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Technical Efficiency of Table Egg Producers in Imo State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author DOO designed the survey. Author PNO also work the report inventory. Author JNU involved in selecting. Author MNO wrote the data analysis. Author IUN also involved in data collection. Author JSO proof read the typed manuscript. Authors CCG, COE they were also involved in data collection and also proof read the Galley proof. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

The study measured the level of technical efficiency and its determinants in table egg production in Imo State, Nigeria by using a stochastic frontier production function to determine individual technical efficiencies of the farmers. Multi stage sampling technique was used to select 105 table egg producers. The estimated technical efficiency ranged from 16.23% to 94.17% with a mean technical efficiency of 62%. The wide variation in the level of technical efficiency indicates that ample opportunities exist for table egg producers to increase their productivity and income through improvements in technical efficiency. Determinants of technical efficiency of table egg producers were found to be credit access, level of education, farming experience, flock size, extension contact and

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membership of farmers' associations/cooperatives, since these variables were found to be positively and significantly related to technical efficiency.

Keywords: Frontier production function; Imo state; table egg; technical efficiency.

1. INTRODUCTION

Poultry production is one of the important subsectors in the Nigerian economy, which can be embarked upon by the people with small or no land capital. [1] reported that the majority of the resource poor households in rural areas own livestock of one type or another and that landless families often own a few goats or chicken and sometimes one or more large ruminants.

Poultry production contributes to people's livelihoods in a variety of ways and its contributions tend to be particularly important for resource poor farmers and educated unemployed persons because it is a source of cash income from sale of chicken and their products and creates self employment opportunities [2]. [3] reported that there has been increase in the contribution of poultry products to Gross Domestic product (GDP) in Nigeria from 26% in 1995 to 27% in 2007. Egg production is a major index of performance of poultry business in Nigeria [4] [5] reported that egg accounts for about 90% of the income from poultry industry. Table egg production enterprise is known to be a very profitable business but if not properly managed, the negligence of the necessary management routine can make the venture to be unprofitable. Egg is a good source of protein and in addition to this, [6] reported that egg contains vitamins A and D, thiamin and riboflavin, which are present in substantial amount. [7] reported that egg has been recognized as one of the best ways of supplying good quality animal protein for human consumption to fulfill their nutrient requirement, because every part of an egg is useful for one thing or the other. Egg ranks only with cow whole milk as the most economically produced animal protein [8, 9]. Despite the nutritive value of egg, its production in the country is grossly inadequate as reflected in the wide gap between demand and supply of the product. This could be attributed to numerous problems that poultry farms in Nigeria are facing. These problems include low capital base, inefficient management, technical or production inefficiency, diseases and pests and poor housing [10], high cost of feeds, poor quality of day old chicks, inadequate extension and training facilities [11].

The table egg production capacity of poultry farms has to increase rapidly to be able to meet up with the increasingly rising demand. For table egg production to increase substantially and sustainably, the present level of technical efficiency must be improved upon. At the moment, there are a limited number of studies on technical efficiency of table egg producers [12,4,8], and none of these studies was conducted in Imo State of Nigeria, thereby leaving an information gap which this study intends to fill.

Efficiency is an important factor of productivity growth especially in developing agriculture where resources are meager. The analysis of efficiency is generally associated with the possibility of farms producing a certain optimal level of output from a given level of resources or certain level of output at least cost. [13,14,15,16], distinguished between at least two types of efficiencies.

Technical efficiency refers to the ability of firms to employ the "best practice" in an industry so that not more than the necessary amount of a given set of inputs is used in producing the "best" level of output [17,12,18,19,20]. Criticisms have been raised about the interpretation of efficiency measures [21,22,23]. To avoid many of these criticisms levied upon efficiency concepts, Ellis (1988) advised that the producers' performance should be estimated only in terms of technical efficiency. This according to him is because measures of technical efficiency rely less heavily on assumptions of perfect knowledge, perfectly competitive markets and the profit maximization objective.

[24] reported that efficiency can be estimated by separately estimating technical and allocative efficiencies from a production frontier using farm survey data. Technical efficiency is defined as the ratio of farmer's actual output to the technically maximum possible output, at given level of resources. Allocative efficiency is expressed as the ratio of the technically maximum output, at the farmer's level of resources to the output obtainable at the optimum level of resources [25].

The major objective of this study is to estimate the technical efficiency of table – egg producers in Imo State, Nigeria. The specific objectives are to:

(i) Examine the socio economic features of table egg producers in Imo State,
(ii) Estimate the technical efficiency of table egg producers in Imo State, and
(iii) Estimate the determinants of technical efficiency of table egg producers in Imo State.

2. METHODOLOGY

This study was conducted in Imo State of Nigeria. It lies within latitudes $5^{0}\,40^{1}$ and $7^{0}\,05^{1}$ North and longitudes $5^{0}\,35^{1}$ and $8^{0}\,30^{1}$ East. It had a population of about 3, 985, 569 People in 2006 [26]. The State is divided into three agricultural zones of Owerri, Orlu and Okigwe, and further divided into 27 Local Government Areas (LGAs). Farming is the major occupation of the people. The weather and environmental conditions of Imo State favour the production of livestock such as poultry, sheep, goats, rabbits and pigs. A multi-stage sampling technique was used to select respondents [27]. The State was stratified into the existing three agricultural zones. Through a pilot survey of the state, table egg producers were identified with the assistance of extension personnel of Imo State Agricultural Development Programme (ADP). The number of table-egg producers indentified varied among the LGAs in each agricultural zone. Two LGAs from each zone that had the highest number of table egg producers were purposively selected, making a total of six LGAs. The sampling frame was the list of table egg producers in each selected LGA. Proportionate sampling followed by random sampling techniques were employed in each LGA to select the sample size made up of 105 table egg producers. The study used mainly primary data which were collected using questionnaire between March and August 2012. The information gathered includes detailed modules on inputs and output in table egg Production. Data were analyzed using Descriptive statistics and Stochastic Production Frontier Model. Descriptive Statistics was used to achieve objective one and they include mean, frequency distribution and percentages. Stochastic production frontier model was used to analyze objectives two and three because it overcomes the limitation of the ordinary least squares (OLS) by providing numerical measures of technical efficiency of individual farmers in a sample.

2.1 The Theoretical Model

A Stochastic Production Function is defined by Yi = F(Xi,B)exp(Vi – Ui), i = 1,2 –n--(1) where Yi is output of the i^{th}. farm, Xi is the vector of input quantities used by the i^{th} farm, B is a vector of unknown parameters to be estimated, f(.) represents an appropriate function (e.g., Cobb – Douglas, translog, etc). The term Vi is a symmetric error, which accounts for random variations in output due to factors beyond the control of the farmer e.g., weather, disease outbreaks, measurement errors etc, while the term Ui is a non negative random variable representing inefficiency in production relative to the stochastic frontier. The random error Vi is assumed to be independently and identically distributed as N(δ, δi2) random variables independent of the Uis which are assumed to be non – negative truncations of the N(0, δi2) distribution. (i.e., half – normal distribution) or have exponential distribution. The Stochastic Frontier model was independently proposed by [28,29]. The technical efficiency of an individual farmer is defined in terms of the ratio of the observed output to the corresponding frontier output, given the available technology.

Technical Efficiency (TE = Yi/Yi* = f (Xi, B) exp (Vi – Ui) / f (Xi, B) exp (Vi)= Exp (- Ui)---- (2)
Where Yi is the observed output and Yi* is the frontier output.

The parameters of the stochastic production frontier function are estimated using the Maximum Likelihood Method (MLE) [28].

2.2 The Empirical Model

For this study, the production technology of table – egg producers in Imo State, Nigeria is assumed to be specified by the Cobb – Douglas frontier production function defined as follows;

Ln Q = b0 + b1lnX1 + b2lnX2 + b3lnX3+ b4lnX4 + b5 ln X5+b6lnX6+ Vi – Ui----------(3)

where; Q is the quantity of eggs produced per production period of 6 months in kg, X1 is size of flock in number of birds, X2 is quantity of feed used in kg, X3 is labour input in mandays, X4 is amount of capital used in naira, X5 is expenditure on medication in naira, and X6 is expenditure on other variable inputs in naira, b0,b1,-----b6 are the regression parameters to be estimated, while Vi and Ui are as defined earlier. In addition, Ui is assumed in this study to follow a half normal distribution as is done in most applied Frontier production literature. It is expected a priori that the parameters b1, b2, b3, b4, b5, b6, will be Positive because increases in the magnitude of variables x1 to x6 will lead to increases in technical efficiency of the farmers.

2.3 Determinants of Technical Efficiency

In order to determine factors contributing to the observed technical efficiency, the following model was formulated and estimated jointly with the stochastic frontier model in a single stage maximum likelihood estimation procedure (using the computer software frontier version 4.1) [30].

TEi = a0 +a1 z1+a2z2+ a3z3 +a4 z4+a5 z5+ a6 z6+a7z7----------(4)

where TEi is the technical efficiency of the i^{th} farmer, Zi is credit access, a dummy variable which takes the value of unity if the farmer has access to credit and zero if otherwise, Z2 is the farmer's age in years, Z3 is farmer's level of education in years, Z4 is farmer's farming experience in years, Z5 is stock size in number of birds, Z6 is number of extension contacts made by the farmer in the year, and Z7 is membership of farmers associations/cooperative societies, a dummy variable which takes the value of unity for membership and zero if otherwise, while a0, a1, ----a7 are parameters to be estimated. It is expected a priori that a1, a3, a4, a5, a6, a7 will be positive, and a2 will be negative.

3. RESULTS AND DISCUSSION

3.1 Socio Economic Features of Table Egg Producers

The Socio economic features of the sampled table egg producers in Imo State are presented in table 1. On the average, a typical table egg producer has 354 layers, used 6329 kg of feed, 203 mandays of labour, N2409.43 amount of capital, N603.22 amount of medication, and N152.61 amount of other variables inputs per layer. Also, a table egg producer is 42 years old, with 7.3 years of education, 18 years of farming experience, household size of 9 People, credit access of 0.43 and 0.39 extension visits. These results suggest that a typical table egg producer in the study area is a small scale farmer, has poor credit access, is young, literate, highly experienced in table egg production, has poor extension contact, and has a large household size. However, the results shown that some of the farmers did not belong to farmers associations/cooperatives.

Table 1. Average characteristics of table egg producers in Imo State, Nigeria

Flock variable	Mean value
size	354 layers
Feed	6,329kg
Labour	203 Mondays
Capital	N2,409.43
Medication	N 603.22
Other variable inputs	N 152.61
Credit access	0.43
Age	42 years
Level of education	7.3 years
Farming experience	18 years
Extension contacts	0.39 visits
Membership of Farmers Associations	0.72
Household size	9 persons

Source: Survey data 2012

3.2 Estimated Stochastic Frontier Production Function

The Maximum Likelihood Estimates (MLE) of the stochastic frontier production Function parameters for table egg producers are presented in table 2. The coefficients of the estimated parameters have the desired signs and are statistically significant. The ratio of the standard error of Ui (δu) to that of Vi (δv) (called lambda (λ) is estimated at 1.638 and it is statistically insignificant at 5% level. Gamma (γ) derived at (λ2/1+λ2) is equal to 0.734. This implies that 73.4% of the total variation in table egg output is due to technical inefficiency.

Table 2. Estimated stochastic frontier production function for table egg producers in Imo State, Nigeria

Variable	Parameters	Estimates
Constant term	b0	0.839
(3.913)**		
Flock size (X1)	b1	0.091
(4.067)**		
Feed (X2)	b2	0.075
(3.164)**		
Labour input (X3)	b3	0.084
(2.963)**		
Capital (X4)	b4	0.038
(2.541)*		
Medication (X5)	b5	0.052
(2.478)*		
Other variable inputs (X6)	b6	0.049
(2.514)*		
Log likelihood function	17	4.510
Sigma (δ)	9.603	(3.116)**
Lambda (λ)	1.638	(1.522)
Gamma (γ)	0.734	
Sample size (n)	105	

*Figures in Parentheses are t – ratios,*Significant at 5%,**Significant at 1%.*

The frequency distribution of technical efficiency of table egg producers is presented in Tables 3. Individual technical efficiency indices range between 16.23% and 94.17% with a mean technical efficiency of 62%. This implies that the level of technical inefficiency of the table egg producers is 38% Seventy percent of the table egg producers had a technical efficiency index of above 50%. The mean technical efficiency of 62% obtained in this study compares favourably with the 66.06% obtained by [12] for poultry egg in Nasarawa State of Nigeria. The level of technical efficiency obtained in this study suggests that opportunities exist for increasing productivity and income through increased efficiency in resource utilization by table egg producers in Imo State, Nigeria.

Table 3. Frequency distribution of technical efficiency of table egg producers in the Imo State, Nigeria

Technical efficiency		
Range (%)	**Frequency**	**Percentage**
≤ 30	2	1.9
31 – 40	5	4.8
41 – 50	14	13.3
51 – 60	23	21.9
61 – 70	39	37.2
71 – 80	8	7.6
81 – 90	10	9.5
91 – 100	4	3.8
Total	105	100

Mean Technical Efficiency 62.0%.
Minimum Technical Efficiency 16.23%.
Maximum Technical Efficiency 94.17%.
Source: Survey data 2012.

3.3 Determinants of Technical Efficiency

The sources of technical efficiency in table egg production are presented in Table 4. Credit access is significant and positively related to technical efficiency. This implies that availability and use of adequate capital shifts the production frontier upwards resulting in higher levels of technical efficiency. Credit is needed to improve production of table eggs and hence the positive relationship between credit access and technical efficiency.

Table 4. Estimated determinants of technical efficiency in table egg production in Imo State, Nigeria

Variable	Parameter	Estimates
Constant term	a0	0.513
(3,107)**		
Credit access (z1)	a1	0.046
(2.391)*		
Age (z2)	a2	-0.055
(-1.443)*		
Level of education (z3)	a3	0.094
(3.176)**		
Farming experience (z4)	a4	0.069
(3.042)**		
Flock size (z5)	a5	0.087
(3.185)**		
Extension contact (z6)	a6	0.066
(2.415)*		
Membership of Farmers Association/cooperatives (z7)	a7	0.038
(2.337)*		

Figures in parentheses are t – ratios
**Significant at 5%*
***Significant at 1%*
Sources: Survey data 2012

This result is consistent with those of [31] in Imo State, Nigeria. [32] in Northern Nigeria, [33] in Eastern Paraguay, and [34] in Philippines. This result, however, differs from that of [35] who found a negative relationship between credit and technical efficiency in Northern Nigeria. Level of education is positively and significantly related to technical efficiency. Education enhances farmer's ability to derive, decode and evaluate useful information as well as improving labour quality. The result obtained in this study agrees with those of [31,32,36] in Nigeria; [37] in Nepal; [38] in Malaysia; and [39] in Dominica. Farming experience is positively and significantly related to technical efficiency. The more experienced a farmer is the more efficient his decision making processes and the more he will be willing to take risks associated with the practice of improved technologies. This result is consistent with those of [31];

[32] in Nigeria; [40] in India, and [41] in Philippines. However, this result differs from that of Onu, et al. whose result showed a negative relationship between farming experience and technical efficiency in cotton production in Nigeria.

Flock size is positively and significantly related to technical efficiency. Large scale farmers are supposed to be more educated, risk takers, to have greater access to credit and to adopt

agricultural technologies more than small scale farmers. This result is in consonance with those of [31,32,41,42]. However, this result contrasts from those of [41,43,37]

[34,39], which found no significant relationship between farm size and technical efficiency. Membership of farmers association/cooperative is positively and significantly related to technical efficiency. Members of farmers associations have more access to agricultural information, credit and other production inputs as well as more enhanced ability to adopt innovations, and is consistent with the result of [31] in Ebonyi State, Nigeria and [35] in Northern Nigeria. Extension contact is positively and significantly related to technical efficiency in accordance with the a priori expectation that extension contact leads to more efficient transmission of information to farmers as well enhancing the adoption of innovations. This result agrees with those of [31,32,40,41]. However, age shows no significant relationship with technical efficiency.

4. CONCLUSION

Table egg production can play a vital role in the socio economic development of Imo State. The technical efficiency of table egg producers range from 16.23% to 94.17% with a mean of 62%, and suggests that there are substantial opportunities to increase productivity and income of table egg producers in Imo State by increasing the efficiency with which resources are used at the farm level.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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