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Allocative Efficiency of Broiler Farmers in Anambra State, Nigeria

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Abstract: ***This study estimated the allocative efficiency of broiler farmers on resource use. This was in proffering solutions to the low productivity experienced by broiler farmers in Anambra State, Nigeria, as a result of a number of challenges militating against their production businesses. The data used were obtained from a cross-sectional survey of broiler farmers in the State. Simple random sampling procedures were used to select 221 farmers for the study. The data collected were analysed using descriptive statistics and ordinary least square regression. The result showed that, among the production factors, only the costs of water, litter materials and fixed inputs did not have significant impacts on the revenue of the broiler farmers (p>0.05). It also showed that only the money allocated to feeding was over-utilised (AE<1) while others were under-utilised. Although each of the inputs utilised by the farmers was inelastic with output (Ep. <1), the farmers operated at increasing returns to scale (∑Ep.>1). Top among the constraints experienced by the farmers were high cost of day-old chicks, high cost of feed, high cost of medication, price fluctuations and poor quality of feed. More extension contact is needed to enlighten farmers on ways they can improve their efficiency in farm inputs utilisation for optimum yield and profit.***

Keywords: Broiler production, allocative efficiency, returns to scale, elasticity, constraints

1. Introduction

Livestock production is an important agricultural subsector of the Nigerian economy considering its contributions in food production, increasing external trade and reducing unemployment in rural areas, in addition to creating new employment opportunities in the industrial and service sectors (Anochili and Onuoha, 2007). Also, its importance in the provision of animal protein in the diet of the people cannot be over emphasised, while the major sources of animal protein in Nigeria include Cattle, sheep, goat, swine, fish and poultry (Olorunwa, 2018). Poultry refers to a wide variety of winged animal species which are nutritionally and economically useful to man (Adesiyan, 2014). Poultry offers a range of uses to humans which include provision of meat and egg, research and medicinal purposes, production of manure which helps to improve the soil fertility, and the feathers provide humans with aesthetic value (Atteh, 2004).

According to the Food and Agricultural Organisation (2010), poultry meat represents about 33% of global meat production, and that chickens and turkeys are the most common sources of poultry meat (87% and 6.7% of total poultry production, respectively). According to the report, other commercially available poultry meats include meat from ducks (4% of total poultry production) and from geese, pigeons, quails, pheasants, ostriches and emus (combined about 2.7% of total poultry production). Also, chicken accounts for about 86% of all poultry raised worldwide while broilers are the main type of chicken produced by modern integrated poultry raising facilities due to their high feed-meat conversion ratio. Poultry production in Nigeria, especially in Anambra State, as stated by Ezeano and Ohaemesi (2019), is practised in almost all communities as a result of its economic viability and potentials in wealth creation and provision of employment especially for the rural dwellers. Consequently, Ezeano and Ohaemesi (2020) reported that the production of broiler and turkey in Anambra State were profitable and viable.

However, the capacity of the livestock subsector in achieving the above outlined values has not been sustained. Firstly, Ume, Ezeano, Dauda and Okeke (2016) reported that the animal protein supply in the Nigerian diet especially in the rural areas have remained inadequate. Secondly, the Nigerian Bureau of Statistics, NBS, (2018) reported that the livestock subsector under Agriculture Gross Domestic Product (GDP) has been experiencing a decreasing growth from 2.94% in 2016, to 1.61% in 2017 and 0.33% in 2018. Thirdly, World Bank (2020) reported that employment in agriculture (% of total employment) in Nigeria has been in southward growth from 42.22% in 2008 to 36.81% in 2018 (World Bank, 2019). To add to this is the high rate of unemployment in the country which has continued to surge; increasing from 7.54% in the first quarter of 2015 to 23.13% (39.14 million people) in the third quarter of 2018 (NBS, 2018). In there port, the NBS stated that 9.9% were unemployed as a result of loss of jobs, while 90.1% were looking for first jobs.

Agricultural sector was the leading provider of employment in Nigeria especially in the sixties and seventies when the sector provided employment for more than 60% of the Nigerian population. But, unfortunately, attention of the key stakeholders became drawn away in the wake of oil discovery to the oil sector which has low capacity of providing employment for the teeming population. Even with the expansion of the oil industry, unemployment has continued to grow at an alarming rate (Njoku and Ihugba, 2011). Consequently, the neglect of the agricultural sector led to a decline in food production which transcended to food importation including poultry products. This subsequently led to the collapse of many government and private owned farms leading to loss of jobs and inherent decline in GDP contribution.

However, successive governments have come up with some programmes aimed at reviving the sector. Such programmes included farm input subsidies and disbursement of credit facilities to farmers. According to Ike and Udeh (2011), the early government agricultural programmes emphasized

poultry farming and contained substantial subsidies in day-old chicks and feeds. This attracted millions of peasant farmers, civil servants, professionals and entrepreneurs into poultry farming at small, medium and large scales. The programmes also included placement of embargoes and high tariffs on the importation of some agricultural products. Ike and Udeh (2011) also reported that the embargo placed on the importation of poultry products in 2002 by the Federal Government was aimed at encouraging local production.

Nonetheless, farmers still produced with low productivity due to a number of challenges militating against their production. The challenges, according to Ezeano, Ume, Okeke and Gbughemobi (2017), include lack of skills and equipment to produce, high cost of feed, high cost of day old chicks, fluctuation in market prices, poor breeds of day old chicks, high cost of building materials, high cost of labour and access to credit. FAO (2014) also reported that small-scale commercial poultry producers often produced with lower efficiency and constraints to securing quality inputs – chicks and feed – and marketing products. Notwithstanding, one of the surest ways of liberating the farmers especially the small scale farmers that constitute the bulk of the farming population from low productivity is through enhancing their efficiency of resource use (Ewuziem, Onyenobi, and Dionkwe, 2009). Therefore, the challenge is that of efficient and sustainable production of poultry (broiler) products in order to meet the farmers' expectations in the nearest future.

This study estimated the allocative efficiency of broiler farmers in resource use. This study specifically estimated – the allocative efficiency indices and the returns to scale of the broiler farmers. It also identified the constraints militating against broiler production business in Anambra State.

Hypothesis (H_0): the production factors have no significant impact on the revenue from broiler production.

2. Materials and Methods

2.1 Study area

The study was carried out in Anambra State, Nigeria in 2019. Anambra State is one of the five states located in the South-eastern region of Nigeria, made up of twenty one (21) LGAs with its capital in Awka. It shares common boundaries with the States of Imo and Rivers in the South, Enugu in the East, Delta in the West and Kogi in the North. The state is located at Latitude $6^{o}20^{1}$N and Longitude $7^{o}00^{1}$E with a total land area of four thousand, eight hundred and forty-four square kilometres (4,844 $km^{2)}$, and a population density of about eight hundred and sixty persons per square kilometres (860/Km^{2}). It has an altitude of 300m above sea level with an annual mean rainfall of 1,220 mm and a mean temperature of 27^{o}C to 30^{o}C between June and December, but rises from 32^{o}C to 34^{o}C between January and April, with the last few months of the dry season marked with intense heat. According to the National Population Commission (NBS, 2017), Anambra state has an estimated population of about (5.5million) people who are 98% and 2% of Igbo and Igala ethnicities respectively (Anambra State Ministry of Agriculture, 2018). The major economic activities in the state are trading and farming (crops and livestock).

2.2 Sample size and Data collection

According to the state Agricultural Ministry of Agriculture (2018), the state has a total of four thousand, six hundred and ninety-eight (4,698) registered poultry farmers. However, the list is not categorised into the poultry species enterprise produced. The result of the preliminary survey carried out showed that about 48% (2,255) of the farmers produced only broilers, 13% (611) produced only turkeys, 21% (987) produced both turkeys and broilers and 14% (658) produced layers while 4% (188) produced other poultry species. This brought the number of broiler farmers to 2,746. This formed the sample frame used for the study.

Anambra State consists of four (4) agricultural zones; namely – Aguata, Anambra, Awka and Onitsha agricultural zones. Multistage sampling technique was used to draw samples for study. From the Anambra State Ministry of Agriculture (2018) data, the LGA with the highest poultry production activities was purposively selected from each of the four agricultural zones in the first stage. This gave a total of four (4) local government areas. In the second stage, a total of seventeen (17) communities were randomly selected from the four (4) local government areas in a proportionate manner. Lastly, with the assistance of trained enumerators, a total of two hundred and thirty-eight (221) broiler farmers were randomly selected also in a proportionate manner from the sample frame. Data for the study were collected through the use of structured questionnaire.

2.3 Methods of Data Analysis

The ordinary least square regression was fitted for the revenue from broiler production using the linear, semi-logarithm and double-logarithm and the exponential forms. The lead equation (exponential) from the four functional forms was chosen based on the value of multiple coefficient of determination (R^2) as well as the sign and significance of the regression parameters.

The empirical production function applied in this study was of the form:

$$\text{Ln } R = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + \ldots\ldots + B_8X_8 + €$$

Where: Ln is logarithm to base e; R = Revenue from the broiler output for the ith farmer (₦);

X_1 = Value of Day old chick/poult (₦); X_2 = Cost of brooding (₦); X_3 = Value of feeds (₦);

X_4 = Cost of medication (₦); X_5 = Cost of labour (₦); X_6 = Fixed assets (depreciation) (₦);

X_7 = Cost of water (₦); X8 = Cost of litter materials (₦); B_0 to B_8 were the coefficients.

€ = Error term. The estimated coefficients formed the basis for the computation of allocative efficiency.

2.4 Allocative Efficiency

Allocative Efficiency (AE) refers to the choice of an optimum combination of inputs consistent with the relative factor prices (Aji, 2011). According to Christopher *et al.*

(2006) it is a measure of firms' success in choosing an optimal set of inputs. It indicates the gains that can be obtained when the input ratios are varied on the bases of some assumptions of about future price structure of the product, factor markets and the goals of the firms. Chukwuji, Inoni, Ogisi, and Oyaide, (2006) maintained that allocative efficiency is achieved for a profit maximizing firm if the firm equates the value of marginal product (MVP) to the unit price of the resource or the marginal factor cost (MFC). For a particular resource, Maximum allocative efficiency is confirmed if the efficiency is equal to one.

The Allocative Efficiency (AE) tool was expressed as:

$$AE = \frac{MVP}{MFC} = 1$$

Note that Allocative efficiency is when MVP = MFC
Where:
MVP (Marginal value product of individual inputs) = MP X Py
MP (Marginal product) = Coefficient
Py (Price of output) = Revenue
MFC (Marginal factor cost)= Unit price of the individual inputs.
Absolute allocative efficiency is confirmed with respect to given input if AE = 1. The input is over-utilized if AE<1 and under-utilized if AE>1.

Elasticity of production and Returns to scale
The elasticity of production is a concept that measures the degree of responsiveness of output to changes in input. It measures the proportionate change in output as a result of a unit change in input, (Ike and Udeh, 2011). The authors added that the estimates of the parameters of production functions were the direct elasticity of production for the various inputs used in the production of the output, given the model specification. Ikeh and Udeh (2011) also stated that the output of poultry production was inelastic with respect to all the inputs used, indicating that a large change in the resource level(s) would lead to a less than proportionate change in output.

The study also utilised descriptive statistical techniques which included frequency distribution and percentage in analysing the constraints faced by the farmers.

3. Results and Discussion

Table 1: Result of the multiple regression analysis for broiler production on revenue

Variable	Coefficient	t – value	Decision
Constant	4.335	128.506***	
Cost of Chicks	0.36	11.862***	Reject
Cost of Brooding	0.039	2.692***	Reject
Cost of Feeding	0.183	6.776***	Reject
Cost of Medication	0.387	12.340***	Reject
Cost of water	0.013	1.06	Accept
Cost of litter	0.015	1.21	Accept
Cost of Labour	0.094	4.684***	Reject
Fixed cost	0.019	1.524	Accept
R Square	0.968	-	-
Adjusted R Square	0.967	-	-
F-value	-	813.730***	-

Dependent Variable: REVENUE

Estimates of the production function
The exponential form of the production functions was selected as the lead equations in both enterprises for recording the highest number of significant coefficients, and highest magnitude of the adjusted $R^2$and F-statistic. From Table 1, the F-ratio was statistically significant at 1%; hence the estimated model was adequate for use in further analysis. The adjusted R^2 of 0.967 indicated that the included predictor variables explained about 97% of the variations in the values of outputs for the enterprise.

As shown in the table, the coefficients of the estimated model for foundation stocks were positive and highly significant at 1%, (*ceteris paribus*). This indicated that a unit increase in the costs of day old chicks resulted to increased revenue by 0.360% in broiler production. For the costs of the inputs used in brooding, there was also a positive relationship with revenue with the coefficient of 0.039. This implied that, keeping other variables constant, increasing the cost allocated to the inputs used in brooding the birds by 1 unit translated to increased output by 0.039% in broiler production. The reasons for the above positive relationship could be that acquiring quality chicks and keeping the young chicks in a conducive environment through the provision of adequate temperature (warmth) results to speedy growth. This sets the birds on the part of proper development, maturity and good yield. This effect was significant at 1% level of probability.

The coefficient for the cost of feed used was also positive (0.183) and significant at 1% level of probability (*ceteris paribus*). The positive sign could be because, purchasing more feeds of good quality for the birds resulted in increased output and revenue for the enterprise. This implied that increasing the amount of money spent on the feed input by 1 unit resulted to 0.183% increase in the revenue from broiler production. This finding was consistent with Ume, Ezeano and Obiekwe (2018), who reported that quality feed intake by animals has direct relationship to productivity with all things being equal.

On the cost of medication administered to the birds, the coefficient (0.387) was significant at 1%. This indicated that increasing the amount spent on medication by 1 unit resulted to an increment in the revenue by 0.387%. This is so because it is expected that as more drugs and veterinary services are procured for poultry birds, output increases. However, this finding contradicts Ume *et al.* (2018) who reported a negative relationship of drugs and medication with productivity.

Also from Table 1, the coefficient (0.094) on the cost of labour was significantly positive at 1% implying that a unit increase in the amount spent on labour led to 0.094% increase in the revenues. This is similar to the finding of Ike and Udeh, (2011) which stated that an addition of more man-days of labour would lead to higher output both in food crops and animal production. This could be due to the fact that farm operations in Nigeria have remained labour intensive.

Hypothesis (H_0) decision: as shown in Table 1, costs of day old chicks, brooding, medication, feeding and labour were

the production factors that had significant impacts ($p<0.05$) on the revenue of broiler enterprises in the State, hence the hypothesis on them was rejected. However, the hypothesis was accepted that costs of water, litter materials and fixed assets had no significant impacts on the revenue ($p>0.05$).

Allocative Efficiency (AE)

Table 2 showed the mean values of inputs and outputs, and the computation of the allocative efficiency of the farmers on each of the inputs used in production.

Table 2: Mean values of inputs, output and efficiency index for broiler farmers

Variable	Price (MFC)	Marg. Product (MP = Coef.)	MVP (MP X Py)	AE index (MVP/MFC)	Decision
Revenue (Py)	2,211.57	-	-	-	-
Feed	963.07	0.183	404.72	0.42	Over-utilised
Labour	75	0.094	207.89	2.77	Under-utilised
Chicks	280	0.360	796.17	2.84	Under-utilised
Medication	62.1	0.387	855.88	13.78	Under-utilised
Brooding	26	0.039	86.25	86.25	Under-utilised
Water	7	0.013	28.75	28.75	Not calculated
Litter material	2	0.015	33.17	33.17	Not calculated
Fixed inputs	5.52	0.019	42.02	42.02	Not calculated

Source: Computed from field survey, 2019

Note: '*' indicates that allocative efficiency index was not derived because the coefficient was not significant at 5% level of probability.

From Table 2, the revenue with the estimated coefficients of each of the parameters from the production function of the multiple regression model, the Marginal Value Products (MVP) of each of the various inputs were derived. The MVP and the unit input price (MFC) were, then, used in deriving the allocative efficiency indices as shown in the table 2. Since the effects (coefficients) of the cost of water, litter materials and fixed inputs used in the production were not significantly different from zero, their allocative efficiencies were not calculated.

The result showed that the broiler farmers did not achieve an allocative efficiency index of '1', indicating that they failed to achieve optimal allocative efficiency. They recorded gross inefficiencies in the use of all the inputs. This result agreed with the findings of Ike and Udeh (2011) on the efficiency of the credit and non-credit user small scale poultry farmers in Delta State, Nigeria. The farmers had their best allocative efficiency (with an efficiency index closest to '1') in the utilisation of the feed input, and their least allocative efficiency (with an efficiency index farthest from '1') in the use of drugs and vaccines (medication). Specifically, the farmers over-utilized (AE<1) the feed input with the AE index of less than '1' (0.42). This result is in agreement with Baruwa and Sofoluwe (2016), who stated that cost of feeding guinea fowl was over-utilized under tropical conditions. It however, disagrees with the finding of Ike and Udeh (2011), which reported that poultry farmers in Delta State, Nigeria under-utilised the feed input. On the other hand, the costs of all the other inputs measured were under-utilised (Eff.>1) by the farmers. This agrees with Ike and Udeh (2011), that broiler farmers in Delta State under-utilised drugs and veterinary services. These findings were generally similar to that of FAO (2014) which reported that small-scale commercial poultry producers often produced with lower efficiency and constraints to securing quality inputs – chicks and feed – and marketing products.

Ike and Udeh (2011) opined that situations of over or under-utilization of farm inputs give indication to the directions in which particular farm inputs could be re-allocated in order to strike at maximum allocative efficiency. Therefore, the farmers need to increase the costs allocated to the feed input, and reduce the costs allocated to the use of other inputs in order to strike at maximum allocative efficiency.

Elasticity of production and Returns to scale

The estimates of the parameters represent elasticity of production (Ep), while their summation gives rise to the returns to scale. From Table 3, it is shown that the broiler enterprise did not have an elasticity of up to '1' in the use of any of the inputs indicating that each of the inputs utilised by the enterprise was inelastic with output. This implied that a change in the use of each of the inputs resulted to a less than proportionate change on the output/revenue.

The return to scale for the broiler enterprise was 1.110 ($\sum Ep.>1$) indicating that output was slightly elastic with respect to all the inputs used in broiler production. This, therefore, implied that the farmers were operating at increasing returns to scale, a change in the costs of resource utilisation led to a larger change in revenue of the broiler enterprise. This finding, however, disagrees with Ikeh and Udeh (2011) which reported that the output of poultry production was inelastic with respect to all the inputs.

Table 3: Elasticity of production and returns to scale

Variable	Elasticity of Production, 'Ep.'
Feed	0.183
Labour	0.094
Chicks/poults	0.360
Cost of Medication	0.387
Cost of Brooding	0.039
Cost of water	0.013
Cost of litter material	0.015
Fixed cost	0.019
Return to scale ($\sum Ep.$)	**1.110**

Source: Computed from field survey, 2019

Constraints faced by the farmers

Table 4 shows the various problems militating against the broiler production business in the area.

Table 4: Constraints faced by the broiler farmers

Constraint	*Freq.*	*%*
High cost of chicks/poults	221	100
High cost of feed	221	100
Price fluctuations	207	93.7
High cost of medication	190	90.50
Poor quality of feed	167	79.50
Insufficient finance	166	79.10
Prevalence of diseases	164	78.10
Theft	152	72.40
Comp. with frozen products	92	41.60
High cost of labour	69	32.90
Low access to good water	67	31.90
Low access to medication	65	31

Source: Field survey, 2019

As shown in Table 4, top among the problems faced by the broiler farmers were high cost of day-old chicks (100%), high cost of feed (100%), high cost of medication (90.5%), price fluctuations (93.7%) and poor quality of feed (79.5%). The farmers also had problems of insufficient finance (79.1%), prevalence of diseases and pests (78.1%) and, theft (72.4%). These findings are in conformity with the findings of Ukwuaba and Inoni (2012) that high cost of day old chicks and poults, high cost of feed, inadequate finance, theft, prevalence of diseases and pests among others, were the factors limiting the profitability of broiler and turkey productions respectively. The implication of these is that increases in the cost of inputs as well as farmers' low access to finances were inhibiting the growth of broiler production business in the area.

4. Recommendations

Based on the findings of this study, the following were, therefore, recommended:

a) More extension contact is needed to enlighten farmers on ways they can improve their efficiency in farm inputs utilisation for optimum yield and profit.
b) Stakeholders at all levels should work towards subsidising the costs of poultry inputs and, or providing credit facilities to help the farmers in growing their businesses.

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