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RESOURCE-USE EFFICIENCY IN SMALL-HOLDER POULTRY EGG PRODUCTION IN RURAL NIGERIA

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Abstract

In response to persistent protein inadequacy in diets, households are involved in poultry keeping. But this requires resource-use like any other economic activity. However, these resources has to be efficiently transformed into product to maximize returns and satisfaction. This study estimated output-oriented technical efficiency using the stochastic production frontier functions which incorporates a model for inefficiency effects. Through the multi stage sampling procedure, 60 small scale poultry egg producers were selected and primary data for the study were obtained using questionnaire. Using the maximum likelihood estimation technique, asymptotic parameter estimates were evaluated to describe the efficiency determinants. Results reveal that feed is the most important and critical resource in poultry egg production and is significant ($P < 0.05$) whereas family labour, drugs and water are positive and significant ($P < 0.10$). Findings also reveal that stocking density is positive and significant at ($P < 0.01$). The average efficiency index of 0.66 suggest that by increasing the stocking density, the output of these farms could be stepped up. Results underscore the need to formulate appropriate policies that will encourage poultry egg producers to expand production.

***Keywords*:** Resource, efficiency, egg, Nigeria.

Introduction

Animal protein consumption in Nigeria is inadequate and is low in the diet of households. This is because the consumption level of animal protein in Nigeria is 4.5g per caput which is below the FAO minimum level of 35g per caput (Ezike and Nwoye, 2004). The rapidly growing and increasing Nigeria population has necessitated the need to increase livestock production to meet the animal protein demand of the populace. This has intensified livestock production in order to step-up the low per capita animal protein intake. Recent and empirical study by Udoh and Etim (2010) suggest that poultry egg production is one of the quickest means of the rapidly increasing animal protein supply.

Efficiency of a firm can be defined as its ability to produce the largest possible quantity of output from a given set of inputs. The modern theory of efficiency dates back to the pioneering work of Farell (1957) who proposed that the efficiency of a firm has two components namely: technical and allocative efficiency and the combination of these two components provide a measure of total economic efficiency (overall efficiency). Technical efficiency which is ability to produce a given level of output with minimum quantity of inputs can be measured either as input-conserving oriented technical efficiency or output-expanding oriented technical efficiency (Jondrow *et al.*, 1982; Ali, 1996). The low per caput animal protein intake may be as a result of inefficient resource utilization by farmers. Despite the involvement of rural dwellers in poultry keeping, the protein intake is declining. This is particularly worrisome because egg is excellent for body maintenance and promotion of body growth, lactation and reproduction. A recent study by Etim *et al.* (2013) suggests that food production could be adversely affected if resources are not efficiently utilized. This study aims at measuring efficiency of resource-use by small holder poultry egg producers.

Methodology

Study Area, Sampling and Data Collection Procedure

The study was conducted in Ibesikpo Asutan Local Government Area of Akwa Ibom State, Nigeria. The area lies within the humid tropical rainforest zone with two distinct seasons – the rainy and short dry season. The annual precipitation ranges from 2000 – 3000mm per annum. The inhabitants are majorly Ibibios and their major occupation is farming and trading.

Primary data were used for this study and were obtain from well structured questionnaire in 2012 cropping season. Through the multistage sampling procedure, 60 farmers were selected using questionnaire. The first stage involved the random selection of 2 rural communities. The second stage was the random selection of 30 farmers to make a total of 60 farmers. Baseline information on socio-economic characteristics, input use and output levels were collected analyzed.

Multiple regression analysis based on a stochastic production frontier model was employed. The model incorporates efficiency determinants into the inefficiency error components as hypothesized by Coelli and Battese (1996) to estimate the efficiency of resource use among producers. This model describes the best and most efficient outcome possible based on the various parameters studied.

By definition, stochastic frontier production function is

$Y_i = F(X_i;\beta) \exp (V_i – U_i) i = 1, 2, ;, N$ (1)

Where Y_i is the output of the ith firm, X_i is the corresponding (MX2) vector of inputs; β is a vector of unknown parameter to be estimated; F(.) denotes an appropriate form, V_i is the symmetric error component that accounts for random effects and exogenous shock; while $U_i < 0$ is a one sided error component that measures technical inefficiency.

The Empirical Model

The study utilized stochastic production frontier, which builds hypothesized efficiency determinants into the inefficiency error components (Coelli and Battese, 1996). We specified a Cobb-Douglas Production function as presented

$\text{Ln } Y = \beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + \beta_6 L_n X_6 + \beta_7 L_n X_7 + V_i - U_i$

Where Y is the value of eggs produced in naira/m^2; X_1 is the stocking density measured as total number of birds per square metre; X_2 is the family labour in mandays; X_3 is the quantity of concentrate fed the birds in kilogram; X_4 is the hired labour in mandays; X_5 is value of medication/drugs in naira; X_6 is the depreciation value of the implements used measured in naira; X_7 is quantity of water in litres.

With $Vi \sim N (0, \sigma v^2)$; and $e^{-ui} = P_0 + P_1(X_8) + P_2(X_9) + P_3(X_{10}) + P_4(X_{11}) + P_5(X_{12}) + Zi$ (2)

Where:

X_8 is the age of the farmer in years

X_9 is the level of educational attainment of the farmer (years)

X_{10} is access to extension services (dummy)

X_{11} is the years of farming experience

X_{12} is the family size (number of household members)

Zi is an error term assumed to be randomly and normally distributed.

The value of the unknown co-efficient in equations (1) and (2) are jointly estimated by maximizing the likelihood function (Yao and Liu, 1998; Udoh and Akintola, 2001; Udoh and Etim, 2006; Udoh and Etim, 2008).

Results and Discussion

Descriptive Statistics

The summary statistics of explanatory variables is shown in table 1. The maximum value of output is 4500kg whereas the mean value is 2907. Results also show that the mean values of stocking density, family labour and age are 84.25 square meters, 90.83 mandays and 46 years respectively. The mean values of capital and education are ₦88,000 and 8 years respectively.

Maximum Likelihood Estimate Results

The model specified was estimated by the maximum likelihood (ML) method using a FRONTIER 4.1 software developed by Coelli (1995). The ML estimates and inefficiency determinants of the specified frontier are presented in Table 2. The sigma square (0.0185) is statistically significant and different from zero ($p < 0.1$). This indicates goodness of fit and the correctness of the specified distribution assumption of the composite error term.

The variance defined as $\lambda = (\sigma u^2/\sigma u^2 + \sigma v^2)$ is estimated to be 65.08 percent. Results imply systematic influences that are unexplained by the production function as the dominant sources of random errors. In other words, about 65.08% in the output level of poultry egg production are explained by the presence of technical inefficiency among the farmers. The presence of one-sided error component in the specified model is thus confirmed suggesting that the ordinary least square estimation would be inappropriate and inadequate representation of the data. The importance of productive resource is revealed in the production function estimates. Feed seems to be the most important resource input with an elasticity of 1.7292. Stock density is the second most important factor, with an elasticity of 0.9606 followed by water and capital with elasticity of 0.8311 and 0.3183 respectively. The estimated coefficients of the inefficiency function explain the technical inefficiency levels among individual farmers. Results suggest that education, technical assistance and experience of farmers positively affect the farm level technical efficiency effects. Findings confirm the fact that higher educational attainment motivates farmers to acquire and utilize innovations more effectively. Rosegrant and Cline (2003) reported that education works directly to enhance the ability of farmers to adopt more advanced technologies and crop management technique thereby achieving higher rates of return on land and the development of a particular area of knowledge of specialization is by experience which eventually leads to improvement in production methods and higher technical efficiency level was posited by (Udoh, 2005; Etim *et al.*, 2005; Udoh and Etim, 2006; Etim *et al.*, 2013).

One important feature of the stochastic production frontier is its ability to estimate individual, farm specific technical, allocative and economic efficiencies. Table 3 shows farm specific efficiency indices. It shows considerable variation of efficiency index across the farms. The fact that all the sampled farms are below one implies that none of the farms reached the frontier of production. With average technical efficiency index of 0.66, there is scope for increasing output and efficiency across the farms.

Conclusion

The study measured the farm level efficiency of poultry egg producers using the stochastic parametric estimation method. Using the Cobb-Douglas production function estimated by maximum likelihood estimation technique, the parameters of resource efficiency determinants were asymptotically efficient, consistent and unbiased. The maximum age and stocking density were 62 years and 220 square meters respectively. The most important farm resources that increased farm output are feed, stocking density, drugs, capital, water and family labour. The result of technical efficiency of individual farms shows that none of the farmers reached the frontier threshold. Given the average efficiency of 0.66

within the context of efficient agricultural production, output could be raised by 34 percent given available and low external input.

References

Ali, M. (1996). Quantifying the socio-economic determinants of sustainable crop production: An application to wheat cultivation in the Tarui of Nepal, *Agricultural Economics.* 14:45-60.

Coelli, J. T. & Battese, G. (1996). Identification of Factors that Influence the Technical Inefficiency of Indian Farmers. *Australian Journal of Agricultural Economics* 40 (2): 103-128.

Coelli, J. T. (1995). Recent development in frontier modeling and efficiency measurement. *Aus. J. Agric. Economics.* 39:219-45.

Etim, N. A., Thompson, D. & Onyenweaku, C. E. (2013). Measuring Efficiency of Yam (*Dioscorea spp*) Production among Resource Poor Farmers in Rural Nigeria. *Journal of Agricultural and Food Sciences,* 1(3): 42-47.

Etim, N. A., Udoh, E. J. and Awoyemi, T. T. (2005). Measuring technical e3fficiency of urban farms in Uyo metropolis. *Global J. Agric Sci.* 4(1): 91-95.

Ezike, K. N. N. and Nwoye, F. C. (2004). The role of banks in financing livestock and fisheries production in Nigeria. Proceedings of the 9th Annual Conference of Animal Science Association of Nigeria, pp. 223-225.

Farrel, M. (1957). The measurement of productive efficiency, *Journal of Royal Statistical Society* ACxx Part 3:253-290.

Forsund, F. R., Lovell, K. and Schmidt, P. (1980). A survey of frontier production functions and their relationship to efficiency measurement. *J. Econometrics,* 13:5-25.

Jondrow, J. C., Lovell, L. S. and Schmidt, P. S. (1982). On the estimation of technical inefficiency in the stochastic frontier production function model. *J. Econ.,* 19:233-238.

Kalaitzandonakes, N. G. W., Shua Xiang and Jianahum, M. (1992). Relationship between technical efficiency and farm size revisited. *Can. J. Agric. Econ.,* 4);427-442.

Rosegrant, M. and Cline, S. (2003). Global food security: Challenges and policies. *Sciences* 302:1917-1919.

Schmidt, P. (1976). On the statistical estimation of parametric frontier production functions. *Review of Economics and Statistics,* 58:238-239.

Shaib, B., Aliyu, A. and Bakshi, J. S. (1997). Nigeria National Agricultural Research Strategy Plan: 1996 – 2010. *Federal Ministry of Agriculture and Natural Resources, Abuja, Nigeria.*

Udoh, E. J. (2005). Technical inefficiency in vegetable farms of humid region? An analysis of dry season farming by urban women in south-south zone, Nigeria. *J. Agric. Soc. Sci.,* 1(2): 80-85.

Udoh, E. J. and Akintola, J. O. (2001). Measurement of the technical efficiency of crop farms in the south eastern region of Nigeria. *Niger J. Econ. Soc. Stud.,* 43(1): 93-104.

Udoh, E. J. and Etim, N. A. (2006). Estimating technical efficiency of waterleaf production in a tropical region. *J. Vegetable Sc.,* 12(3): 5-13.

Udoh, E. J. and Etim, N. A. (2007). Application of stochastic production frontier in the estimation of technical efficiency of cassava based farms in Akwa Ibom State, Nigeria. *Agric. J.,* 2(6): 731-735.

Udoh, E. J. and Etim. N. A. (2008). Measurement of farm-level efficiency of waterleaf *(Talinum triangulare)* production among city farmers in Akwa Ibom State, Nigeria. *Journal of Sustainable Development in Agriculture and Environment*, 3(2): 47-54.

Udoh, E. J. and Etim. N. A. (2010). Measuring farm level efficiency of peri-urban poultry egg producers in Akwa Ibom State, Nigeria. In proceeding of 35th Annual Conference of Nigerian Society for Animal Production Eds. Babayemi, O. J., Abu, O. A. and Ewola, E. O. had at University of Ibadan, 14-17th March, 2010, pp. 657-659.

Yao, S. and Lui, Z. (1996). Determinant of grain production and technical efficiency in China. *J. Agric. Econ.,* 49:171-184.

Annexure:

Table 1: Mean, minimum and maximum values of output and explanatory variables

Variables	Units	Mean Value	Range
Output	Kilogram	2907	1840 – 4,500
Stocking Density	Square meters	84.25	120 – 220
Family Labour	Mandays	90.83	20 – 210.37
Feed	Kilogram	85	50 – 200
Hired Labour	Man days	118.90	35 – 242.08
Medication/Drugs	Naira	1800	900 – 2,750
Capital	Naira	88,000	45,200 – 115,000
Water	Litres	2,300	1,000 – 3,500
Age	Years	46	19 – 62
Education	Years	8	4 – 13
Experience	Years	13	6 – 20

Table 2: Maximum likelihood estimates and inefficiency function

Variable	Coefficients	Asymptotic t-value
Production Function		
Constant term (β_0)	0.2601	4.4302***
Stocking density (β_1)	0.9606	14.2661***
Family labour (β_2)	0.1899	1.8278*
Feed (β_3)	1.7292	2.3652**
Hired labour (β_4)	0.1552	1.5028
Medication/drugs (β_5)	0.0446	1.6613*
Capital (β_6)	0.3183	2.0170**
Water (β_7)	0.8311	1.8284*
Explainers of inefficiency		
Constant (P_0)	1.0089	2.0256**
Age (P_1)	0.7702	1.0871
Education (P_2)	0.1039	1.9906**
Technical Assistance (P_3)	0.5131	1.8330*
Experience (P_4)	-1.0623	-2.1982**
Household size (P_5)	0.8120	1.0390
Diagnostic Statistics		
Sigma-square (δs_2)	0.0185	2.8710***
Gamma λ	0.6508	2.2251**
Ln (likelihood)	14.0210	
LR test	6.8121	
Quasi function	1.7041	
Number of observation	60	

Note: All explanatory variables are in natural logarithms. A negative sign of the parameters in the inefficiency function implies that the associated variable has positive effect on technical efficiency and a positive sign indicate the reverse is true.

Asterisk indicate significance *** 1%, ** 5%, * 10%

Source: Computer print out of Frontier 4.1

Table 3: Farm specific resource-use efficiency indices

Efficiency Class[z]	Frequency	Percentage
0.01 – 0.13	3	5
0.14 – 0.39	17	28.33
0.40 – 0.65	25	41.67
0.66 – 0.91	9	15
>0.92	6	10

[z] The range of the efficiency index is 0.05 – 0.96 with an average of 0.66