Profitability and Technical Efficiency of Chicken Production in Kaduna State, Nigeria

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Abstract

Achieving profitability in production is a great challenge facing chicken producers and is constrained by inefficiency and other challenges facing the chicken production industry. Technical efficiency in chicken was a strategy in mitigating the profitability problem. The study was based on technical efficiency of input on output and profitability of chicken production in Kaduna state, Nigeria. A cross sectional survey was adopted using questionnaires. Farm records were used and interview administered on a sample of 166 chicken producers in Kaduna State, Nigeria. The result revealed that profitability existed in chicken production in the study area, especially in layer production. The result further revealed that the mean of technical efficiencies in chicken production was 0.64 for pullet production, 0.73 for layer and 0.81 for the broiler production which means inefficiencies existed in chicken production in the study area.

Keywords: technical efficiency, profitability, layer, broiler and pullet chicken production.

Introduction

In the past, chicken production involved raising chicken in the back yard for family daily egg and meat consumption, but chicken production today is highly specialized as profit maximizing and efficient enterprise with huge business that splits into several operations as hatcheries, pullet, meat and eggs production that serve as a sources of income and employment to the large number of people in the poultry industry. It was estimated that 74 per cent of the world poultry meat and 68 per cent of eggs were produced in a way that is described as intensive poultry production and more than 50 million chickens are being raised annually as sources of food for good number of people in the world (Evans, 2013).

The largest chicken producers in the world from 2006 to 2014 includes China, Indonesia, and India in Asia, United State of America, France, Germany and United Kingdom in Europe, South Africa and Nigeria in Africa. The industry has been growing in terms of size, income and employment especially in Asia and Africa (FAO, 2006).

Chicken production in Nigeria was considered as one of the important subsectors due to its relevance in providing employment for the job seekers, creating business opportunities for entrepreneurship and a major source of protein from meat and egg which was considered to be one of the most nutritious food intakes and acceptable by the major religions in the country (Ohajianya *et al.*, 2014). Apart from generating quick economic return to the producers, the subsector provides direct jobs opportunities to the greater number of Nigerian populace and it also generate substantial income to those working under the sector (Afolabi *et al.*, 2013) and (Abiola, 2007). Sahel (2015) described the Nigerian poultry industry as one of the largest in Africa because of the huge capital that involved which was estimated to the tune of ₦80 billion ($600 million), the industry products comprises 165 million birds that produced 650,000 metric ton (MT) of eggs as the largest in Africa and 290,000 MT of poultry meat as the second largest, after South Africa.

Chicken subsector in Kaduna state provides employment opportunities to over 50 percent of the people mostly at subsistence level (Tabari, 2015). Commercial chicken production was categorized in to small-, medium- and large-scale enterprises in Kaduna state, but the majority of the chicken producers fall within the category of small and medium scale producers. This subsector has an advantage over other livestock sector in providing income and greater employment opportunities to the good number of people in Kaduna state (Emaikwu *et al.*, 2012; Tabari, 2015).

Chicken production constituted 50% in the distribution of poultry production in Kaduna state and egg production captured a larger share of the market than broiler production. Effort must be put in order to improve the weight of egg and broiler chicken (NBS/CADP, 2010). The chicken production depends largely on external and internal factors. The external factors include the environment, weather, government policy and markets which are considered in the process of production and these factors are generally not within the control of the producers, but can be managed when efficient chicken production technique is being practiced. The internal factors were regarded as input factors employed in the process of chicken production in order to achieve optimal level of production, sustainability and profitability. The efficiency of factor inputs employed in the process of chicken production maximizes output and profitability. On the other hand, inefficient use of these factor inputs can create serious consequences on the level of chicken output and profitability (Udoh & Etim, 2009).

Efficiency is a relationship between the quantity of factor input and the level of output that defines a frontier for a firm in an industry. The measurements of efficiency in production are straighter and more accurate than the measurement of productivity because of the comparison that involved between factors on their contribution to output or the most efficient frontier. The comparison can be in form of ratio of given input in relation to maximum potential output or the ratio obtained of a given minimum input required to produce a given level of output which defines the optimum level of productivity possibilities and technical efficiency of such input (Darajo & Samir, 2007).

Technical efficiency happens when there is no possibility to increase the output without increasing the input. In chicken production technical efficiency refers to the ability of a chicken producer to employ the best techniques and practice in the process of chicken production when a given input can produce a maximum level of output. This efficiency can be seen in terms of allocation efficiency which refers to the choice of optimum combination of input consistent with the price of factors and Economic efficiency which describes the ability of chicken producer to maximize profit by observing the price of input (Eze *et al.,* 2012).

Problem Statement

Despite production growth rate of 5% of chicken output since 2000 (Tijjani *et al.,* 2006) which slowed down from 2008 to 2.5%, however the demand for chicken output of 65gm and supply of 7gm daily has indicated a wide gap between demand and supply of chicken output in Nigeria. This decline in production is as a result of sharp increase in cost of chicken production input and other challenges (FAO, 2012) and (Ike, 2011).

Chicken production in Nigeria in general and Kaduna state in particular is faced with numerous challenges ranging from inefficiency in production, low profitability, marketing, Government policy, infrastructures decay, high cost of feed and other input used in the process of chicken production. Other problems includes poor breed, low eggs and poor weight as a result of diseases and pest, poor quality feeds and inefficiency of management, lack of capital, risk and uncertainty of the business that arises from price fluctuations, unexpected depreciation of investment, unstable supply of quality feeds, these and many more challenges have affected the productivity, efficiency and profitability of the business despite the growth in the demand for chicken output. This could be the reason why the subsector contribution to GDP over the years remains at 10% (Achoja, 2012; Heise *et al.,* 2015).

Objective of the study

i. To determine the technical efficiency of chicken Production in Kaduna State.
ii. To determine the Profitability of chicken Production in Kaduna State.

Methodology

Study Area Description

The research was conducted in Kaduna State as one of the 36 states in Nigeria. It has 23 local governments with a population of 8 million (Kaduna State 2015). The state covers an area of about 48,473.2 kilometres and occupies the central portion of northern Nigeria and lies between latitude 90 and 140 North of the Equator. The state extends from tropical grassland (savannah) in the South to Sudan savannah in the North. The Savannah region covers the southern part with vegetation and tall trees. The Sudan Savannah covers the Northern part with veldt grass and short tress. The state has arable land of about 4.5 million hectares and only 2.02 million hectares are in actual cultivation. The state has vast expanse of fertile land growing both food and cash crops and it has rivers that provides opportunities for irrigation and fish farming. More than 70 percent of the work force earns their livelihood from the production of food crops, cash crops and livestock (Kaduna State 2010). Commercial poultry production is receiving wider popularity and acceptability by day as a result of the growing demand for poultry meat and egg. The research considered 9 Local Government areas where commercial poultry producers concentrated, 3 Local Governments from zone one (northern zone) which comprises Zaria, Sabon Gari and Lere Local Governments. Four Local Government from zone two (Central zone) which comprises Kaduna North, Kaduna South, Igabi and Chukun. The two Local Governments from zone three (Southern zone) were Kachia and Sanga respectively.

Source of Data Collection

This study was cross sectional survey that gathered information from farm records, questionnaire and supplementary interview administered to the commercial chicken producers in Kaduna State, which also served as primary sources of data. The researchers also used publications, documents, journals, library materials and sources of secondary data.

Sample Procedure

A stratified random sampling procedure was applied whereby chicken producers were divided into areas and randomly selected based on the inclusion criteria, such as years of chicken production experience (minimum of 10 years) and must be commercial chicken producers and based in Kaduna State from the selected 9 Local Government areas that covered by the study and the respondents rate of the questionnaire was 71% as indicated in Table 1.

Table1

Response Rates of the Distributed Questionnaires

Response Rate	**Frequency**	**Percentage (%)**
Response	166	71
Non Response	84	29
Total	**250**	**100**

Sources: Primary Data, 2015

Table 2 indicates the age distribution of the respondents and their frequencies. The greater numbers of respondents were at the ages of 36 to 40 which constituted 40.4% and the least percentage was 9.0% between the ages of 46 and above.

Table 2

Demographic Characteristics of the respondents

Age Group	**Frequency**	**Percentage**	**Cumulative Percentage**
20-25	4	2.4	2.4
26-30	11	6.6	9.0
31-35	40	24.1	33.1
36-40	67	40.4	73.5
41-45	29	17.5	91.0
46-above	15	9.0	100.0
Total	166	100.0	

Sources: Primary Data, 2015

Educational Level of Respondents

The level of education percentages of the respondents of this study is captured in Table 3.

Table 3

Level of Education of Respondents

Qualification	Frequency	Percentage	Cumulative Percentage
Secondary	39	23.5	23.5
Certificate	2	1.2	24.7
Diploma	62	37.3	62.0
Bachelors	30	18.1	80.1
Masters	2	1.2	81.3
Others	31	18.7	100.0
Total	166	100.0	

Sources: Primary Data, 2015

Table 3 showed the percentages of educational level of chicken producers. Diploma level of education has the greatest percentage of 37.3%, followed by the secondary level of education 23.5% and the least was 1.2% of chicken producers with certificate level of education. To some greater extent the chicken producers in Kaduna State attained one level of education or the other.

Table 4

Experience in Chicken Production

Years of experience	Frequency	Percentage	Cumulative Percentage
10 years	48	28.9	28.9
11-20 years	116	69.9	98.8
21-30 years	1	.6	99.4
31+ years	1	.6	100.0
Total	166	100.0	

Sources: Primary Data, 2015

Results in Table 4 reveal that the chicken producers engaged in chicken production activities with 10years experience was 28.9%. While the majority of chicken producers that spent 11 to 20 years in chicken production business constitutes 69.9%.

Table 5

Returned Questionnaires by Chicken Farms

Local Governments	Frequency	Percentage	Cumulative Percentage
Chukun	14	8.4	8.4
Igabi	21	12.7	21.1
Kachia	16	9.6	30.7
K/ North	25	15.1	45.8
K/ South	24	14.5	60.2
Lere	18	10.8	71.1
Sabongari	15	9.0	80.1
Sanga	14	8.4	88.6
Zaria	19	11.4	100.0
Total	166	100.0	

Sources: Primary Data, 2015

The farm location for the chicken production activities is indicated in Table 5 that the majority of the chicken producers whose questionnaires were returned were from Kaduna North and Kaduna South, followed by Igabi and Zaria local government respectively. The choice of these Local Governments was due to the concentration of people and chicken farms, nearness to market and availability of resources in these local government areas as confirmed by the (KADP, 2007).

Table 6

Type of Chicken Production

Poultry Production	Frequency	Percent	Cumulative Percent
Broiler	55	33.1	33.1
Pullet	7	4.2	37.3
Layer	104	62.7	100.0
Total	166	100.0	

Sources: Primary Data, 2015

Table 6 indicates the types of chicken production in the study area, where broiler production farms constitutes 33.1%, pullet farms 4.2% and layer farms 62.7%.

Method of Data Analysis

Descriptive statistics such as, frequencies and percentages, were used to describe Socio-economic characteristics of the respondents. ML stochastic production frontier model was used for the analysis of technical efficiency and net farm income (NFI) which adopted the method of Return per Naira Invested (RNI) was used in profitability analyses.

A stochastic production frontier model was specified as:

Model Specification

Technical efficiency of chicken production was described as: $\ln Yi = \beta_0 + \beta_1 \ln X_1 i + \beta_2 \ln X_2 i + \beta_3 \ln X_3 i + \beta_4 \ln X_4 i + Vi - Ui$ Where subscript i refers to the observation of ith farmers, ln = Logarithm to base e,

Y = Poultry Output of the farmers (kg)

X1= Labour (Man-hour)

X2 = Feed (kg)

X3= Vaccine (mg)

X4= Flock size (numbers)

The inefficiency effects, Vi is a random error term assumed to be independently and identically distributed as N (0, σ_V^2). U_i is defined as:

$U_i = \delta_0 + \delta_1 \ln Z_1 i + \delta_2 \ln Z_2 i + \delta_3 \ln Z_3 i + \delta_4 \ln Z_4 i + \delta_5 \ln Z_5 i$ Where:

U_i= Technical inefficiency of the ith farmer

Z_1= Age of the farmer (years)

Z_2= Years of education of the ith farmer

Z_3= Sex of the ith farmer (1= male, 0= female)

Z_4 = Marital status of the ith farmer (1=married, 0= single) Z_5= Farming experience of the ith farmer (Years of farming) Profitability of chicken production was described as:

$$D = \frac{P - S}{N}$$

Where:

D= depreciation (₦),

P= purchased value (₦),

S= salvage value (₦),

N= life span of asset (years).

Return per Naira invested (RNI) was obtained by dividing the total revenue (TR) by the total cost (TC).

Therefore; $$\textbf{RNI} = \frac{TR}{TC}$$

Where:

RNI = Returns per Naira invested

TR = Total revenue from poultry input sales

TC = Total cost

Result and Discussion

Estimated Technical Efficiency and Inefficiency of Chicken Production

Broiler Chicken Production

The ML estimates and inefficiency determinants of the specified frontier are presented in Table 3.0 the study revealed that the generalized log likelihood function of broiler was -15.19. Thus, the functional form that is, Cobb-Douglas used in this estimation is an adequate representation of the data. The value of gamma (γ) is estimated to be 0.379 and it's significant at ($p<0.01$) level of probability. The 38% of random variation in the broiler output was due to the inefficiency chicken producers in their respective sites. However, the average technical efficiency for the farmers was 0.81 which is (81%), there is scope of (19%) can be achieved if the producers adopt recent technology and techniques used by the best broiler producers.

The estimated coefficient of labour (-0.012) is an indication that labour was inversely related to the output of the broiler farmers at 5% probability level, 1% increase in labour will decrease the output of the broiler farmers by 0.12% *ceteris paribus*. This result agrees with the findings of (Afolabi *et al.,* 2013). The estimated coefficient of feed (0.008) was positively to the broiler output at 1% probability level. This finding conforms to that of (Hussain *et al.,* 2012). The coefficient of vaccine was positive at 0.009 but not significant. However, this indicates that a unit increase in vaccine will result in an increase in broiler output

by 0.009 units which is line with the finding of (Effiong & Umo, 2011). Flock size was 0.097 at 1% level. The positivity shows a direct relationship of the flock size with broiler output in the study area.

The estimated result of inefficiency model contained in the same table 3.0 a negative sign on a parameter means that the variable reduces technical inefficiency, while a positive sign increases technical inefficiency. Age estimated coefficient was -0.001, education -0.954 and Farming experience -0.006 implies that, these variables were negatively related to the technical inefficiencies of broiler production in the study area at 1% probability level.

Layer Chicken Production

The ML estimates and inefficiency determinants of the specified frontier are presented in Table 3.0. The study revealed that the generalized log likelihood function of layer was -15.18. The value of (γ) estimates 0.842 at significant level ($p<0.01$) of probability, there was 84% random variation in the layer output as a result farmers' inefficiency in their respective farms. The value of ($\boldsymbol{\sigma^2}$) was significantly different from zero level of probability. This indicates a good fit and correctness of the specified distributional assumptions of the composite error terms while the gamma γ indicates the systematic influences that are unexplained by the production function and the dominant sources of random error. This means that the inefficiency effects make significant contribution to the technical inefficiencies of layer producers.

Table 7 indicates that the major drivers of output in the layer producers in the study area were labour, feed, vaccine and flock size. However, the estimated coefficients of the parameters of production function (feed, labour and flock size) were positive and significant at 1% and 5% level of probability. The average technical efficiency for the layer producers was 0.73 which is (73%) of potential output. Thus, there is scope of 27% to increase the efficiency, by adopting techniques used by the best layers farmers. This result is in line with that of Tijjani, *et al.* (2012), Begun *et al.* (2013), Ohajianya *et al. (*2013) and Achoja (2010).

The technical inefficiency coefficients of Age was -0.001 at 1% level of probability. This means the older the layer producers, the lower the technical inefficiency and this can be attributed to their respective experienced in that field as they grow old and hence, their farms tend to be less inefficient because of their involvement in the supervision and operations of their farms. Educational was -2.12 with inefficiency at 1% probability level. This implies that a unit increase in the education of the layer producers will decrease their technical inefficiency. Layer production years of experience had an estimated coefficient of -0.0064; this is in agreement with Ike (2011), Eze *et al.* (2012) and Ohajianya *et al.* (2013) in their separate studies reviled that educational level, age of the farmer and years of experience put in layer production contributed positively to the efficiency of layer output.

Pullet Chicken Production

The ML estimates and generalized log likelihood function was -96.118. The Cobb-Douglas used in this estimation is an adequate representation of the data. The value of the (γ) was 0.716 at ($p<0.01$) level of probability, which is implies that 72% of random variation in the pullet output was due to the producers' inefficiencies. However, the average technical efficiency for the pullet producers was 0.64 (64%) of output from a given mixture of production inputs, there is scope of (36%) of increasing the efficiency, if techniques used by the best pullet farmers are adopted.

The coefficient of labour 0.21 was positive at 1% level of probability; the more farmers spend on hired labour, the higher the number of man-days working on the farm and the larger the number of chickens because of the attention the chicken received.

The coefficient of feed (0.33) was positively related at 1% probability level, this finding was in conformity with that of (Hussain *et al.*, 2012). The coefficient of the flock size (0.18) was positive and significant at 1% which is in line with the report of Bamiro *et al.*, (2006) in his study that, the lager the flock size, the higher, the number of pullet chicken.

The age coefficient (0.082) of pullet producers was positively related to the technical inefficiency at 10% level of significant. The educational level coefficient value (-0.30) of the producers showed a negative relationship with technical inefficiency at 5% level of significant, while years of experience in pullet production indicated a positive relationship (0.0346).

Table 7

Technical Efficiency and Inefficiency of Chicken production

	Broiler		Layer		Pullet	
Variables	coefficients	*t*	coefficients	*t*	coefficients	*t*
Production Variable						
Constant	2.66***	15.17	5.93***	19.29	5.09	9.69
Labor	-0.41**	-2.12	0.03**	0.623	0.21***	3.43
Feed	0.008***	3.80	0.02***	4.83	0.33***	4.53
Vaccine	0.01	0.39	0.02	0.34	0.102	3.31
Flock size	0.10***	2.70	0.23**	3.43	0.18***	2.67
Efficiency Variable						
Constant	0.13**	2.08	0.23***	2.64		
Age	-0.00***	-3.01	-0.00***	-3.81	-1.34	-0.76
Education	-0.95***	-2.53	-2.12***	-3.22	0.08*	1.84
Sex	0.00	1.50	0.00	0.41	-0.30**	-2.54
Marital status	-0.00	-0.02	0.00	0.31	0.01	0.04
Farming experience	-0.01***	-2.50	-0.005	-0.02	0.12	1.47
Sigma square σ^2	0.18***	26.18	0.40***	33.29	0.35	0.60
Gamma γ	0.38***	9.19	0.84***	11.69	0.76***	3.52
Log likelihood function	-15.19		-15.18		0.71***	3.55
LR test	11.66		11.66		-96.11	
Mean efficiency	**0.81**		**0.73**		**0.64**	

*** P<0.01, **P<0.05, *P<0.1

Source: Primary data, 2015

Profitability of Chicken Production in Kaduna State

The profitability of chicken production is discussed by their type of output, such as Egg, Broiler chicken and Pullet breed as indicated in Table 8.

Layer Chicken Production Profitability

The total cost of layer production consists of variable and total fixed cost such as, Day Old Chicken (DOC), feeds, vaccine/drugs, labour electricity were regarded as variable cost. The total fixed cost comprises poultry equipment, repairs and maintenance. The total variable cost was the major cost in layer production which constituted 99.93% of the total production cost while fixed cost was 0.128%. The feed constitutes the major cost in layer production (73.3%). This finding agreed with the studies of Gangwar (2013), Vincent *et al.* (2010), Nwandu *et al.* (2015), and Mairuri and Muturi, 2013).

The revenue was from the sales of eggs per crate, spent layers, manure/litter and gunny bags. Return per Naira investment was 6.15. The layer production in the study area was profitable as indicated by the

RNI decision rule whichstated that (RNI>1) implies profitability, (RNI<1) is a loss and (RNI=1) is breakeven in chicken production. This is in line with the study of (Afolabi *et al.*, 2013), (Tijjani e*t al.*, 2012) and (Evbuomwan, 2005).

Broiler Chicken Production Profitability

In Table 3.1 the broiler cost of production was analysed, the major cost was the total variable cost which constitutes 99.93% of the total production cost, while the total fixed cost was 0.069% of the total cost of production. The profit was based on sales of Broiler chicken, manure/litter and feed bags as revealed by the study. The profitability of broiler production was N1.91 in the study area as indicated by the (RNI>1) this finding was in line with the studies of Bamiro *et al.* (2013), Hamra (2009) and Balamuran and Gunaharang (2009).

Pullet Production Profitability

Table 3.1 also shows the cost of Pullet chicken production in Kaduna State, the greater percentage of the total cost was the variable cost (99.96%), on the other hand 0.03% constituted the fixed cost. Pullet production profitability was N1.69 in the area as revealed by the study as indicated by the (RNI>1). The profit was realized from the sales of point of lay chicken by the producers when the birds attained the ages of 18-20 weeks, other sales includes manure, litter and empty feed bags.

Table 9

Profitability of Chicken production in Kaduna state

Cost of Production	Value (#/y) Layer Production	%	Value (#/y) Broiler Production	%	Value (#/y) Pullet Production	g%
Total variables						
Cost of day old chicks	8082231.2	15.722	509036	34.025	8663333	30.7729
Cost of feeds	38947528	73.289	3909150	55.025	15958667	56.698
Cost of Vaccine/Drugs	2983514.1	5.615	1293128	7.987	705250	2.506
Cost of Labor/Salary	3014376.8	5.673	284234.4	1.139	2137433	7.594
Cost of Electricity	73518.455	0.0128	184446	1.139	673233.9	2.392
Sub total	**53101192**	**99.935**	**16179994**	**99.931**	**28137917**	**99.969**
Total fixed cost						
Cost of Equipment	1799.7828	0.003	1784	0.011	38.50	0.014
Repairs/maintenance	32605..657	0.061	5227.2	0.032	1803	0.006
Cost of Housing/cage			4112	0.024	3008.333	0.011
Sub total	**34405.439**	**0.061**	**11123.2**	**0.069**	**8661.333**	**0.031**
Total cost of Production	**53135598**	**100**	**16191118**	**100**	**28146578**	**100**
Revenue						
Sales of Eggs	**322161020**					
Sales of Broiler Chicken				**29042711**		**47237083**
Sales of Pullet Chicken						
Sales of spent Layers	4703828.8					
Sales of manure litter	29742.424		1927032			541083.3
Sales of Bags	960.202		34470			541083.3
Total Revenue	**326895551**		**31004213**			**47778167**
Net farm Income	**73759953**		**14813095**			**196331589**
Return per Naira (RNI)	**6.15**		**1.91**			**1.69**

Source: Primary Data, 2015

Conclusion and Recommendation

This study revealed that technical efficiency existed in the study area as indicated by the coefficient values of the production function, for instance 0.73 for broiler production, 0.81 for layer chicken production and 0.64% for pullet production. There are some gaps to be filled for these farms to be fully technically efficient. The study also revealed that profitability existed in chicken production in the study area based on the RNI values, but layer as the most profitable investment. It is recommended that chicken production in the study

area should use techniques adopted by the best chicken producers in order to be technical and profit efficient.

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