



ANALYSIS OF ECONOMIC EFFICIENCY AMONG BROILER POULTRY PRODUCERS IN JERE LOCAL GOVERNMENT AREA, BORNO STATE, NIGERIA

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Abstract

The study estimated economic efficiency among broiler poultry producers in Jere Local Government Area, Borno State, Nigeria.

Five (5) wards were purposively selected out of the existing fifteen (15) wards in the area. These were areas where broiler

Keywords:

Economic Efficiency, Broiler Poultry Producers, Jere, Borno State, Nigeria

poultry producers are predominantly found. One hundred and fifty (150) broiler poultry producers were

INTRODUCTION

Poultry represents both local and exotic fowls which are raised and fattened for their products. This include eggs, meat and in some cases feathers. Birds that are raised as poultry include fowls, turkey, ducks and geese, among others (Hassan, Ahmadu, Yusuf, Dawang, Rahman, Abdulsalami, & Omokore, 2016). Poultry production consists of two parts: poultry egg production and poultry meat production. In the case of meat type poultry, they are fast growing with very efficient feed to meat conversion ratio. Feed utilization by poultry has dual purpose of body maintenance and growth. The birds feed on properly

randomly and indicates that about at 1%. The study proportionately 97.33% of the broiler recommended that selected from the five poultry producers there is need to re-wards for the study, were economically strategies the through a simple inefficient while 2.67% extension program random sampling were fully efficient in designed for broiler procedure from the list the study area. The poultry farmers in of broiler poultry maximum and order to ensure that producers that was minimum economic they comply with the obtained from their efficiency estimates various recommended association. Data for were 1.0000 and input use that would the study were 0.0100 respectively, maximize their profit. collected from both with a mean of 0.3030. There is also need to primary and The result also improve on the quality secondary information indicates that of adult education sources. The analytical educational level and extension program to tools employed for this off-farm income were educate broiler study includes negative and poultry producers on descriptive statistics, significant at 1% and efficient use of farm data envelopment 10% levels inputs that would their analysis (DEA) and respectively while economic efficiency Tobit regression household size was level. analysis. The finding positive and significant

formulated diet to aid meat or egg production. The industry under egg and meat production has continued to be major livestock industry in Nigeria (Hassan et al., 2016). Substantial number of small, medium, and large scale poultry farms is located in the industry. The Nigerian poultry industry comprises about 180 million birds – Nigeria has the second largest chicken population in Africa after South Africa (Sahel, 2015) – producing 650 000 tons of eggs and 300 000 tons of poultry meat in 2013 (FAOSTAT, 2017). Nigeria hosts more than 45% of the poultry in the West Africa sub region (Oladimeji, Abdulsalam, Ajao, Abdulrahman & Abdulazeez, 2017; World Health Organization (WHO), 2006). Poultry production in Nigeria amounts up to 454 billion tons of meat and 3.8 million eggs per year, about 80

million chicken are raised in extensive systems, 60 million in semi-intensive systems and the remaining 40 million in intensive systems (ASL 2050, 2018). The Nigerian poultry sub-sector has a great potential for wide range of reasons. According to Oduntan (2016), the Nigeria poultry sub-sector contributes 25% of the agriculture Gross Domestic Product (GDP) of the country and it is probably the single largest sub-sector in agriculture. Poultry farming has considerable potentiality for providing income opportunities, reducing malnutrition, generating employment opportunity and alleviating poverty especially for small farmers in Nigeria (Hassan et al., 2016). Furthermore, small farmers can start poultry farm at their homestead area at low cost compared to other livestock farming. In addition, poultry farming also provides opportunities for other industries like feed mills, hatcheries etc.

The production growth in poultry sub-sector needs to be nurtured through either technological progress or an increase in efficiency in order to stand the demand pressure and self-sufficiency of egg and meat production (Hassan et al., 2016). Evaluating poultry farms efficiency is therefore essential as this may possibly be the initial stage in a process that result to significant resources utilization. The increasing competitiveness of the domestic and foreign markets has demanded the improvement of management practices by the farmers in order to increase the technical and economic efficiency of their farms (Carvalho, Zilli, Mendes, Morello & Bonamigo, 2015). Farm profitability depends on internal and external factors. The main internal factors are economy of scale; farmer's age; use of machinery; land productivity; application of management technologies etc (Carvalho et al., 2015). Despite the nutritive value of poultry meat, its production in Nigeria is grossly inadequate as reflected in the wide gap between demand and supply of the product (Ohajianya, Mgbada, Onu, Enyia, Henri-Ukoha, Ben-Chendo & Godson-Ibeji, 2013). This could be attributed to numerous problems that poultry farmers in Nigeria are facing. These problems include low capital base, inefficient management, technical inefficiency, economic inefficiency, diseases and parasites and poor housing (Ohajianya et al., 2013). This study estimated economic

efficiency among broiler poultry producers in Jere Local Government Area, Borno State, Nigeria.

Objectives of the Study

The main objective of the study was to estimate economic efficiency among broiler poultry producers in Jere Local Government Area, Borno State, Nigeria. The specific objectives were to: estimate the level of economic efficiency among the broiler poultry producers; and estimate the determinants of economic inefficiency among the broiler poultry producers.

Hypothesis of Study

The following hypotheses were postulated for testing: H_0 : there is no significant relationship between socio-economic determinants economic inefficiency; and H_a : there is significant relationship between socio-economic determinants economic inefficiency.

THEORETICAL FRAMEWORK

The two key techniques used in measuring firm efficiency based on the microeconomics theory of production are the parametric stochastic frontier (SFA) production function and a non-parametric Data envelopment Analysis (DEA) approach. The measurement of efficiency of any decision making unit DMU (hospitals, bank, insurance companies, and firms or farms) that use multiple-inputs and generate multiple-outputs is complex and comparisons across units are difficult (Bhat et al., 2001). In their study, Charnes & Cooper (1984) proposed a non-parametric technique known as DEA approach in such situations to measure efficiency. The DEA employs linear programming methods to create a frontier. The DEA frontier is composed of real observations and does not depend on the description of a functional form for the frontier. The DEA is also free from assumptions about its form and makes no assumptions about the distribution of the efficiency. In situations where there is need for specification of multiple-outputs, the DEA would be the most desired method, because it can more easily accommodate multiple-outputs. The

deterministic nature of the DEA raises questions about its usefulness despite these advantages in situations where statistical noise is likely to affect the DEA results. Another criticism often levelled at the DEA approach is lack of formal tests available to assess the validity of the functional form generated by optimization of the DEA problem. The SFA is a single-output multiple-input approach that can cope with statistical noise, which may be present in the data as a result of measurement errors, variation in weather conditions and missing variables. According to Henderson & Kingwell (2002), the DEA approach is superior to SFA with regards to the extent of beneficial information it provides despite its limitations.

The DEA method for instance, pinpoints inefficient firm that have similar production mix for every technically efficient firm (that is their efficient peers). This may perhaps be valuable for farm management because it provides a practical example for the inefficient farms on how much more productive they might be. Similarly, Coelli et al. (1998) indicated that the DEA may be the preferred method in agricultural industries with controlled production environments and where the quality of inputs and outputs does not vary from firm to firm.

METHODOLOGY

Study area

The study area was Maiduguri Metropolis of Borno State, Nigeria. It lies within latitudes 11⁰90 N and 12⁰05N and longitudes 13⁰20E and 12⁰20E, it occupies a total landmass of 160 square kilometer (Ministry of Land and Survey (MLS), 2018), with a total mass of about 50,778 square kilometers. It shares boundaries with Konduga to South and Jere local government area to the Northeast. Maiduguri Metropolis has a population of 521, 492 people, which was projected to be 706, 597 for 2017 based on an annual growth rate of 2.8 per cent (National Population Commission (NPC), 2006). The study area is characterized by dry and rainy seasons. It has a short rainfall period of about three months that lasts from July to September with an average of 647 mm per annum. The temperature ranges between 35⁰C and 44⁰C for the greater part of the year (Nigeria Metrological Station, 2018). The vegetation of the study area comprises of

trees, shrubs and grasses. The major food crop cultivated are maize, millet, sorghum, rice, wheat, cowpea and groundnut as well as vegetables such as onion, tomato, cabbage, lettuce, spinach and watermelon. Livestock commonly produced are cattle, sheep, goat, poultry and fish farming.

Sampling Technique

A total of five (5) wards were purposively selected out of the existing fifteen (15) wards in the area. These were areas where broiler poultry farmers are predominantly found. The wards are Gamboru I, Gwange, Gamboru II, Bolori and Bulabulin. A total of one hundred and fifty (150) broiler poultry farmers were randomly and proportionately selected from the five wards for the study, through a simple random sampling procedure from the list of broiler poultry farmers that was obtained from their association.

Method of Data Collection

Data for the study were collected from both primary and secondary information sources. The secondary sources of information included journal, textbooks, internet, conference papers, past projects, dissertation etc. The primary data were collected using structured questionnaire that would be administered to 150 broiler poultry farmers in the study area. Data were collected on total number of chicks in the farm (number); total quantity of feed (kg); drugs & Vaccines (liters); family labour (man-days); hired labour (man-days); cost incurred on other inputs (N), cost of chicks (N), cost of feed (N), cost of drugs & vaccines (N), opportunity cost of family labour (N), cost of hired labour (N), and cost incurred on other inputs (N). Data were also collected age of farmer in years, years spent in formal education, number of persons in the household, experience in broiler poultry farming in years, broiler poultry production income in naira, access to credit facilities: 1 if the farmer has access to credit and 0 otherwise, extension contacts: 1 if frequent contact with extension agents and 0 otherwise, and membership of poultry producers association: 1 member, 0 otherwise.

Analytical Techniques

The analytical tools employed for this study includes descriptive statistics, data envelopment analysis (DEA) and Tobit regression analysis.

Data Envelopment Analysis Model

The selection of input or output-oriented DEA model depends on the quantities of inputs or output the broiler poultry farm have (Coelli et al., 1998). Since farmers have more control over inputs than output, we therefore employed the input-oriented DEA model in this study. The overall technical efficiency and pure technical efficiency under the assumption of constant returns to scale (CRS) and variable returns to scale (VRS) based on the input -oriented DEA model following Coelli et al. (1998) is stated below. The input-oriented constant return to scale (CRS) is specified as:

$$\begin{aligned} & \text{Min } \theta, \lambda \theta \\ & \text{Subject to} \\ & -y_i + Y\lambda \geq 0 \\ & \theta x_i - X\lambda \geq 0 \\ & \lambda \geq 0 \end{aligned}$$

Where:

Y_j = output matrix for N broiler poultry farms

θ_j = overall technical efficiency of the ith broiler poultry farm

λ_j = N x 1 constraints

X_j = input matrix for N broiler poultry farms

y_i = output of the ith broiler poultry farm (Total quantity of broiler poultry birds produced (kg))

x_i = input vector of $x_{1i}, x_{2i}, \dots, x_{5i}$ inputs of the ith broiler poultry farm

x_{i1} = Total number of chicks in the farm (number)

x_{i2} = Total quantity of feed (kg)

x_{i3} = Drugs & Vaccines (liters)

x_{i4} = Hired labour (man-days)

x_{i5} = Family labour (man-days)

$i = 1, 2, 3$, broiler poultry farms

The input-oriented variable return to scale (VRS) DEA model for calculation of pure technical efficiency is expressed (Coelli et. al., 1998) as:

$$\begin{aligned} & \text{Min}_{\theta, \lambda} \theta, \\ & \text{Subject to} \\ & -y_i + Y\lambda \geq 0 \\ & \theta x_i - X\lambda \geq 0 \\ & N1'\lambda = 1 \\ & \lambda \geq 0 \end{aligned}$$

Where:

θ = the pure technical efficiency of ith broiler poultry farm, $N1'\lambda=1$ is a convexity constraint which ensure that an inefficient farm is only benchmark against farms of similar size. While the scale efficiency can be estimated by dividing the overall technical efficiency (TE_{CRS}) by pure technical efficiency (TE_{VRS}). It is expressed as:

$$SE = TE_{CRS} / TE_{VRS}$$

Where:

$SE = 1$, implies scale efficiency (SE) or constant return to scale (CRS)
 $SE < 1$, implies scale inefficiency. The farms scale inefficiency arise due to presence of either increasing returns to scale or decreasing return to scale. This can be determined by estimating another DEA model under non-increasing returns to scale (NIRS). Following Coelli, et al. (1998), input oriented (VRS) DEA model under non-increasing returns to scale (NIRS) is expressed as:

$$\begin{aligned} & \text{Min}_{\theta, \lambda} \theta, \\ & \text{Subject to} \\ & -y_i + Y\lambda \geq 0 \\ & x_i - X\lambda \geq 0 \\ & N1'\lambda \leq 1 \\ & \lambda \geq 0 \end{aligned}$$

According to Haji (2006), the standard procedure for the estimation of economic efficiency is first solving the cost minimization problem by DEA and then defining the economic efficiency as the ratio of minimum cost

to the observed cost. It is stated following Coelli, et al. (1998), cost minimization DEA model as:

$$\begin{aligned} & \text{Min } \lambda, x_i^E w_i x_i^E \\ & \text{Subject to} \\ & -y_i + Y\lambda \geq 0 \\ & x_i^E X\lambda \geq 0 \\ & N1' \lambda = 1 \\ & \lambda \geq 0 \end{aligned}$$

Where:

w_i = vector of input price $w_{i1}, w_{i2}, w_{i3}, w_{i4}, w_{i5}$ of the i th farm

x_i^E = cost minimizing vector of input quantities for i th farm

N = total number of farms in the sample

w_{i1} = Cost of chicks (N)

w_{i2} = Cost of feed (N)

w_{i3} = Cost of drugs & vaccines (N)

w_{i4} = Cost of hired labour (N)

w_{i5} = Opportunity cost of family labour (N)

$i = 1, 2, 3$, broiler poultry farms

The economic efficiency (EE) is the ratio of minimum cost and observed cost. Therefore, economic efficiency = minimum cost / observed cost. It is expressed as:

$$EE = w_{ij} x_{ij}^E / w_{ij} x_i$$

Tobit Regression Analysis

The economic efficiency estimates obtained from the solution of the DEA problem at the first stage were subtracted from one and later regressed on determinants of inefficiency at the second stage using a Tobit regression model. The economic inefficiency score (dependent variable) were obtained by deducting the economic efficiency scores from one following Ismail (2015), Ogunyinka & Ajibefun (2004) and Featherstone et al. (1997). The economic inefficiency estimates regressed on the determinants of inefficiency with a Tobit model was appropriate since the

inefficiency estimates ranged between zero and unity (Tijani et al., 2017). The reduced form of the Tobit regression model is expressed as:

$$\text{Economic Inefficiency}_i = \alpha_0 + \alpha_1 Z_{i1} + \alpha_2 Z_{i2} + \alpha_3 Z_{i3} + \alpha_4 Z_{i4} + \alpha_5 Z_{i5} + \alpha_6 Z_{i6} + \alpha_7 Z_{i7} + \varepsilon_i$$

Where:

Economic Inefficiency_{ij} = inefficiency score for ith broiler poultry farmer (i.e. economic inefficiencies scores);

α_0 = intercept coefficient;

$\alpha_1 - \alpha_{18}$ = parameters to be estimated;

Z_1 = age of a farmer squared (years);

Z_2 = educational level (years spent in formal education);

Z_3 = household size (number);

Z_4 = experience in broiler poultry farming (years);

Z_5 = broiler poultry farm income (N);

Z_6 = Non-farm income (N)

Z_7 = Off-farm income (N)

ε = error term

$i = 1, 2, 3 \dots N$ broiler poultry farms

RESULTS AND DISCUSSIONS

Economic Efficiency among Broiler Poultry Producers

The economic efficiency among broiler poultry producers was estimated using data envelopment analysis (DEA). The findings in table 1 indicates that about 97.33% of the broiler poultry producers were economically inefficient while 2.67% were fully efficient in the study area. The maximum and minimum economic efficiency estimates were 1.0000 and 0.0100 respectively, with a mean 0.3030. On the average, the broiler poultry producers were operating at 30.30% efficiency level. This indicates about 69.70% economic inefficiency exist among the broiler poultry producers in the study area. This further implies, high prospect of reducing amount of inputs to enhance the broiler poultry producer's economic efficiency in the study area.

Table 1: Distribution of Economic Efficiency among Broiler Poultry Producers

Efficiency Class	Frequency	Percentage (%)
0.001-0.100	15	10.00
0.101-0.200	43	28.67
0.201-0.300	35	23.33
0.301-0.400	20	13.33
0.401-0.500	15	10.00
0.501-0.600	10	6.67
0.601-0.700	04	2.67
0.701-0.800	01	0.67
0.801-0.900	02	1.33
0.901-0.999	01	0.67
1.000	04	2.67
Total	150	100
Minimum Efficiency	0.0100	
Maximum Efficiency	1.0000	
Mean Efficiency	0.3030	

Source: Computed from Field Survey Data, 2018.

Determinants of Economic Inefficiency among Broiler Poultry Producers

The determinants of economic inefficiency were estimated by regressing the economic efficiency scores against the age of farmer squared, educational level, household size, and experience in broiler poultry farming, broiler poultry farm income and non-farm income specified in the Tobit regression model. The finding in table 2 indicates that educational level and off-farm income were negative and significant at 1% and 10% levels respectively while household size was positive and significant at 1%. The negative coefficient of educational level suggests that the higher the level of broiler poultry producer's education the more likely the farmer would be economically efficient.

The negative coefficient of off-farm income implies that economic inefficiency decreases with increase in broiler poultry producer's off-farm income. This might be due to the fact that broiler poultry producers who earn higher income from off-farm activities can purchase improved inputs

that increase output. The positive coefficient of household size suggests that broiler poultry producers with large number persons in their household tend to be economically inefficient. This might be due to the large number of persons in the household that increases household consumption expenditure.

Table 2: Determinants of Economic Inefficiency among Broiler Poultry Producers

Items	Estimated Parameter	Coefficients	Standard Error	T-values
Constant	Z ₀	0.2909631	0.1225729	2.37**
Age of farmer Squared	Z ₁	0.00254	0.00489	0.52 ^{NS}
Educational level	Z ₂	-0.0081109	0.0028549	-2.84***
Household size	Z ₃	0.0169254	0.0064362	2.63***
Experience in broiler poultry farming	Z ₄	-0.0008199	0.0027302	-0.30 ^{NS}
Broiler poultry farm income	Z ₅	1.03e-07	9.29e-08	1.11 ^{NS}
Non-farm income	Z ₆	1.41e-07	6.94e-07	0.20 ^{NS}
Off-farm income	Z ₇	-1.63e-06	9.97e-07	-1.64*
Log Likelihood		42.84336		
Log Likelihood Ratio		50.24(0.0000***)		

Source: Estimated using field survey data, 2018, *= Significant at 10%, **= Significant at 5%, *** = Significant at 1%

CONCLUSION AND RECOMMENDATIONS

The importance of poultry to national economy cannot be over emphasized as it has become popular for the small holders that have contributed to the economy of the country. The study concludes that there was high prospect of reducing amount of inputs to enhance the broiler poultry producer's economic efficiency in the study area. The study also indicates that educational level and off-farm income reduce economic inefficiency while household size increase economic inefficiency in the study area. Based on findings of the study, the following recommendations were made:

- i. There is need to re-strategies the extension program designed for broiler poultry producers in order to ensure that they comply with

the various recommended input use that would maximize their profit.

- ii. There is also need to improve on the quality of adult education extension program to educate broiler poultry producers on efficient use of farm inputs that would improve their economic efficiency level.

REFERENCES

- ASL 2050 (2018). Livestock production systems spotlight Nigeria. FAO, Rome, Italy.
- Bhat, R., Verma, B. B., & Reuban, E. (2001). Hospital Efficiency and Data Envelopment Analysis: An Empirical Analysis of District Hospitals and Grant-in-Aid Hospitals in Gujarat State of India. Indian Institute of Management, Ahmedabad, Guzrat, India, 40pp.
- Carvalho, E. H., Zilli, J. B., Mendes, A. S., Morello, G. M., & Bonamigo, D. V. (2015). Main factors that affect the economic efficiency of broiler breeder production. *Brazilian Journal of Poultry Science*, 17(1), 11-16.
- Charnes, A., & Cooper, W. W. (1984). Preface to topics in data envelopment analysis. *Annals of Operations research*, 2(1), 59-94.
- Coelli, T. J., Rao, D. P., O'Donnell, C. J., & Battese, G. E. (1998). An introduction to productivity and efficiency analysis. Springer Science: New York.
- FAOSTAT. (2018). Food and Agricultural Organization of the United Nations. www.fao.org/faostat/en/#data/QA
- Featherstone, A. M., Langemeier, M. R., & Ismet, M. (1997). A nonparametric analysis of efficiency for a sample of Kansas beef cow farms. *Journal of Agricultural and Applied Economics*, 29(01), 175-184.
- Food and Agriculture Organization, FAO (2006). Livestock statistic; 2006.
- Haji, J. (2006). Production efficiency of smallholders' vegetable-dominated mixed farming system in eastern Ethiopia: A non-parametric approach. *Journal of African Economies*, 16(1), 1-27.
- Hassan, A. A., Ahmadu, J. H., Yusuf, O., Dawang, N. C., Rahman, S. A., Abdulsalam, Z., & Omokore, D. F. (2016). Evaluation of Production Efficiency of Poultry Egg Farms in Kaduna State, Nigeria: An Application of Data Envelopment Analysis. *Journal of Animal Production Research*, 28(1), 179-188.
- Henderson, B. B., & Kingwell, R. S. (2002, February). An Investigation of the Technical and Allocative Efficiency of Broadacre Farmers. In

- Conference (46th), Canberra from Australian Agricultural and Resource Economics Society. Australia.
- Ismail, E. A. R. (2015). A Tobit Regression Approach Based on DEA Efficiency Scores. *Global Journal of Engineering Science and Research Management*. 2(4): (April, 2015).
- Ministry of Land and Survey (MLS) (2018). Maiduguri, Borno State, Nigeria Office Memo File
- National Population Census (2006), Human Population Figures of Census in Nigeria.
- Nigeria Metrological Station (2018). Meteorological Data, Office Memo File, Maiduguri Borno State, Nigeria.
- Oduntan, A. (2016). "The Role of Poultry Industry in Economic Revival of Nigeria". May, 23rd 2016. <http://businesstimesafrica.net/index.php/agriculture/item/1196-nigeria-poultry-contributes-25-to-gdp>, Accessed on 11/11/2019 by 11.42 AM
- Ogunyinka, E. O., & Ajibefun, I. A. (2004). Determinants of technical inefficiency on farm production: Tobit analysis approach to the NDE farmers in Ondo State [Nigeria]. *International Journal of Agriculture and Biology (Pakistan)*.
- Ohajianya, D. O., Mgbada, J. U., Onu, P. N., Enyia, C. O., Henri-Ukoha, A., Ben-Chendo, N. G., & Godson-Ibeji, C. C. (2013). Technical and economic efficiencies in poultry production in Imo State, Nigeria. *Journal of Experimental Agriculture International*, 927-938.
- Oladimeji, Y. U., Abdulsalam, Z., Ajao, A. M., Abdulrahman, S., & Abdulazeez, R. O. (2017). Profit Efficiency of Broiler Production among Public Servant Household Heads in Kwara State, Nigeria: A Coping Strategy. *Asian J. of Econs. Bus. and Acc*, 2(2), 1-8.
- Sahel (2015). An Assessment of the Nigerian Poultry Sector. <http://sahelcp.com/anassessment-of-the-nigerian-poultry-sector/>. SAHEL 11: 1-3.
- Tijani, B. A., Latif, I. A. Shamsudin, M. N. and Kamarulzaman, N. H. (2017). Economic Efficiency among Oil Palm Smallholders According to Crop Age in Johor Malaysia. *Int. J. Agric.Sc & Vet.Med*. Vol. 5, No. 2, 2017.
- World Health Organization, WHO (2006). *Livestock statistics; 2006*.