015). Assessment of the Profitability of Poultry Egg Farming in Ogun State, Nigeria. *African Journal of Poultry Farming*, **3** (4): 092-096.
 23. MERE, C.U., ATER, P.I. & EZIHE, J.A.C. (2017). Analysis of profitability and constraints of Table Egg Production Enterprises in Benue State, Nigeria. *International Journal of Environment, Agriculture and Biotechnology*, **2**(6): 2936-2943.
 24. HABIB, A.O., AFOLAMI, C.A., BALOGUN, O.L. & HABIB, S.T. (2017). Elasticity of Production and Profitability of Feed Milling Systems of Poultry Egg Farmers in Ogun State, Nigeria. *International Journal of Livestock Research*, **7**(11): 132-142.
 25. OSINOWO, O.H. & TOLORUNJU, E.T. (2019). Technical Efficiency of Poultry Egg Production in Ogun State. *Nigerian Journal of Agribusiness and Rural Development*, **1**(51): 51–58.
 26. DOGAN, N., KAYGISIZ, P. & ALTINEL, A. (2018). Technical and Economic Efficiency of Laying Hen Farms in Koya, Turkey. *Brazilian Journal of Poultry Science*, **20**(2): 263-272.
 27. ABAH, H.O., NWANKO, A.U. & ORGEM, C.M. (2019). Waste Management Practices in Selected Poultry Farms and its Effect on the Environment and Human Health in Makurdi, Nigeria. *International Journal of Environment, Agriculture and Biotechnology*, **4**(1): 121-127.