Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 17, Issue 1, 2017
PRINT ISSN 2284-7995, E-ISSN 2285-3952

TECHNICAL EFFICIENCY OF POULTRY ENTERPRENEURS IN ABIA STATE: A STOCHASTIC FRONTIER APPROACH

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Abstract

This study examined the technical efficiency of the agribusiness poultry entrepreneurs in Abia state. Multi-stage sampling technique was adopted in selecting 180 poultry farmers. An estimated gamma value (γ) of 42.11% was highly significant at 1% level of probability implying that 42.11% of random variation in the output of the poultry entrepreneurs was due to the inefficiency in their respective farms and not as a result of random variability. Feed and drugs/vaccines were positively related to output of the poultry operators respectively while labour input and capital inputs were negatively related to output of the poultry. The average poultry operators were able to obtain 81% of potential output from a given mixture of production inputs. Age and credit access negatively influenced the technical efficiency of the poultry entrepreneurs while stock size, business experience and level of education positively affected efficiency of the entrepreneurs. Insufficient funds and theft were the major problems affecting poultry farming in the study area. Efforts to reducing the costs incurred on fixed items by these entrepreneurs should be encouraged such as provision of timely loans and credits by banks to reduce time lag in production cycles. Credits inform of stocks, feeds and drugs/vaccines from trusted sources will boost productivity, efficiency and income with little financial burdens.

Key words**:** *efficiency, entrepreneurs, poultry, stochastic, Abia*

INTRODUCTION

If agribusiness is stretched to the farthest limits, more than 75% of all business operations in Nigeria may be classified as agribusiness in form or typology and it provides a broad range of investment opportunities for both institutional and private investors [22]. Thus, there are strong synergies between agribusiness and the performance of agriculture for development.

A growing trend in developing countries is the complexity in isolating the process of agribusiness and its contribution to Gross domestic product, reduction of poverty and food insecurity scourge. This sector is doubtlessly considered crucial in providing a blueprint for economic development. This importance is echoed by studies carried out by [23, 20]. The need for efficiency in this sector becomes very important given the geometric rise in population and consequent rising food demand. Thus, efficiency in agribusiness sector is critically important if output is to increase at a sufficient level to meet escalating demand for food [18]. Food remains a basic human need and major source of nutrients needed for human existence, hence, the need for its availability and accessibility. There is a global clue that food abound and yet, more than 780 million people are chronically malnourished. The condition is worse in developing nations where millions of people simply cannot obtain the food they need for a healthy and productive life.

The result is a big gap between national supply and national demand for food. Progress in the agricultural sector has remained unsatisfactory. Common staples in most Nigerian homes are insufficient and do not provide a balanced diet as such, malnutrition is prevalent in most homes. This has led to massive importation of foods and massive foreign debt. This is true following empirical data which revealed that while food output increased at 2.5%, food demand increased at a rate more than 3.5% due to high rate of population growth of 3.18% [8, 1, 9].

There is therefore a case for ensuring the enforcement of agribusiness support systems at both micro and macro levels and engaging active policy actors in achieving increased food production, food security and livelihood stability through the instrumentation of the agribusiness sector having provided a template on its capacity to drive economic development.

The term efficiency was introduced by [7] based on the concept of Koopmans (1951). Debreu (1951), Kumbhakar *et al*. (1991), and Battese and Coelli (1995) propose the redial type of efficiency measurement and recommend that the factors responsible for inefficiency should be considered for measuring the performance or production efficiency. [5] observed that measures of inefficiency are based on residuals derived from the estimation of a stochastic frontier. The productive efficiency of the firm can be described as its ability to produce output with a certain bundle of inputs in a given technological context. A number of studies such as [4, 25, 11] examined the technical efficiency of manufacturing firms of developing countries.

Stochastic frontier approach is also widely used in measuring technical efficiency, allocative efficiency, and economic efficiency for the agricultural sector. [17, 10, 12, 26, 27, 15] used this technique to estimate technical efficiency of this sector. This study uses the stochastic frontier approach to assess the technical efficiency of the seafood processing firms of Bangladesh with the assumption that the actual production cannot exceed the maximum possible output with the given input quantities [2, 16].

Increasing efficiency implies either more output is produced with the same amount of inputs or that fewer inputs are required to produce the same level of output [24]. The highest productivity (efficient point) is achieved when maximum output is obtained for a particular input level. Hence, productivity growth encompasses changes in efficiency, and increasing efficiency has been shown to raise productivity [24] and in this study, the poultry sub-sector.

MATERIALS AND METHODS

The study was carried out in Abia State, Nigeria. Abia State is located in the south east geopolitical zone of Nigeria. The state lies between longitude 04 45' and 07 00' and 08 10' East. The state has a population of about 2,833,999 persons [19]. Geographically, the state lies within latitude 4^{o} 49 and latitude North of equator and longitude 6^{o}47 North and longitude north of Greenwich meridian. The state is known for her agricultural strides including crops and livestock farming. Almost all the households in the state engage in chicken production at varying levels. However, data was collected only from commercial poultry farmers. A multi-stage sampling technique was adopted. One LGA was selected from each of the three (3) agricultural zones from which two (2) autonomous communities were selected from where thirty (30) poultry entrepreneurs were selected. Thus, a total of 180 poultry agribusiness enterprises were selected for this study.

To estimate the production function and technical efficiency of the agribusiness poultry entrepreneurs, the Cobb-Douglas and Translog forms of the Stochastic Production Function were analyzed. As a rule of the thumb, the Cobb-Douglas is selected over the Translog when the second order coefficients of the Translog are less than zero. Generally, a stochastic frontier production function is defined by:

$$Y_i = f(X_i; \beta) \exp(V_i - U_i), \; i = 1, 2, \ldots\ldots\ldots\ldots (1)$$

where: Y_i is output of the i^{th} entrepreneur, X_i is the vector of input quantities used by the i^{th} entrepreneur, β is a vector of unknown parameters to be estimated, f () represents an appropriate function (e.g Cobb Douglas, translog etc). The term V_i is a symmetric error, which accounts for random variations in output due to factors beyond the control of the entrepreneurs e.g. weather, disease outbreaks, measurements errors etc., while the term U_i is a non-negative random variable representing inefficiency in production relative to the stochastic frontier. The random error V_i is

assumed to be independently and identically distributed as $N(\sigma,sv^2)$ random variables independent of the U_i's which are assumed to be non-negative truncation of the $N(\sigma,sv^2)$ distribution (i.e. half-normal distribution) or have exponential distribution.

This stochastic frontier model was independently proposed by [2 and 16]. The technical efficiency of an individual entrepreneur is defined in terms of the ratio of the observed output to the corresponding frontier output, given the available technology.

Technical efficiency

$$(TE) = Y_i/Y_i^* = f(X_i; \beta) \exp (V_i - U_i) / f(X_i, \beta) \exp (V_i) = \exp (-U_i) \text{ …….....(2)}$$

where: Y_i is the observed output and Yi* is the frontier output. The parameters of the stochastic frontier production function are estimated using the Maximum Likelihood method. For the purpose of this study, the production technology of arable crop farmers in Abia State, Nigeria is assumed to be specified using the Cobb-Douglas production frontier as follows [21]:

$$LnQ = b_0 + b_1 lnX_1 + b_2 lnX_2 + b_3 lnX_3 + b_4 lnX_4 + b_5 lnX_5 + V_i - U_i \text{ …….. (3)}$$

where:

Q = Total value of poultry (₦)
X_1 = Feed (₦)
X_2 = Labour input (man days)
X_3 = Drugs/vaccines (₦)
X_4 = Capital inputs (made up of depreciation charges on farm tools/equipment, interest on borrowed capital, taxes, insurance and rent measured in naira)
$b_1 – b_5$ = Coefficients of the parameters to be estimated
Vi – Ui = as earlier stated

In order to determine factors affecting the technical efficiency of the poultry entrepreneurs in the study area, the following model as 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 was employed:

$$TEi: = a_0 + a_1Z_1 + a_2Z_2 + a_3Z_3 + a_4Z_4 + a_5Z_5 + a_6Z_6 + a_7Z_7 \text{ …….....(4)}$$

where:

TE_i = Technical efficiency of the i^{th} poultry entrepreneur
Z_1 = Entrepreneur's age (Years)
Z_2 = Credit access (1=yes, 0=otherwise)
Z_3 = Stock size (Number of birds in stock)
Z_4 = Business experience (Years)
Z_5 = Cooperative membership (Dummy: Yes=1, otherwise=0)
Z_6 = Entrepreneur's level of education (Years)
Z_7 = Household size
$a_0 \ldots a_7$ = Coefficients of efficiency parameters to be estimated.

RESULTS AND DISCUSSIONS

Average statistics of the poultry entrepreneurs

The average statistics of the poultry enterprises are presented in Table 1.

The result showed a mean age of 41.2 years of entrepreneurs indicating that they are young and should be vibrant, enterprising and highly efficient.

Table 1. Average statistics

Statistic	Mean	SD	Min	Max
Age (Years)	41.22	7.60	26.00	55.00
Education	9.66	2.76	5.00	20.00
Experience	6.27	2.49	2.00	15.00
Household size	3.00	1.66	0.00	6.00
Number of birds	120	20.6	35	350
Income received	80,000	120.	30,000	400,000
Male (%)	56			
Married (%)	67			
Credit users (%)	65			
Cooperative				

Source: Field survey, 2016

The majority (56%) of the poultry enterprises are men dominated. The result shows that a large proportion of the poultry entrepreneurs (67%) were married. A mean experience of 11 years is fair as they respondents could stand on their own and take well-informed decisions. Experience plays an important role in improving the efficiency of entrepreneurs through allocation and utilization of resources since they can understand the intricacies of the business better.

The household size and structure of a family is a major determinant of a lot of important indices such as per capita income, consumption, and welfare and food security. It affects farm efficiency through the supply of labour at no cost especially where a majority of the household members are not dependents (aged and children). The result shows that a very large part of the poultry entrepreneurs (80%) are cooperative members. Membership of cooperative society is a strong requirement by commercial financial institutions to advance loans to farmers. The entrepreneurs kept a mean number of 120 birds. Poultry entrepreneurs with larger farm sizes are expected to be more efficient and profitable and vice-versa. The result shows that the respondents received an average of N80, 000 for every production cycle. With an increase in income, the entrepreneurs can re-invest the excess thereby increasing size and breaking the vicious cycle of poverty.

Determinants of output of the poultry entrepreneurs

To determine the factors affecting the output of the poultry entrepreneurs, the

Cobb-Douglas form of the stochastic production frontier model was employed. The model specified was estimated by the maximum likelihood (ML) method using FRONTIER 4.1 software developed by Coelli. The result is presented in Table 2.

The study showed a log likelihood function was -67.786 for the poultry entrepreneurs. 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. An estimated gamma value (γ) of 42.11% was highly significant at 1% level of probability. This implies that 42.11% of random variation in the output of the poultry entrepreneurs was due to the inefficiency in their respective farms and not as a result of random variability. The value of sigma squared ($\boldsymbol{\sigma^2}$) was significantly different from level of probability. This means that the inefficiency effects make significant contribution to the technical inefficiencies of the poultry entrepreneurs.

Table 2. Poultry entrepreneurs' Cobb-Douglas production function estimates

Variable	Parameters	Coefficient	Standard-error	t-ratio
Intercept	b_0	6.085	0.4521	13.4594***
X_1 = Feed	b_1	0.1245	0.0187	6.6578***
X_2 = Labour	b_2	-0.2221	0.0452	-4.9137***
X_3 = Drugs/vaccines	b_3	0.2019	0.0583	3.4634**
X_4 = Capital inputs (₦)	b_4	-0.5214	0.2001	-2.6060**
sigma-squared		0.6112	0.1254	4.8740***
Gamma		0.4211	0.1009	4.1734***
LR test of the one-sided error		98.006		
log likelihood function		-67.786		
Total number of observations		180		
Mean efficiency		0.81		

Source: Field survey, 2016

***, ** and * are significant at 1%, 5% and 10% respectively.

The average technical efficiency was 0.81 implying that on the average, the poultry operators were able to obtain 81% of potential output from a given mixture of production inputs. Thus, in a short run, there is minimal scope (19%) of increasing the efficiency, by adopting the technology and techniques used by the best entrepreneurs.

The coefficient of feed was positive at 1% level of probability implying that increasing the feed given the birds will increase their output (meat and egg). Coefficient of elasticity (marginal effect) shows that for every 1% increase in the volume of feed given the birds (usually measured in Kg), output will increase by 0.1245%.

The coefficient of labour was negatively related to output of the poultry entrepreneurs at 1% level of significance implying that an increase in labour input will lead a decrease in output. This further suggests that the labour input is over-utilized and as such, diminishing marginal returns is obtained. The result further implies that the entrepreneurs particularly utilized hired labour without monitoring the effect on their profits.

The coefficient of drugs and vaccine was positively related to output of the poultry entrepreneurs at 5% significant of level. This shows that an increase in the inputs increased the output. Capital inputs was negative for the entrepreneurs at 5% significant level implying that as depreciation costs increase, output decreases. This is expected since costs are leakages from farmers stock of resources.

Technical efficiency of poultry entrepreneurs in Abia state

The technical efficiency distributions of the poultry entrepreneurs as well as the efficiency determinants are presented in this section. The frequency distribution of the poultry entrepreneurs according to their level of efficiency is presented in Tables 3 and 4.

The result in Table 3 shows that majority (45%) of the poultry entrepreneurs had technical efficiency (TE) of 0.61 – 0.8 with a mean of 0.81 implying that on the average, the operators were technically efficient and well-positioned to increase output.

The poultry entrepreneur with the best and least practice had technical efficiencies of 0.90 and 0.22 respectively implying that on the average, output fell by 10% from the maximum possible level attainable due to inefficiency by the entrepreneurs.

Table 3. Frequency distribution of poultry entrepreneurs by technical efficiency

Efficiency level	Frequency (f)	Percentage (%)
≤ 0.3	15	8
0.21 – 0.40	21	12
0.41 – 0.60	27	15
0.61 – 0.80	81	45
0.81 – 1.00	36	20
Total	180	100
Minimum	0.22	
Maximum	0.90	
Mean	0.81	

Source: Field survey, 2016

The poultry entrepreneur with the best and least practice had technical efficiencies of 0.90 and 0.22 respectively implying that on the average, output fell by 10% from the maximum possible level attainable due to inefficiency by the entrepreneurs.

Determinants of technical efficiency by the poultry entrepreneurs

The factors affecting the technical efficiency of the poultry entrepreneurs as jointly estimated with the output determinants from the Frontier model is presented in Table 4.

Table 4. Determinants of tech. efficiency

Variables	Coef	S.E	t-ratio
Intercept	0.58	0.09	5.88***
Age of entrepreneurs	-0.12	0.05	-2.27**
Credit access	-0.24	0.09	-2.48**
Stock size	0.55	0.02	25.07***
Business experience	0.11	0.07	1.56*
Coop. membership	0.08	0.10	0.76
Level of education	0.21	0.01	11.29***
Household size	-0.11	0.09	-1.25

Source: Field survey, 2016

***, ** and * are significant at 1%, 5% and 10% respectively.

The negative coefficient of age (0.1255) for the poultry entrepreneurs implies that increasing age by one unit will decrease technical efficiency by 0.1255%. This finding

does agree with *a priori* expectation. It is expected that ageing entrepreneurs would be less energetic to work, leading to low productivity as well as low technical efficiency.

The coefficient of credit utilization (0.2451) had a negative relationship with technical efficiency among poultry operators. Credit availability shifts the cash constraint outwards and enables entrepreneurs to make timely purchases of those inputs which they cannot provide from their own resources. However, a negative relationship implies that these entrepreneurs are either under-utilizing the credits or they use them for unproductive ventures other than the reason for accessing them.

The coefficient (0.5541) for stock size was positive for the poultry entrepreneurs implying that technical efficiency will increase by 0.5541 unit with a one unit increase in stock size. Large size entrepreneurs are usually more stable and have easier access to credit facilities. These generate higher incomes and in turn increase efficiency. Business experience and level of education were positively signed for the poultry operators indicating that the more experience and knowledge (through education) they acquire, the more technically efficient they become.

Problems of poultry farming

The problems affecting poultry production in the study area are listed and ranked in their order of severity in Table 5.

Table 5. Problems affecting poultry entrepreneurs in the study area

Problems	(f)*	(%)	Rank
Insufficiency of fund	60	29	1st
Theft	52	25	2nd
Fire outbreak	43	21	3rd
Poor sales	28	13	4th
Bad road networks	26	12	5th
Total	**209**	**100**	

Source: Field survey, 2016
*Multiple responses

The result shows that insufficient funds and theft were the major problems affecting poultry farming in the study area.

CONCLUSIONS

This study examined the technical efficiency of the agribusiness poultry entrepreneurs in Aba, Abia state. The mean age of poultry farmers' estimated approximately at 45 years is an indication that the farmers are still in their productive age. The stochastic frontier maximum likelihood estimates result revealed significant positive influence of Feed and drugs/vaccines on the output (and invariably, profitability level) in the combined poultry enterprise while depreciation and labour cost exerted negative influence on output. For the efficiency model, stock size and business experience exerted positive influence the entrepreneurs' efficiency while credit access and age of the entrepreneurs had negative influence. However, the negative influence of credit could be explained by the poor conditions encountered, high interest rates, loan diversion and under-utilization of the said credits. Insufficient funds and thefts were the major challenges faced by these entrepreneurs.

Efforts to reducing the costs incurred on fixed items by these entrepreneurs should be encouraged. Government should make available certain incentives to farmers so as to avoid the problem of loan diversion. Credits inform of stocks, feeds and drugs/vaccines from trusted sources will boost productivity, efficiency and income with little financial burdens. The problem of fund insufficiency will be solved if these entrepreneurs form cooperatives such that they can pool their resources together and assist needy members. By this, they would certainly reduce the over-dependence on bank loans with its attendant problems. Formulation of policies that would discourage the importation of chicken will encourage more people to go into production since there would be an increased demand for the locally produced chicken. Such policies would guarantee confidence since glut in the market would be eradicated.

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