TECHNICAL EFFICIENCY OF BROILER PRODUCTION IN UMUAHIA, ABIA STATE, NIGERIA

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ABSTRACT

This study measured the technical efficiency and its determinants in poultry broiler production in Umuahia Capital Territory of Abia State, Nigeria, using the stochastic frontier production function. Purposive and multi-stage random sampling techniques were used to select 60 poultry broiler farmers from which the input-output data were collected using a pre-tested and structured questionnaire. The result showed that the estimated farm level technical efficiency ranged from 08% and 97% with a mean of 75%. The socio-economic determinants of technical efficiency were extension contact, household size, age and educational level.

Keywords: Technical Efficiency, Poultry Broilers, Stochastic Frontier and Production Function.

INTRODUCTION

Animal protein is crucial for normal physical and mental development of the human being. Its deficit has serious adverse effects on the economic development of the country in terms of reduction in human productivity, incidence of high infant mortality, malnutrition and related diseases (FAO, 1985). The major sources of animal protein in Nigeria are beef cattle, fish, sheep, goat, pigs and poultry. Poultry production especially the broiler enterprise has great potentials for increasing protein supply in Nigeria. This is ascribed to the fast growth rates and prolificacy of the animal. Poultry also offer short-term investments opportunities and thus helps to increase meat availability thereby improving the standard of living of the people (Onyenweaku and Awuja, 1991).

The major problem of the poultry production in Nigeria is that of low productivity and inefficiency in resource allocation and utilization (Onyenweaku and Effiong, 2006). The poultry industry in Nigeria is characterized by high production costs, low profit margins, and high feed cost. Evidence by Olayide, (1976) shows that increase in livestock production in Nigeria derives mainly from average expansion rather than higher intensification and productivity of resources use. This implies that the present production and supply chain is inadequate, (Olaofe, 2004), hence the need to provide an intending broiler farmers with useful information that will assist and sustain poultry industry in Nigeria.

This study was guided by the following specific objectives:

1. To estimate the farmers technical efficiency in poultry broiler production in Umuahia Capital Territory;
2. To estimate the determinants of the technical efficiency in the study areas;

METHODOLOGY

Theoretical Frame Work: A stochastic production function is given by

\[ Y_i = f (X_i, \beta) \exp (V_i - U_j) = 1, 2 \ldots n \] (1)
Where $Y_i$ is output of the $i^{th}$ farm, $X_i$ is the vector of input quantities used by the $i^{th}$ farm, $\beta$ is vector of unknown parameters to be estimated, $f(\cdot)$ represents an appropriate function (e.g. Cobb-Douglas, Translog, etc). The term $V_i$ is a symmetric error, which accounts for random variation in output due to factors beyond the control of the farmer e.g. weather, disease outbreaks, measurement errors, etc., while the term $U_j$ is a non negative random variable representing inefficiency production relative to the stochastic frontier. The random error $V_i$ is assumed to be independent and identically distributed as $N(0, \delta^2_v)$ random variables independent of the $U_j$ which are assumed to be non negative truncations of the $N(0, \delta^2_u)$ distribution (i.e. half normal distribution) or have exponential distribution (Aigner et al., 1977).

The stochastic frontier was independently proposed by Aigner et al. (1977) and Van-den Broeck (1977). 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 (Onyenweaku and Effiong, 2006).

Technical efficiency (TE) = $Y_i / Y_i^*$
\[ = f(X_i, \beta) \exp(V_i - U_j) / f(X_i, \beta) \exp(V_i) = \exp(-U_j) \] .................................................. (2)

Where $Y_i = \text{observed output}$
$Y_i^* = \text{frontier output}$

The parameters of the stochastic frontier function are estimated using the maximum likelihood method/ratio.

The Empirical Model: For this study, the production technology of poultry broiler farmers in Umuahia Capital Territory of Abia State is assumed to be specified by the Cobb-Douglas frontier production function defined as follows:

\[ \ln Q = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + V_i - U_j \] ........................................ (3)

Where $Q = \text{value of broiler produced per farm (N)}$
$X_1 = \text{stock size}$
$X_2 = \text{value of feeds and feed supplements (Kg)}$
$X_3 = \text{labour input (man days)}$
$X_4 = \text{value of drugs and medication (N)}$
$X_5 = \text{other costs (depreciation costs on fixed inputs) (N)}$
$V_i = \text{random error}$
$U_j = \text{technical inefficiency}$

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 (Coelli, 1996) as follows:

\[ \text{TE} = a_0 + a_1 Z_1 + a_2 Z_2 + a_3 Z_3 + a_4 Z_4 + \ldots + a_9 Z_9 \] .................................................. (4)

Where $TE = \text{Technical Efficiency pf the i-th farmer}$
$Z_1 = \text{Credit access (N)}$
$Z_2 = \text{Age of farmers (Years)}$
$Z_3 = \text{Level of education on the farmers (Years)}$
$Z_4 = \text{Membership of farmers association/ cooperatives}$
$Z_5 = \text{Frequency of contact with extension agents}$
$Z_6 = \text{Gender of the farmer [Male = 1, Female = 2]}$
While $a_0, a_1, a_2...a_9$ are the parameters to be estimated.

The Study Area: The study was conducted in the Umuahia Capital Territory which comprised four, (4) development centres viz: Umuahia North, Umuahia South, Ikwuano and Isiala Ngwa South. This area was purposively chosen due to the intensity and predominance of poultry broiler production (Echebiri et al., 2006).

Purposive and multi-stage random sampling techniques were used in the selection of samples. First, Umuahia North and South were purposively selected due to their being the nucleus of the Abia State capital territory and the intensity and population of poultry broiler production in the two local government areas (USLEEDS, 2006 and UNLEEDS, 2006). Second, 14 autonomous communities or political wards were selected each from the two local government areas. This gave a total of 28 autonomous communities. Third, 20 villages were randomly from the 28 autonomous communities ensuring that 10 villages each were selected from each local government area. The sample frame of the broiler poultry farmers were obtained from agricultural extension agents in charge of the circles. Finally, 3 broilers poultry farmers were randomly chosen from each village giving a total sample size of 60 broiler poultry farmers. Instrument of data collection was a well structured and pretested questionnaire.

RESULTS AND DISCUSSION
The mean socio-economic characteristics of poultry broiler farmers are presented in Table 1. The table shows that the mean age of the broiler farmers was 38 years. The attraction of the youths towards broiler production could be because of the inherent viability and profit potentials of the business (Chukwu, 2007). The result shows that the typical broiler farmer had 7.5 years of formal education. The level of education attained by a farmer not only increases his farm efficiency and productivity but also enhances his ability to understand and evaluate new production technologies (Obasi, 1991).

The result further indicates that the mean farming experience of the farmers was 4.4 years. Experience in farming is a key factor affecting production. The longer the years of experience, the more exposed the farmer becomes and the more efficient the farmer is expected to be (Nwaogu, 2006). The mean stock size is characterized generally by smallholder farmers. This is in consonance with Omotosho and Ladele (1999) that classified poultry farm of 1000 birds and below as small-scale. The mean household size of the broiler poultry farmers was 6 persons. This has implication on the provision of labour in the farm.

Table 1: Mean Socio-Economic Characteristics of Broiler Farmers in Umuahia Capital Territory Abia State Nigeria.

<table>
<thead>
<tr>
<th>Socio-economic variable</th>
<th>Mean value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of farmers</td>
<td>38 years</td>
</tr>
<tr>
<td>Educational level</td>
<td>7.5 years</td>
</tr>
<tr>
<td>Farming experience</td>
<td>4.4 years</td>
</tr>
<tr>
<td>Stock size</td>
<td>271.4 birds</td>
</tr>
<tr>
<td>Household size</td>
<td>6 persons</td>
</tr>
</tbody>
</table>

Estimated Production Functions: The Maximum Likelihood Estimates (MLE) of the stochastic frontier production parameters for poultry broilers are presented in Table 2. The table shows that of the five production factors, stock size, feed intake and labour input were highly significant at 1.0% risk level and this, have high influence on the value of output of broilers. The estimated coefficient for stock size is positive (6.239) and implies that every one percent increase in stock size would lead to 6.239 percent increase in the value of broilers produced. This is in consonance with Effiong (2005) and Nwachukwu and Onyewaku (2007) that the larger the stock size the less inefficient a farmer becomes.

Consistence with theory, feed intake had positive coefficient and statistically significance at 99% confidence level. With an elasticity of 1.130, the enterprise operates in stage one of the classical production function and by implication, increase in feed intake should be encouraged. This result is consistent with the findings of Belbase and Grabowski (1985) whose study established that production and quantity of feed are directly related.

Labour input has a coefficient of 1.169 and has a high t-value (9.766). Its implication is that increase in labour input reduces technical efficiency. Given the production elasticity of -1.169, the broiler farmers in the study area are either misallocating or over utilizing labour. This finding contradicts Iwueke (1987) and Ezeh (2006) that farm operations especially in Nigeria are labour intensive.

### Table 2: Estimated Stochastic Frontier Production Function for Poultry Broilers in Umuahia Capital Territory of Abia State Nigeria

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant term</td>
<td>$B_0$</td>
<td>14.717</td>
<td>0.001</td>
<td>14.700***</td>
</tr>
<tr>
<td>Stock size</td>
<td>$B_1$</td>
<td>6.239</td>
<td>0.561</td>
<td>11.128***</td>
</tr>
<tr>
<td>Feed intake</td>
<td>$B_2$</td>
<td>1.130</td>
<td>0.139</td>
<td>8.133***</td>
</tr>
<tr>
<td>Labour input</td>
<td>$B_3$</td>
<td>-1.169</td>
<td>0.119</td>
<td>-9.766***</td>
</tr>
<tr>
<td>Drugs and medication</td>
<td>$B_4$</td>
<td>0.197</td>
<td>0.207</td>
<td>0.951</td>
</tr>
<tr>
<td>Depreciation cost</td>
<td>$B_5$</td>
<td>-0.112</td>
<td>0.154</td>
<td>-0.728</td>
</tr>
</tbody>
</table>

*Source: computed from field survey data, 2010.*
***Significant at 1%; **Significant at 5%; * Significant at 10%

Sources of Technical Efficiency: The determinants of technical efficiency in broiler production are presented in Table 3. The result of the analysis showed that age, education, extension contact and household size were statistical significant at varied risk levels.

Farmer’s age showed a negative relationship with technical efficiency. This result agrees with that of Onyenweaku et al., (2004); Onyenweaku and Nwaru, (2005); Ayibefun and Daramola, (2003); Okeke, (2000) which implied that increasing age would lead to decrease in technical efficiency since ageing farmers would be less energetic to work in the farm. But this result disagrees with those of Belbase and Grabowski, (1997) whose results showed age to be positively related to technical efficiency.

Education shows a negative but significant relationship with technical efficiency. This result disagrees with Onyenweaku and Nwaru, (2005); Onyenweaku et al., (2004); Onu et al., (2000); Amaze and Olayemi, (2000); Belbase and Grabowski, (1985); Kalirajan and Shand, (1986); and Bravo-Ureta and Pinheiro, (1997), whose results showed education and technical efficiency to be positively related.

Extension contact has a positive coefficient and statistically significant at 5% risk level. This result is in consonance with Ayibefun et al., (2000); Onyenweaku et al., (2004); Amaze and Olayemi, (2000); and Kalirajan, (1981).
Household size is found to be positive and significant. This suggests that larger households may utilize family labour which helps in reducing labour cost and creates formidable basis for improved technical efficiency (Mubmik and Flinn, 1998).

However, this result disagrees with the findings of Nwachukwu and Onyenweaku, (2007); Onyenweaku and Nwaru, (2004); and Bravo-Ureta and Pinheiro, (1997), which showed household size and technical efficiency to be negative and significantly related.

Table 3: Sources of Technical Efficiency in Broiler Production

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Access</td>
<td>Z₁</td>
<td>1.980</td>
<td>1.289</td>
<td>1.537</td>
</tr>
<tr>
<td>Age</td>
<td>Z₂</td>
<td>-0.898</td>
<td>0.349</td>
<td>-2.574**</td>
</tr>
<tr>
<td>Education</td>
<td>Z₃</td>
<td>1.519</td>
<td>0.476</td>
<td>-3.188***</td>
</tr>
<tr>
<td>Membership of Coop. Society</td>
<td>Z₄</td>
<td>-2.559</td>
<td>2.223</td>
<td>-1.149</td>
</tr>
<tr>
<td>Extension Contact</td>
<td>Z₅</td>
<td>4.173</td>
<td>1.887</td>
<td>2.211**</td>
</tr>
<tr>
<td>Gender</td>
<td>Z₆</td>
<td>0.104</td>
<td>0.964</td>
<td>0.108</td>
</tr>
<tr>
<td>Farm Location</td>
<td>Z₇</td>
<td>6.144</td>
<td>2.336</td>
<td>0.263</td>
</tr>
<tr>
<td>Farming Experience</td>
<td>Z₈</td>
<td>-0.907</td>
<td>0.941</td>
<td>-0.964</td>
</tr>
<tr>
<td>Household Size</td>
<td>Z₉</td>
<td>3.116</td>
<td>1.138</td>
<td>2.734**</td>
</tr>
<tr>
<td>Diagnostic Statistics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Variance</td>
<td>σ²</td>
<td>1.950</td>
<td>0.498</td>
<td>3.913***</td>
</tr>
<tr>
<td>Variance Ratio</td>
<td>Y</td>
<td>0.950</td>
<td>0.033</td>
<td>300.363</td>
</tr>
<tr>
<td>L R Test</td>
<td></td>
<td>82.121</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log Likelihood Function</td>
<td></td>
<td>-24.899</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: computed from field survey data, 2010

*** Significant at 1%; ** Significant at 5%; * Significant at 10%

The diagnostic statistics have coefficients that are all statistically significant at 99.5 confidence level. The coefficient of total variance ($\sigma^2$) is 1.950 while the variance ratio (Y) is 0.992. Variance ratio measures the ratio of the variance of farm specific technical efficiency to the total variance. This means that 99.2% of the variance in output among the broiler farmers was due to the disparities in technical efficiency. The total variance of 1.950 is statistically significant and as such, indicates a good fit and the correctness of the specified distributional assumption of composite error term.

Given that about 87% of the broiler farmers have efficiency indices above average (0.50), the frontier broiler farmers therefore are more or less output maximizers while the non-frontier broiler farmers represent only 13.33%. To bridge the gap between the technical efficiency levels of the best and the worst broiler farmers, the average broiler farmer needs a cost saving of 22.68% to become the best efficient broiler farmer.

Distribution of Technical Efficiency: Table 4 presents the distribution of technical efficiency of the broiler farmers in Umuahia Capital Territory. It shows that about 875 of the broiler farmers in the study areas operate within technical efficiency range of between 0.61 and 1.00. The estimates are skewed to the right; implying high level of efficiency. The minimum efficiency is 0.08 which indicates gross underutilization of resources while the maximum technical efficiency is 0.97. In other words, the best technically efficient broiler farmer operates almost on the frontier.
Table 4: Distribution of Technical Efficiency in Poultry Broiler Production in Abia State, Nigeria

<table>
<thead>
<tr>
<th>Technical Efficiency Range</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.20</td>
<td>8</td>
<td>3.33</td>
</tr>
<tr>
<td>0.21-0.40</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>0.41-0.60</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>0.61-0.80</td>
<td>2</td>
<td>3.33</td>
</tr>
<tr>
<td>0.81-1.00</td>
<td>50</td>
<td>83.34</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

Maximum Technical Efficiency  0.97
Minimum Technical Efficiency   0.08
Mean Technical Efficiency          0.08

Source: computed from field survey data, 2010

CONCLUSION AND RECOMMENDATION

The results of this study showed that technical efficiency of broiler production in Umuahia Capital Territory, Abia State is relatively high. Individual levels of technical efficiency ranged between 8% and 97% with a mean of 75%, suggesting that opportunities still exist for increasing productivity and incomes of broiler farmers in the study area. This can be achieved by increasing the efficiency of resource use at the farm level up to 25%.

Based on the findings of this study, the following recommendation will suffice in improving the efficiency of broiler farmers:

1. Policies aimed at increasing broiler farmers scale of operation through improved access and subsidies to production inputs like feed, drugs/medication and capital as well as targeting relevant policies at experienced broiler farmers, will be necessary for increasing efficiency.
2. Extension agents should be motivated continually by giving them facilities and monetary allowances increased so that they can frequently visit the farms and introduce new packages of technologies that promote productivity and efficiency to the broiler farmers.

REFERENCES


