# TECHNICAL EFFICIENCY OF DIFFERENT FACTOR INPUT ON POULTRY PRODUCTION IN KADUNA STATE, NIGERIA

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**Abstract**

*The study was conducted to determine the technical efficiency of different factor inputs on poultry production in Kaduna state and 9 local governments were selected using stratified random sampling. Data was collected with the used of structured questionnaire from 166 poultry producers which consist layers, broilers and pullet. Frequencies, percentages and stochastic frontier production function were adopted in the analysis of data. The study was based on factor inputs efficiency such as feed, stocking of birds, labor and drugs in poultry production. The average technical efficiency of layer producers in the study area was 73%, broilers81% and pullet was 64% as revealed by the study. The study further*

[redacted]

***KEYWORDS:*** *Technical efficiency, Technical inefficiency, Broiler, Layer and pullet production.*

*revealed that labor, feeds and flock size have significant influence on poultry production while vaccine cost have less influence. Age, education and years of farming experience led to decrease in technical inefficiency.*

## Introduction

An agricultural activity encompasses production in orchards, cattle ranch, beekeeping, fishery, crops production, sugarcane plantation and poultry production (McConnel and Brue, 2008). In the past, poultry farming involved raising chicken in the back yard for family daily egg and meat consumption, but poultry production today is highly specialized



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as profit maximizing and efficient enterprise (Hamra 2010). World watch institute (2006) 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 free range which is an alternative to the former. More than 50 million chickens are being raised annually as sources of food from both their meat and eggs. The largest poultry producers in the world from 2006 to 2013 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).

Poultry production in Nigeria was considered as one of the important sub sector due to its relevance in providing employment for the job seekers and creating business opportunities for entrepreneurship. It generates quick economic return to the producers and the subsector provided direct jobs opportunities to 10-15% as well as income in Nigeria (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 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. The livestock subsector contributed 25% - 27% to the Gross Domestic Product (GDP) in which Poultry sector contribution to that effect was 10% over the years (Achoja 2012). Poultry production became one of the major source of protein from meat, egg and it was considered to be one of the most nutritious food intake and acceptable by the major religions in the country (Ohajianya et al 2014).

Poultry production was categorized as small, medium and large scale enterprises in Kaduna state, where the majority of the poultry 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) and (Tabari 2015).

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Despite the contribution of this subsector, the production in the country in general and Kaduna state in particular is grossly inadequate as compared to the wide gap between demand of 65gm and supply of 7gm daily (Ike 2011). This was attributed to numerous problems and challenges associated with the poultry production in Nigeria such as poor breed, low eggs and poor weight as a result of diseases and pest, poor quality and unstable supply of feeds and inefficiency of management as well as poultry factor inputs. Other includes lack of capital, risk and uncertainty of the business that arises from price fluctuations, unexpected depreciation of investment and general high cost of poultry production (Omodele and Okereke 2014).

**Objective of the study**

The main objective of the study is to determine the technical efficiency of different factor inputs on poultry production in Kaduna state.

**Methodology**

**Study area description:** The research was conducted in Kaduna State as one of the 36 state in Nigeria. It has 23 local governments, with a population of 6,006,562 million as at 2006 (NPC 2006) and increased to 7.8 million (Kaduna state 2014). 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 has arable land of about 4.5 million hectares and only 2.02 million hectares are in actual cultivation (Kaduna State 2010). Commercial poultry production is receiving wider popularity and acceptability day by day as a result of the growing demand for poultry meat and egg as well as providing employment and income to the greater number of people in the state. This research was conducted in 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.

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**Source of data collection:** This study was cross sectional survey which gathered information from farm records and panel procedures with the use of questionnaire and interview administered to the poultry producers in Kaduna state, which served as primary sources of data. The used of publications, documents, journals, library materials and theories that have Universal validity as the sources of secondary data.

**Sample procedure:** A stratified random sampling procedure was applied. Where by poultry producers were divided into areas and randomly selected based on the inclusion criteria, such as years of poultry production experience (minimum of 10 years), commercial poultry producers and based in Kaduna state from the selected 9 local government areas of study. Chukun local government 14 farms, Igabi 21 and Kachia local governments16 farms, while Kaduna north 25 farms, Kaduna south 24, Lere, Sabongari and Sanga, 18, 15, 14 respectively and Zaria local government 19 farms were selected**.** These areas are predominantly poultry producers, 166 responded by submitting their questionnaires from the 250 distributed as indicated in table 1.0

**Table 1.0 Response Rate of the Distributed Questionnaires**

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

***Source: Primary Data 2015***

Table 1.1 showed the age distribution of the respondents and their frequencies. The dominant respondents were from the ages of 36-40, (40.4%) and 31-35 (24.1%) as indicated in table.

**Table 1.1 Demographic characteristics of the respondents**

| Age of the Respondents | | Frequency | Percent |
|---|---|---|---|
| | 20-25 | 4 | 2.4 |
| | 26-30 | 11 | 6.6 |
| | 31-35 | 40 | 24.1 |

| | | | |
|---|---|---|---|
| | 36-40 | 67 | 40.4 |
| | 41-45 | 29 | 17.5 |
| | 46-above | 15 | 9.0 |
| | Total | 166 | 100.0 |

**Sources: Primary data 2015**

**Educational Level of Respondents**

The level of education was presented in table 1.2 below.

**Table 1.2: Level of Education of Respondents**

| Response | | Frequency | Percent |
|---|---|---|---|
| Valid | Secondary | 39 | 23.5 |
| | Certificate | 2 | 1.2 |
| | Diploma | 62 | 37.3 |
| | Bachelors | 30 | 18.1 |
| | Masters | 2 | 1.2 |
| | Others | 31 | 18.7 |
| | Total | 166 | 100.0 |

**Source: Primary data 2015**

Table 1.2 showed the percentages of educational level of poultry producers. Diploma level of education have the greater percentage of (37.3%), followed by the secondary level of education (23.5%), as indicated in the table, to some extent the poultry producers in Kaduna state attained one level of education or the other.

**Table 1.3 Experience in Poultry Production**

| Response | | Frequency |
|---|---|---|
| | 10 years | 48 |
| | 11-20 years | 116 |
| | 21-30 years | 1 |
| | 31+ years | 1 |
| | Total | 166 |

**Source: Primary data 2015**

Results in table 1.3 above revealed that the overall poultry producers engaged in poultry production activities for 10 years were (28.9%). While the majority (69.9%) poultry producers that spent 11 to 20 years in poultry business.

**Method of data analysis**

Descriptive analysis, statistics such as, frequencies and percentages, were used to describe socioeconomic characteristics of the respondents. ML stochastic production frontier model was used for the analysis of technical efficiency. A stochastic production frontier model was specified below.

**Model Specification**

$lnYi= \beta_0 + \beta_1 lnX_1i+ \beta_2 lnX_2i+ \beta_3 lnX_3i+ \beta_4 lnX_4i + Vi - Ui$

Where subscript i refer to the observation of ith farmers,

ln = Logarithm to base e,

Y = poultry Output of the ith farmers (kg)

X1= Labor (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, $\sigma_V^2$). $U_i$ represents technical inefficiency and is identically and distributed as a truncated normal with truncations at zero of the normal distribution. The $U_i$ is defined as:

$U_i= \delta_0+ \delta_1 lnZ_1i+ \delta_2 lnZ_2i+ \delta_3 lnZ_3i+ \delta_4 lnZ_4i+ \delta_5 lnZ_5i$

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)

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**Result and Discussion**

**Estimated technical efficiency of Layer farmers**

The ML estimates and inefficiency determinants of the specified frontier are presented in Table 2.0.The study revealed that the generalized log likelihood function was -15.18. The log likelihood function implies that inefficiency exist in the data set. The log likelihood ratio value represents the value that maximizes the joint densities in the estimated model. 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 0.842 and it was highly significant at ($p<0.01$) level of probability. This is consistent with the theory that true γ-value should be greater than zero. This implies that 84% of random variation in the layer output produced was due to the producers' inefficiency in their respective sites and not as a result of random variability. Since these factors are under the control of the poultry producers, reducing the influence of the effect of γ will greatly enhance the technical efficiency of the producers and improve their output. The value of sigma squared (**$\sigma^2$**) 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 2.0 Technical efficiency of Layer Production**

| Variables | Parameters | Coefficients | Standard error | T-Value |
|---|---|---|---|---|
| **Production Variable** | | | | |
| Constant | $\beta_0$ | 5.927*** | 0.307 | 19.286 |
| Labour | $\beta_1$ | 0.027** | 0.043 | 0.625 |
| Feed | $\beta_2$ | 0.017*** | 0.004 | 4.831 |
| Vaccine | $\beta_3$ | 0.017 | 0.050 | 0.341 |
| Flock size | $\beta_4$ | 0.216** | 0.063 | 3.432 |
| **Inefficiency Variable** | | | | |


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|---|---|---|---|---|
| Constant | $Z_0$ | 0.295*** | 0.112 | 2.638 |
| Age | $Z_1$ | -0.003*** | 0.0007 | -3.814 |
| Education | $Z_2$ | -2.124*** | 0.660 | -3.218 |
| Farming experience | $Z_5$ | -0.0045 | 0.234 | -0.019 |
| | | | | |
| **S**igma-square | $(\sigma^2)$ | 0.396*** | 0.012 | 33.282 |
| Gamma | $(\gamma)$ | 0.842*** | 0.072 | 11.689 |
| Log likelihood function | *L/f* | -15.18 | | |
| LR test | | 11.66 | | |
| Mean efficiency | | 0.73 | | |

**Sauces: Primary data 2015**

The maximum likelihood estimates of the Cobb-Douglas stochastic production frontier model presented in table 2.0 indicated that the major drivers of the output of the layer producers in the study area were labor, feed, vaccine and flock size. However, the estimated coefficients of the parameters of production function (feed, labor and flock size) were positive and significant at 1% and 5% level of probability which play a major role in layers production in the study area. The average technical efficiency for the layer producers was 0.73 implying that, on the average, the respondents are able to obtain 73% of potential output from a given mixture of production inputs. Thus, in a short run, there is minimal scope (27%) of increasing the efficiency, by adopting the technology and techniques used by the best layers producers. The estimated coefficients cost of vaccine was statistically not significant.

Feed has a positive coefficient and is significant at 1% level of significant. This agrees with *a priori* expectation. This suggests that the more the quantity of feeds allocated to the poultry birds; the larger will be the size of the birds and thus, the higher the number of eggs and income obtained by poultry producers.

Flock size was positive and is significant at 5% level of significance. The positive coefficient is the elasticity of production and it shows that there is a direct relationship between flock size and egg output in the study area. It shows that a unit increase in flock size would bring forth a corresponding 0.216 increase in poultry egg output. This finding is in line with that of Tijjani, et al (2012), Begun et al (2012), Ohajianya (2014) and Achoja (2010) that the larger the flock sizes of a poultry farm, the higher the number of egg output and income the producers generate in their poultry egg production.

Age of the layer producers was negatively related to the technical inefficiency of the layer producers in the study area and was statistically significant at 1% probability level. This means that a unit increase in the age of the layer producers will increase their technical efficiency by a magnitude of 0.001. Therefore, the older the layer producers, the lower their technical inefficiency and this could be attributed to the ability of the layer producers to be fully involve in the day to day activities of their farms 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 status of the layer producers was negatively related to the technical inefficiency of the layer producers in the study area. This study is in line with *a priori* expectation and was statistically significant at 1% probability level. This implies that a unit increase in the education of the layer producers will decrease their technical inefficiency. This is because the more educated the layer producers, the better will be their managerial ability in handling the operations of their layers farms and also, education enhances their ability to acquire technical knowledge with respect to adoption of technologies geared towards increasing their efficiency.

Layer production years of experience had an estimated coefficient of (-0.0064) and this implies that the poultry production experience of the layer producers was inversely related to the technical inefficiency of the layer producers in Kaduna state. The years of experience in poultry production equally indicates a positive relationship with the number of eggs produced in Kaduna state. This is in agreement with Ike (2011), Eze et al (2012) and Ohajianya (2013) where educational level, age of the farmer and years of experience put in layer production contributed positively to the efficiency of layer output as revealed in their separate studies

**Table 2.1 Technical efficiency of Broiler Production**

| Variables | Parameters | Coefficients | Standard error | T-Value |
|---|---|---|---|---|
| **Production Variable** | | | | |
| Constant | $\beta_0$ | 2.663*** | 0.176 | 15.169 |
| Labour | $\beta_1$ | -0.412** | 0.194 | -2.123 |
| Feed | $\beta_2$ | 0.008*** | 0.002 | 3.800 |
| Vaccine | $\beta_3$ | 0.009 | 0.023 | 0.391 |
| Flock size | $\beta_4$ | 0.097*** | 0.036 | 2.700 |
| **Inefficiency Variable** | | | | |
| Constant | $Z_0$ | 0.133** | 0.064 | 2.075 |
| Age | $Z_1$ | -0.001*** | 0.0004 | -3.012 |
| Education | $Z_2$ | -0.954*** | 0.3772 | -2.531 |
| Sex | $Z_3$ | 0.002 | 0.001 | 1.503 |
| Marital status | $Z_4$ | -0.002 | 0.134 | -0.015 |
| Farming experience | $Z_5$ | -0.006*** | 0.002 | -2.501 |
| | | | | |
| **S**igma-square | ($\sigma^2$) | 0.178*** | 0.007 | 26.176 |
| Gamma | ($\gamma$) | 0.379*** | 0.041 | 9.194 |
| Log likelihood function | *L/f* | -15.187 | | |
| LR test | | 11.66 | | |
| Mean efficiency | | 0.81 | | |

**Sauces: Primary data 2015**

The ML estimates and inefficiency determinants of the specified frontier are presented in Table 2.1. The study revealed that the generalized log likelihood function was -15.187. 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 was highly significant at ($p<0.01$) level of probability. The 38% of random variation in the broiler output of the farmers was due to their inefficiency in their respective sites and not as a result of random variability. However, the average technical efficiency for the farmers was 0.81 which is (81%), there is minimal scope (19%) of increasing the efficiency, by adopting the technology and techniques used by the best broiler farmer.

The estimated coefficient of labour (0.012) is an indication that labour was inversely related to the output of the broiler farmers and was statistically significant at 5% probability level. This suggests that one percent increase in the quantity of labour will decrease the output of the broiler farmers by 1.2%*ceteris paribus*. Hence, labour had decreasing influence on output of the broiler farmers. This agrees with the *a priori* expectation. The negative coefficient showed over utilization of labour input in broiler production. This result agrees with the findings in a study by Afolabi et-al (2013), in their study of profitability and resource-use efficiency in poultry egg farming in Ogun state, Nigeria found out that labour input has a negative signed coefficient of elasticity of production of -0.726 and these shows over utilization of labour input.

The estimated coefficient of feed (0.008) is an indication that the quantity of feed was positively related to the output of the broiler farmers and this was statistically significant at 1% probability level. This finding conforms to that of Hussain *et al*. (2012) who reported the feeds was positively related to output and was significant at 1% probability.

The estimated coefficient of cost of vaccine is 0.009 and was not significant; it however indicates that a unit increase in cost of vaccine would result in an increase in broiler output by 0.009 units. This finding is in line with Effiong and Umo (2011).

The coefficient of flock size was 0.097 and is significant at 1% level. The positive coefficient is the elasticity of production and it shows that there is a direct relationship between flock size and broiler output in the study area.

It shows that a unit increase in flock size would bring forth a corresponding 0.097 increase in poultry output.

The estimated result of inefficiency model contained in table 2.1, 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 with an estimated coefficient of -0.006 this implies that, these variables broiler of producers were negatively related to the technical inefficiencies in the study area and was statistically significant at 1% probability level.

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**Table 2.2 Technical efficiency of Pullet Production**

| Variable | Coefficient | Standard error | T value |
|---|---|---|---|
| Production model | | | |
| **Constant** | 5.0866 | 0.5249 | 9.69 |
| **Labor** | 0.2102*** | 0.0613 | 3.43 |
| **Feed** | 0.3295*** | 0.0728 | 4.53 |
| **Vaccine** | 0.1018 | 0.3369 | 3.31 |
| **Flock size** | 0.1795*** | 0.0673 | 2.67 |
| | | | |
| Inefficiency model | | | |
| **Constant** | -1.338 | 1.751 | -0.76 |
| **Age** | 0.082* | 0.044 | 1.84 |
| **Education** | -0.301** | 0.118 | -2.54 |
| **Sex** | 0.010 | 0.253 | 0.04 |
| **Marital status** | 0.119 | 0.081 | 1.47 |
| **Farming experience** | 0.346 | 0.578 | 0.60 |
| | | | |
| **Sigma squared** | 0.759*** | 0.215 | 3.52 |
| **Gamma** | 0.716*** | 0.201 | 3.55 |
| **Log likelihood** | -96.118 | | |
| **Mean** | 0.64 | | |

**Sauces: Primary data 2015**

The ML estimates and inefficiency determinants of the specified frontier are presented in Table 2.2 The study revealed that the generalized log likelihood function was -96.118. The Cobb-Douglas used in this estimation is an adequate representation of the data. The value of gamma (γ) is estimated to be 0.716 and significant at ($p<0.01$) level of probability, which is greater than zero. This implies that 72% of random variation in the pullet output was due to the producers' inefficiency in their respective sites and not as a result of random variability. The value of sigma squared (**$\sigma^2$**) 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. However, the average technical efficiency for the pullet producers was 0.64 implying that, on the average of 64% output from a given mixture of production inputs. Thus, in a short run, there is minimal scope (36%) of increasing the efficiency, by adopting the technology and techniques used by the best pullet farmer.

The result indicates that the coefficient of labour was positive and significant at 1%. This contradicts with the *a priori* expectation. The positive coefficient of the cost of labour suggests that the higher the cost of labour, the more poultry farmers obtain pullet output. The reason is that, the more farmers spend on hired labour, the higher the number of man-days working on the farm and the larger the number of poultry birds on farm and attentions birds receive.

The quantity of feed was positively related to the output of the pullet farmers and this was statistically significant at 1% probability level. This implies that one percent increase in the quantity of feeds will increase the output of the pullet farmers by about 0.329 magnitudes *ceteris paribus*. This finding conforms to that of Hussain*et al*. (2012) who reported that feeds were positively related to output and was significant at 1% probability level.

The coefficient of the flock size was positive and significant at 1%. This finding is in line with the report of Ajibefun and Daramola (2000), Subahash et al. (1999) and Bamiro et al. (2006) that the lager the flock size of a poultry

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farm, the higher, the number of eggs and income farmers generate in poultry production.

The age of the pullet producers was positively related to the technical inefficiency of the producers in the study area (0.082) and was statistically significant at 10% probability level.

The educational level of the producers showed a negative relationship of the producers in the study area (-0.301) and was statistically significant at 5% level, while years of experience in pullet production indicated a positive relationship (0.0346).

**Conclusion and Recommendation**

This study revealed that the coefficient of 73%, 81% and 64% technical efficiency of poultry producers in the study area indicated that the farmers were not fully technically efficient, especially the pullet producers due to inability of farmers to adopt the technology and techniques used by the best poultry farmer. It is recommended that poultry production in this study area must be able to adopt new and improved technologies that are both labor and cost effective, bearing in mind the goal of maximizing and efficient use of factor resources. Poultry producers should be encouraged through education and technical knowhow in the use of poultry production materials as well as government should endeavour to make adequate provision of infrastructures and subsidies of poultry input, this will improve poultry production and reduce the technical inefficiencies.

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