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Technical Efficiency of Small Scale Poultry-Egg Production in Nigeria: Empirical Study of Poultry Farmers in Imo State, Nigeria

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Abstract: The purpose of this study was to determine the technical efficiency of poultry egg production in Nigeria. A sample of 60 poultry-egg farmers was selected by multistage sampling procedure and data were collected by using a structured questionnaire. A stochastic frontier production function was specified and estimated, using maximum likelihood estimation. The results showed that labour, farm size, feed cost, capital and utilities have a positive and significant impact on output and mean technical efficiency is 0.58 with a range of 0.43-0.76. Farm size, extension contact, credit, feed intake, drugs, level of education and farming experience had positive and significant impact on technical efficiency. On the contrary, labour had a significant negative effect on technical efficiency. Recommendations include increase in farm size, provision of more extension services and increased access to credit, medication, education and cheap feed.

Key words: Efficiency, egg, farmers, poultry, technical, Nigeria

INTRODUCTION

The Nigerian Poultry industry is dominated by small scale farmers who on the aggregate raise the bulk of the birds for egg production and meat, but individually rear less than 1000 birds (MANR, 1998). The poultry industry goes a long way in providing animal protein for the populace because it yields the quickest returns and provides for meat and eggs in a very short time. Poultry eggs rank second to cow milk in terms of nutritive value and are the most economically produced animal protein (FAO, 1990). According to Esingmer (1991) and Banerjee (1992), poultry egg nearly approaches a perfect balance of all food nutrients. The egg yolk and albumen contain 17.5 and 10% protein by weight, respectively. A medium sized egg supplies about 80 calories of energy to our body and vitamin A. In addition to meat and eggs, the poultry industry provides raw materials for the production of vaccines, mattresses, etc and offers employment to many people (Bank, 1979).

In Nigeria, the poultry population accounts for 71.38% of the total livestock kept In the country and supplies 17% of animal protein need of the population (FAO, 1990). The major problems associated with the raising of layers commercially are their susceptibility to diseases and sensitivity to feeding and other environmental factors such as temperature, relative humidity, ventilation, light and sound. Low productivity of poultry farmers have been attributed to technical inefficiency and traditional methods adopted by poultry farmers (Okorie, 1986).

Lack of proper management in terms of feeding, housing and health care, among other factors account for technical inefficiency in poultry production. Therefore, the emphasis is how to change the level of input needed in poultry-egg production to maximize output. This forms the focus of this study, using Imo State as a case study. Imo State is used as a case study because the State has many poultry-egg enterprises and a large market for poultry products because of its large population density. The inputs used in poultry farming are house, capital equipments, labour, day old chicks, vaccine, drugs, feed and utilities. Literature does not provide record of efficiency on the use of these resources in Imo State.

Therefore, the specific objectives of this study were to:

- Measure the technical efficiency of poultry-egg production in Imo State.
- Determine the factors influencing technical efficiency in poultry-egg production and disentangle their individual effects.

Bhasin (2002) defined technical efficiency as the ability of a farmer to obtain maximum output for a given set of inputs. Thus, a firm is considered to be more

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technically efficient than another when given the same quantities of measurable inputs, it consistently produces a larger output (Odii, 1998).

Different authors have identified a number of factors influencing technical efficiency. Coelli and Battese (1996) stressed that the number of years of schooling, farm size and age of farmers are positively related to technical efficiency. Similarly, Obwona (2000) identified education, family size, credit accessibility, extension services and health status as contributing positively to efficiency of tobacco farmers in Uganda. Ajibefun and Daramola (2003) found that the age of farmer, level of education and level of investment are the most significant determinants of technical efficiency.

On the measurement of technical efficiency, two methods normally adopted are the classical and the frontier approaches. The classical approach compares the ratio of output (for example, number of eggs laid in a poultry farm daily) to a particular input (for example, quantity of feed given to the laying birds). The classical approach was not used for this study because it does not consider other factors which affect output, namely quality of feed, genetic composition of laying birds, ambient temperature and humidity.

The frontier approach was used in this study. The frontier measure of technical efficiency implies that efficient firms are those operating on the production frontier. Therefore, the amount by which a farm firm lies below its production frontier is taken as the measure of inefficiency (Farrel, 1957). Chirwa (2002) suggested that measurement of efficiency can be grouped into non-parametric frontiers and parametric frontiers. The non parametric approach can be used where a farmer produces multiple output. According to Bhasin (2002), the major criticism of the non-parametric approach is that the maximum possible output is derived using only marginal data and not all observations in the sample. Another criticism is that the method has very demanding data needs and statistical inferences from the estimates cannot be derived (since non-parametric frontiers do not impose a functional form on the production frontiers and do not make assumptions about the error terms).

The parametric approach imposes a functional form on the production and makes assumptions about the data. The most common functional forms include the Cobb-Douglas, constant elasticity of substitution and trans-log production functions. The other distinction is between deterministic and stochastic frontier (Chirwa, 2002). Deterministic frontiers assume that all the deviations from the frontier are as a result of firms inefficiency while stochastic frontiers assume that part of the deviations from the frontier are due to random events (reflecting measurement errors and statistical noise) and part is due to firm specific inefficiency (Forsund *et al*., 1980; Fried *et al*., 1993; Battese, 1992; and Coelli *et al*., 1998).

Few studies on poultry production in Imo State focused on economics of poultry production (Amadi, 2002), part time commercial poultry farming (Ohajianya, 2003), problems and prospects of poultry production (Ndubuisi, 1992). None of these studies examined the factors that determine technical efficiency and the sources of inefficiency in the poultry industry in Imo State. This study filled the gap in the previous studies.

Theoretical framework: For appropriate structuring of our model, we used the stochastic frontier production function approach. The mathematical presentation is of the form:

$$Y_{i'} = F(X_{i'}, \beta) \exp(v_{i'}-u_{i'}) \text{ (for } \backslash=1,2,\ldots, n) \quad (1)$$

Where:

$Y_{i'}$ = Output of the ith firm
$X_{i'}$ = Vector of inputs of the ith firm
β = Vector of unknown parameters to be estimated
exp = Exponential base of natural logarithm
$v_{i'}$ = Error term associated with random factors outside the control of firm or management
$U_{i'}$ = Error term which captures the effects of technical inefficiency.

V_i is assumed normally distributed with zero mean and constant variance. $U_{i'}$ has half normal distribution with zero mean and constant variance (Bhasin, 2002).

Technical Efficiency ($TE_{i'}$) of an individual farmer is defined as the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by the farmer.

$$TE_i = \frac{Y_i}{Y^*_i} = \frac{F(X, \beta) \exp(V_i - U_i)}{F(X, \beta) \exp(V_i)} = \exp(-U_i)$$

Where; $Y_{i'}$ = observed output and $Y_{i'}$* = frontier output.

MATERIALS AND METHODS

This study was conducted in Imo State, Nigeria, comprising 27 Local Government Areas. The state is divided into 3 Agricultural zones namely Owerri, Orlu and Okigwe Zones. Imo State lies between latitudes 40^0 45^1 and 60^0 15^1 North and longitudes 60^0 30^1 and 80^0 9^1 East.

Sampling procedure: Multistage sampling technique was adopted. Two Local Government Areas (LGAs) were selected by simple random sampling from each of the 3 agricultural zones to give a total of 6 LGAs for the

study. Ten poultry-egg farmers were selected randomly from each LGA to give a sample of 60 poultry-egg farmers used for the study.

Data collection technique: A structured questionnaire was used in data collection. In order to avoid improper filling of the questionnaire by illiterate farmers, the researcher used the questionnaire as interview schedule and filled the questionnaire on the spot as the farmers provided the answers.

Data analysis: Objectives were analyzed by stochastic frontier production functions specified and estimated using maximum likelihood method. Drawing from Eq. 1 and Bravo and Pinheiro (1993), the model was specified as:

$$PO = \beta_0 + \beta_1 InL + \beta_2 InFs + \beta_3 InFD + \beta_4 InDM + \beta_5 Ink + \beta_6 InUO + v_{i'} - u_{i'} \ldots \quad (3)$$

Where:

In = Natural logarithm
P0 = Value of poultry output (Value of eggs, poultry manure and culled layers, in naira)
L = Labour input (₦)
FS = Farm Size (number of birds)
FD = Feed intake (₦)
DM = Drugs and medication (₦)
K = Capital input (Depreciation of farm equipment and poultry house valued in naira).
U0 = Utilities and other expenses (made up of electricity, water supply, kerosene and transportation valued in naira).

$V_{i'}$ and U_{i} are as defined in Eq. 1.

Based on Eq. 3, Eq. 4 was specified to identify the factors which influence technical efficiency.

$$Exp.(-U_{i'}) = \alpha_0 + \alpha_1 K + \alpha_2 FD + \alpha_3 DM + \alpha_4 L + \alpha_5 FS + \alpha_6 Ext + \alpha_7 CA + \alpha_8 MS + \alpha_9 ED + \alpha_{10} SEX + \alpha_{11} FE + \Sigma \quad (4)$$

Where,

EXP. ($-U_{i'}$) = Technical efficiency of ith farm firm.
EXT = Number of extension contacts in a production cycle.
CA = Access to credit (CA = 1 for access to credit and CA = O otherwise).
MS = Marital Status (MS = 1 for married and O for single).
ED = Level of farmers education (years of schooling).
SEX = Sex of farmer (sex = 1 for males and sex = 0 for females).
FE = Farming experience (years of farming).
Σ = Error term

RESULTS AND DISCUSSION

The results of the estimation of Eq. 3 and 4 simultaneously, using the maximum-likelihood technique are given on Table 1. The estimate of sigma (δ) is significantly different from zero indicating goodness of fit of the model and correctness of distributional assumptions specified. Thus, the model was used for discussion. Table 2 shows the distribution of farmers according to their technical efficiency.

The major factors affecting the output of poultry eggs are farm size, labour, feed intake, capital and utilities (Table 1). The coefficient of labour is positive and significant at 5%. That is, an increase in labour input brings about an increase in the output of poultry eggs. Similarly, the coefficient of farm size has a positive and significant association with output at 1%

Table 1: Maximum likelihood estimates of the Production frontier with efficiency model

Variables	Coefficients	t-ratios
Production factors		
L (Labour)	0.5049**	2.5283
FS (Farmsize)	0.0957***	2.9721
FD (Feed intake)	0.2306***	3.7496
DM (Drugs)	0.0722	1.1817
K (Capital)	0.0698***	2.8032
U0 (Utilities)	0.0377***	3.222
Constant	4.8712***	7.0413
Efficiency Factors		
K (capital)	0.0249	1.2640
FD (Fed intake)	0.3103***	3.0362
DM (Drugs)	0.0744***	2.9641
L (Labour)	-0.1066**	-2.2729
FS (Farm size)	0.3315***	2.9973
EXT (Extension contacts)	0.0877**	2.2035
CA (Access to Credit	0.0211**	2.4253
MS (Marital Status)	0.0388	1.3242
ED (Level of education)	0.0529**	2.3828
SEX (Sex of respondent)	-0.0666	-1.0151
FE (Farming experience)	0.0489**	2.4697
Constant	4.2186***	6.8009
8	1305.49	0.003
*	7.3019**	5.4437
m	0.99	
N	60	

Note: *, ** and ***mean significant at the 10, 5 and 1% levels, respectively

Table 2: Distribution of farmers according to their technical efficiency

Technical efficiency	No. of farmers	Percentage
0.41-0.50	11	18.3
0.51-0.60	24	40.0
0.61-0.70	19	31.0
0.71-0.80	6	10.0
Total	60	100.0

Source: Field survey, 2004

level of significance. This implies that poultry egg production increases with increase in number of birds reared.

Furthermore, the coefficient of feed consumption, capital and utilities are positive and significant at 1%. That is, the consumption of increased quantities of these inputs goes with increase in poultry egg production. This result is expected because increased consumption of say, utilities in a poultry farm means longer period of supply of light, water, etc., which increases the level of activities of the birds and consequently egg production. The same explanation goes for feed and capital consumption.

Technical efficiency of the farmers and the factors influencing it: The gamma (m) was estimated, using the equation:

$$\Upsilon = \frac{\lambda^2}{1+\lambda^2}$$

(Bravo-Ureta and Pinheiro, 1993).

Gamma (Υ) was found to be 99%, implying that technical inefficiency accounts for 99% of the total variation in output among poultry-egg farmers in the study area. The technical efficiency of farmers range from 0.42-0.76, with a mean of 0.58. The distribution of farmers according to their technical efficiency is shown on Table 2.

The factors which influence the technical efficiency of the farmers are feed intake, drugs, labour input, farm size, extension contact, credit, education and farming experience. Feed intake has a positive effect on technical efficiency at 1% level of significance. This indicates that the higher the feed intake by the birds, the greater the technical efficiency of the farmers. This result is supported by Olayide and Heady (1982), who said that feed intake has constant marginal efficiency until a maximum egg output per hen is attained. With constant feed-egg transformation rate, the limit of a hen's capacity to produce eggs economically, lies in her ability to assimilate feed. The coefficient of drugs is positive and significant at the 1% level. This implies that proper management involving the administration of adequate medication to the birds will improve the technical efficiency of farmers.

Farm size has a significant positive effect on technical efficiency at 1% level of significance. This implies that the farmers were not operating at full capacity and would increase output by increasing the number of birds reared. Also extension has a positive impact on efficiency at 5% level of significance. These results agree with the findings of Ajibefun and Aderinola (2004). This is probably because extension agents frequently introduce packages and information which enhance the productivity of the farmers and promote their efficiency.

Furthermore, credit has a significant positive effect on technical efficiency. This implies that farmers who use credit in production are more technically efficient than those who did not receive credit. The reason might be that access to credit enable the farmers to acquire improved technology which invariably promotes efficiency. This result is consistent with Onu and Adebayo (2000) and Obwona (2000).

Education influenced technical efficiency positively and significantly. This is in line with the result obtained by Weir (1999). This result is expected because educated farmers are more receptive to improved farming techniques, than the less educated and are therefore more technically efficient. Similarly, farming experience has a positive significant effect on technical efficiency as 5 percent level. A similar result was obtained by Onu and Adebayo (2000) and Ajibefun and Aderinola (2004). The result implies that the more experienced farmers are more technically efficient than the less experienced ones. This is probably because experience builds up knowledge which improves efficiency. Contrary to expectation, labour input is inversely related to efficiency. This means that the farmers were operating in the "stage three" of production and labour had decreasing negative returns.

RECOMMENDATIONS

From the findings of this study the following recommendations are tenable:

- It was found that extension services contribute to efficiency of poultry-egg production. Government should therefore encourage extension agents through the provision of incentives such as in-service training, scholarships, exchange programmes and better salaries.
- The poultry-egg farmers should be given more access to credit. This could be done by encouraging them to form cooperative associations to act as one body. The loans given to them by the Nigerian Agricultural Cooperative and Rural Development Bank (NACRDB) should be increased, by increasing government grant to the bank.
- Improving the level of education of the farmers will improve their efficiency. The farmers will be encouraged to improve their level of education by establishing adult literacy programme in all the rural areas within the reach of the farmers.

- Poultry farmers in a given locality should pull their resources together to form a poultry-feed producer cooperative society. Their feed-mill will ensure a regular supply of cheap feed to the farmers. Private sector participation in rural feed-mill industry is also necessary. Availability of credits and other incentives will encourage the investment.
- Adequate medication at the right intervals will ensure healthy growth of the birds and the attainment of maximum egg-laying capacity.
- Increase in farmsize (number of birds kept) will increase efficiency. This will ensure full utilization of available labour which has diminishing negative returns.
- The more experienced farmers should be given preference in the provision of incentives because they are more efficient than the less experienced.

CONCLUSION

The role played by poultry-egg industry cannot be over-emphasized. Improvement in the efficiency of the poultry-egg farmers is therefore a worthwhile venture. It is hoped that if the findings of this paper and the recommendations arising from it are taken seriously by policy-makers the poultry-egg industry might have a rapid and sustained growth.

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