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Cost Function and Profitability Analysis of Broiler Production in Edo State, Nigeria.

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Abstract
There has been a lingering problem of finding adequate means of increasing net returns to farmers in the broiler business. These farmers are largely untrained, and may not be able to determine the specific factors that constitute production cost and how these factors affect overall farm profit. This study therefore, carried out a cost function and profitability analysis of broiler production in Edo State, Nigeria. A multi-stage sampling procedure was employed in selecting the 140 broiler farmers interviewed for the study. The Cost function analysis was carried out using the Stochastic Frontier technique, while the Budgetary Analysis Technique was used in analysing the profitability of respondents in broiler production. Results obtained from the study indicated that all the explanatory variables, with the exception of medication cost, conformed to a priori expectation as the estimated coefficients for output, bird cost, feed cost and labour cost gave positive values. The result of the t – test showed that output and expenses on stock size were statistically different from zero at 1% and 5% levels of significance respectively, indicating that these variables significantly affected production cost in the study area. The effects of output and stock size on production cost suggest that there were significant economies to be exploited by broiler farmers in the study area. Broiler farmers on the average, reared about 666 birds per batch and produced about 1,785 kg of birds at an estimated total variable cost of ₦ 659,683 and sold at an average price of ₦ 811 per kilogram, earning an average gross margin per production period of ₦ 624,158. The estimated gross margin per bird was ₦ 937, indicating that broiler production was profitable in the study area, with a return per naira invested of 95 kobo. The study concluded that, though broiler production enterprise was found to be profitable, significant gaps exist that could be exploited by broiler farmers in the study area, in order to achieve the neoclassical assumption of optimum profit.

Keywords: Broiler, Budgetary Analysis, Cobb-Douglas, Cost Function, Maximum Likelihood, Profitability, Stochastic Frontier.

Introduction
The poultry population in Nigeria has been estimated to be 140 million [1]. In the past, poultry farming involved raising chickens in the backyard for daily egg production and family consumption. Poultry business has changed from subsistence to commercial poultry farming [2]. This agrees with the findings of [3], that poultry farming is now a huge business that is split into several operations including hatcheries, broiler farms for meat production, pullet farms for egg production etc. According to [3], the poultry industry has emerged as the most dynamic and fastest expanding segment in the animal husbandry sector.

Chicken (*Gallus domesticus*) as an integral part of poultry, is a very important bird usually raised for economic benefits. Broilers are chickens raised for meat production [4]. These are specially developed breeds that have the ability of quick growth and feed conversion efficiency [5]. Several breakthroughs in poultry science have led to the development of genetically superior breeds capable of higher meat production, even under adverse climatic conditions that offer the opportunities to expand the production of poultry on a large scale. Poultry keeping has some advantages over other livestock production, some of which include, the fact that they are good converters of feed into useable proteins in meat and eggs, production cost per unit is relatively low, returns to investment is high if properly taken care of and lastly it has a short production cycle such that capital is not tied down over a long period [6]. This is in line with the findings of [7], that in comparison with beef industry, poultry enjoys a relative advantage of ease of management, higher turnover, quick returns to capital invested and wider acceptance of its products for human consumption. The major component of poultry output is meat and it is mainly from broilers, and it accounts for two-thirds of the value of output while eggs account for the remaining one-third [5].

Poultry production has been identified as a means of ensuring sustainable family income. It can be established with minimum capital and as a side project [8]. Moreover the birds can fend for themselves on free range without much

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care [9]. Depending on the farm size, broiler farming can be the main source of family income or can provide subsidiary income to farmers throughout the year. Broilers are marketed at an average age of around 56 days, it is a short term enterprise and therefore a number of batches can be raised within a year [2]. Broiler production is carried out in all parts of the country with no known religious, social or cultural inhibitions associated with their consumption. The structure of the poultry industry in Nigeria is represented by approximately 40% of commercial operations and 60% of backyard poultry farmers [10].

The poultry industry has a high multiplier effect. It generates direct employment in farming, hatcheries and pharmaceutical sectors. It generates employment in the processing and marketing sectors thus augmenting employment in both rural and urban areas [5]. The industry is one of the sub – sectors of agriculture in Nigeria that has developed to the status of agribusiness with the primary aim of profit maximization, as distinct from subsistence production [11]. While it is obvious that profit can be made, a condition necessary for more producers to enter the business under a competitive enterprise environment is the issue that these farmers are largely untrained, and may not be able to estimate in measurable terms, their level of profitability. Another question is whether the farmers would be able to determine the specific factors that constitute production cost and how these factors affect overall farm profit?

Broiler farmers need to seek for means of increasing net returns by reducing production costs, profit being a negative function of cost. This stems from the fact that farmers have little or no control over the forces of demand and prices for their products; they are virtually sentenced to be "price takers" in an assumed pure competitive market. The study therefore, sought to answer two questions. Firstly, how profitable is broiler production among broiler farmers in Edo State? Secondly, what are the specific factors that affect the cost of broiler production, and by implication, accruable profit in the study area?

The objectives of the study were thus to determine the profitability of broiler production among the respondents. Secondly, to estimate and analyze the cost function for broiler production in the study area.

Methodology

The Study Area: The study was conducted in Edo State, Nigeria. The State lies within the geographical co-ordinates of Longitudes 05^{o} 04' and 06^{o} 43' East of the Greenwich meridian and Latitudes 05^{o} 44' and 07^{o} 34' North of the Equator. The State is characterized by a tropical climate that ranges from humid to sub-humid at different times of the year, two distinct seasons – rainy and dry seasons and an average temperature ranging from a minimum of 24^{o}C to a maximum of 33^{o}C. The three distinct vegetations identified in the State are Mangrove Forest, Fresh Swamp and Savannah vegetations. The major occupations of Edo people outside widespread employment in the civil service are trading, teaching, farming (including poultry production), fishing, metal and wood work, carving and other related artisanal endeavours.

Sampling Techniques and Sample Size: A multi stage sampling procedure was employed in selecting respondents for this study as follows:

Stage 1: The three Agro-Ecological Zones of the State (Edo South, Central and North) as delineated by Edo State Agricultural Development Programme (ADP), were purposively selected in order to have a State wide coverage.

Stage 11: Three Local Government Areas (LGAs) were randomly selected from each of the three Agro – Ecological zones in the State, making a total of nine LGAs. The selected LGAs are: Ikpoba Okha, Oredo and Ovia North East from Edo South; Esan South East, Esan Central and Igueben from Edo Central and Etsako East, Owan East and Owan West from Edo North.

Stage 111: Snowballing sampling technique was used to select 70 respondents from each zone in order to have equal representation of the zones. A total of 210 respondents were sampled out of which 140 presented useful data for analysis, giving a response rate of 67%. The data from the remaining 70 respondents could not be used, due to obvious inconsistencies and perceived exaggerations in the information provided. The highest response rate was obtained from Edo South (86%) while Edo North had the lowest response rate of 46%.

Method of Data Collection: The primary data used in this study were obtained from a cross - sectional survey of broiler farmers in the State via the use of a well structured questionnaire. Data were collected on the socioeconomic characteristics of the farmers, matured weight of broilers, farm size, and number of batches reared annually, amount and cost of labour, feed and medication used, other variable costs, weight of matured broilers, price of matured broilers and constraints faced by the broiler farmers.

Method of Data Analysis

***Profitability Analysis*:** Profitability of production was estimated with the use of Budgetary Analysis Techniques. Two profitability indicators (gross margin, and return per naira invested) were estimated.

Gross Margin Technique: The gross margin model is expressed as follows;

$$GM = TR - TVC \quad \ldots\ldots (1)$$

Where; GM = Gross Margin, TR = Total Revenue and TVC = Total Variable Cost.

*Return per Naira Invested***:**

$$R/I = GM / TVC \quad \ldots\ldots (2)$$

Where; R/I = Return per naira Invested, GM = Gross Margin, TVC = Total Variable Cost [12, 13, 14 and 15].

Cost Function Analysis: The linearised Cobb – Douglas form of the Stochastic Frontier Cost Function for estimating farm level overall economic efficiency is specified explicitly as;

$$\ln C = a_0 + a_1 1nk_{1i} + a_2 \ln k_{2i} + a_3 \ln k_{3i} + a_4 \ln k_{4i} + a_5 \ln k_{5i} + (V_i + U_i) \quad \ldots\ldots (5)$$

[16]

Where: C = total production cost, ln = natural logarithm, a_0-a_4 = econometric parameters of the cost function to be estimated, k_1 = output produced (kg), k_2 = cost of day old chicks (₦), k_3 = feed cost (₦), k_4 = cost of labour (₦), k_5 = cost of medication (₦), V_i = random error term, which captures the random variation in output, which are due to the factors that are not within the influence of the producer. It is assumed to be independent of U_i, identical and normally distributed with zero mean and constant variance $(0, \delta^2)$.

U_i = non – negative random error term representing the deviations from the frontier cost function, which is attributed to controllable factors (technical inefficiency). It is independent of V_i, half normal and identically distributed with zero mean and constant variance $(0, \partial^2)$.

However because inefficiencies are assumed to always increase costs, error components have positive signs [17]. The Frontier Cost Function was Estimated using the Maximum Likelihood Methods as obtained from the FRONTIER version 4.1c [16].

Other estimated parameters include sigma squared (δ^2) which indicates the goodness of fit of the model used, and is expressed as:

$$\delta^2 = \delta^2_v + \delta^2_u \quad \ldots\ldots (10)$$

Where: δ^2 = overall variance of the model, δ^2_v = variance of error term due to noise, δ^2_u = variance of error term due to technical inefficiency effects. Also, γ (gamma) was estimated. It measures the total variation of broiler output cost from the frontier output cost which can be attributed to technical inefficiency [18]. It is expressed as:

$$\gamma = \delta^2 u / \delta^2 \quad \ldots\ldots (11)$$

By estimation, $0 \leq \gamma \leq 1$. If $\gamma = 0$, it implies that all deviations from the frontier are due entirely to noise. If $\gamma = 1$, it implies that all deviations are due to technical inefficiency effects.

Results and Discussion

Profitability Analysis of Broiler Production in the Study Area: Results presented in Table 1 show that overall broiler production was carried out on small scale basis, following the classification of size by Omotosho and Ladele [19]. Chukwuji, *et al.,* [20], also demonstrated that broiler farmers were characteristically smallholders, as majority of their stock were less than 1,000 birds at a time. The findings of Yusuf and Malomo [21] and Taru, *et al.* [22], showed that majority of poultry farmers operated on small scale basis. On the average, broiler farmers in the study area reared about 666 birds per batch and produced about 1,785 kg of birds at an average price of ₦ 811 per kilogram. The average gross return per respondent was estimated at ₦ 1,283,841.

The results also indicate that variable cost of production was the major cost associated with broiler production. Since the farmers operated generally on small scale basis (666 birds on the average) over 80% of them used parts of their compounds/homes while the remaining few used rented facilities to rear both broilers and layers. This further corroborates the assertion of Sani *et al.,* [8] and Oladeebo and Ambe – lamidi [23], that poultry production requires minimal capital investment. This is a further justification for the use of gross margin analysis in the estimation of the profitability of an enterprise with negligible fixed cost. The total variable cost included cost of day old chicks, feed, labour, medication and others (wood shavings and sundry miscellaneous expenses). The cost of feed per batch was ₦ 418,242 representing 73 % of the total variable cost. This agrees with the findings of Adepoju [24], that the major cost element in poultry production was feed cost, which accounted for about 80% of production cost. This also compares favourably with findings of Okafor *et al.* [25] and Effiong and Onyeweaku [2], that feed cost is the major important single cost item associated with poultry production. This underpins the importance of feed availability and affordability, if poultry production is to be improved.

The average gross margin for broiler production in the study area, which represents the portion of total sales revenue that an enterprise retains after incurring the direct costs associated with producing the goods sold by the enterprise, was estimated to be ₦ 624,158 and the average gross margin per bird was ₦ 937, indicating that broiler production was profitable in the study area. The average return on naira invested was 0.95, indicating that every ₦ 1 invested in broiler production by the respondents earned an average amount of 95 kobo for the farmer. These values indicate that returns from broiler production were substantial, notwithstanding the high cost of production. Broiler

production was found to be profitable in the study area and thus, effort at expanding this important subsector of our micro economy would be a good policy decision.

Table 1: Mean Gross Margin and Return per Naira Invested in Broiler Production

Item	Unit of measurement	Amount
Average number of birds stocked		666
Average output (Survivals x average weight)	Kilogramme	1785
Price per kg	Naira	811
Total revenue (Survivals x price per bird)	Naira	1,283,841
Total cost of day old chicks	Naira	123,124
Feed cost	Naira	481,124
Labour cost	Naira	36,499
Medication cost	Naira	17,818
Others	Naira	1000
Total variable cost	Naira	659,683
Gross margin	Naira	624,158
Gross margin per bird	Naira	937
Return on investment	Naira	0.95

Source: Survey Data, (2012).

Table 2: Result of the Maximum Likelihood Estimates of the Cobb – Douglas Frontier Cost Function in the Study Area

Variable	Parameter	t - value
Constant	2.94	0.87
Output	0.88	8.84*
Bird cost	0.33	1.74**
Feed cost	0.29	1.04
Labour cost	0.15	0.92
Medication cost	-0.03	-0.02
Sigma squared	0.06	0.75
Gamma	0.02	0.19
Log likelihood	-4.03	

Source: Survey Data, (2012).
*Significant at 1 % level
** Significant at 10 % level

Cost Function Analysis

The result (as presented in Table 2), shows that all the explanatory variables, with the exception of medication cost, conformed to a priori expectation. This is based on the fact that the estimated coefficients of output, bird cost, feed cost and labour cost, gave positive values. This indicates that as these factors increased, total cost of production increased, *ceteris paribus.* The coefficient of medication cost was negative implying that as the use of this factor increased, total cost of production decreased. A possible explanation for this observation could be that initial expenses on medication could have been very effective, as the farmers recorded low mortality and fast growth rate until the point where it may have been grossly over-utilised. However, this can only be confirmed by a production function analysis.

The result of the t – test showed that output and expenses on stock size were statistically different from zero at ($p < 0.01$) and ($p < 0.05$), indicating that these variables significantly affected production cost in the study area. The effects of output and stock size on production cost suggest that there are significant economies to be exploited by broiler farmers in the study area.

The estimated cost function equation is:

$\text{Ln } C = 2.94 + 0.88K_1 + 0.33K_2 + 0.29K_3 + 0.15K_4 - 0.03K_5$

Conclusion and Recommendation

It can safely be concluded, based on findings from this study that, although broiler production enterprise was found to be profitable in the study area (as shown in the result of the gross margin analysis), significant gaps still exist that could be exploited by broiler farmers in the study area in order to achieve the neoclassical assumption of optimum profit. This is evident from the fact that the scales of their holdings are small, suggesting that there could be great potential for increasing gross output and, by implication profit, *ceteris paribus*.

The study therefore recommends that effort be geared towards increasing average stock size per farmer and reducing the cost of medication in broiler production in the study area. One way of doing this is to ensure broiler farmers have access to credit facilities, especially soft loans. This would ultimately lead to higher profit, since there is great potential for increasing returns from broiler production.

References

1. R.A. Ocholi, I.L., Oyetunde, P., Kornbish, M.O., Odigbo and L. Taarna, Epidemiology of an Outbreak of Highly Pathogenic Avian Influenza Caused by the Virus Subtype H5N1 In Nigeria In 2006. *VOM J. Vet. Sci., Nat. Vet. Res.* 6(1): 1- 8 (2006).
2. O.E., Effiong and C.E., Onyeweaku, Profit Efficiency in Broiler Production in Akwa Ibom State, *Int'l J. Agri.Dvpt*., 4(1): 11-17 (2006).
3. C.F., Hamra, An Assessment of the Potential Profitability Of Poultry Farms: A Broiler Farm Feasibility Case Study. M.sc Thesis: University Of Tennesse, Martin, USA. (2010).
4. F.S. Idachaba, Food Security in Nigeria: Challenges under Democratic Dispensation. Paper Presented on the 9th ARMTI Annual Lecture. (2004).
5. M.J., Bhende, Production and Cost of Broiler Meat: A Case Study of Karnataka. Research Report: IX ADRT/118 (2006).
6. J.A., Akinwumi and E.A., Adeyeye, Economic Analysis of Nigerian Poultry Industry. Report Submitted to Federal Livestock Department, Lagos. (1979).
7. U., Haruna and B.M., Hamidu, Economic Analysis of Turkey Production in West African Zone of Bauchi State, Nigeria. Proceedings 9th Annual Conference, Animal Science Association of Nigeria. September 13th – 16th. Abakaliki: Ebonyi State University. (2004).
8. R.M., Sani, I., Tahir and S., Kushwaha, Economics of Poultry Production in Bauchi State: A Case Study of Bauchi Local Government Area. *Nig. J. Anim. Prod.*, 27: 109 – 113 (2000).
9. G.N., Umeh and B.I., Odo, Profitability of Poultry Production among School Leavers in Anaocha Local Government Area (LGA) Of Anambra State, Nigeria. *Nig. J. Anim. Prod*., 29: 76 – 80 (2002).
10. E., Watch, Highly Pathogenic Avian Influenza Spread into Nigeria. FAO Publications, Egypt. Wholesome Meat and Fish (Slaughter-House) Act, 2005. Conditions of Licensing of Poultry Slaughter – House. Agri – Food and Veterinary Authority of Singapore. (2006).
11. C., Nwajiuba and E., Nwoke, Inflation and Poultry Industry in Nigeria: Implication for Profitability. In: Oji, U.I. and O.O. Mgbere (Eds). Proceedings of the 5th Annual Conference of Animal Science Society of Nigeria. Port Harcourt, Nigeria pp. 206 – 208. (2006).
12. J.O., Olukosi and P.O., Erhabor, Introduction to Farm Management Economics: Principles and Applications. AGITAB Publishers Ltd Zaria, Nigeria. (2005).
13. B.M., Samn, Gross Margin Analysis and Linear Programming: Tools in Understanding How Farmers in The Guinea Savanna of Nigeria Rejected the Most Profitable Type of Sorghum Recommended by Scientists. Proceedings: Pre – Conference of Western Agricultural Economics Association 2009 Meeting. June 24, pp 1 – 20. (2009).
14. B.T., Mohammed, J.J., Aduba, I., Jilasaya and I.C., Ozumba, Farmers Resource Use Efficiency in Sorghum Production in Nigeria. *Conti. J. Agricultural Econs.* 5(2): 21 - 30 (2011).
15. C.O., Emokaro and P.O., Erhabor, 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. Manage.* 18 (1): 131-136 (2014).
16. T.J., Coelli, "A Guide To Frontier Version 4.1c: A Computer Programme for Stochastic Frontier Production and Cost Function Estimation": Working Paper 96/07,Centre for Efficiency and Productivity Analysis Dept. of Econometrics, University of New England, Armidale, Australia (1996).
17. T.J., Coelli, D.S., Prasada Rao and G.E., Battese, An Introduction to Efficiency and Productivity Analysis Kluwer Academic Publishers, Boston/Dordrecht. (1998).
18. G.E., Battese and G.S., Corra, Estimation of a Production Model with Application to the Pastoral of Eastern Australia. *Austrl. J. Agric. Econs*. 42 (21): 169 – 179 (1997).

19. O.A., Omotosho and A.A., Ladele, Management Problems in Large Scale Poultry Business in Nigeria. *Faman Journal,* 3: 27 – 35 (1988).
20. Chukwuji, C.O., Inoni, O.E. Ogisi, O.D. and Olayide, W.J. (2004). A Quantitative Determination of Allocative Efficiency in Broiler Production Delta State. *Agricultura Conspectus Scientificus,* 71(1): 21-26 (2006).
21. S.A., Yusuf and O., Malomo, Technical Efficiency of Poultry Egg Production in Ogun State : A Data Envelopment Analysis (DEA) Approach. *Inter. J. of Poultry Sc*. 6 (9): 622-629 (2007).
22. V.B., Taru, G.E., Nkwi, A.I., Modugu and J., Reuben, Economics of Broiler Production in Meme Division of Cameroon. *J. Agri. Sci.,* 1 (2):83 – 87 (2010).
23. J.O., Oladeebo and A.I. Ambe – Lamidi, Profitability, Input Elasticities and Economic Efficiency Of Poultry Production Among Youth Farmers in Osun State, Nigeria. *Int. J. Poultry Sc*. 6 (12): 994 – 998 (2007).
24. A.A., Adepoju, Technical Efficiency of Egg Production in Osun State. *Int. J. Agric. Econs. and Rural Dev.,* 1 : 1 – 8 (2008).
25. R.M., Okafor, M.A., Odii and U., Obih, Profitability Analysis in Poultry Production in Imo State, Nigeria. Proceedings of the 20th annual national conference of Technology and Agricultural Development in Nigeria. Forestry Research Institute of Nigeria, Federal College of Forestry, Jos, Nigeria. Pp. 392 – 397 (2006).