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TECHNICAL EFFICIENCY OF ENUGU URBAN BROILER FARMERS IN ENUGU STATE, NIGERIA

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ABSTRACT
The study measured the level of technical efficiency and among determinants in broiler farmers in Enugu urban of Enugu State, Nigeria using stochastic frontier production function. Multi-stage sampling technique was used to select 120 broiler farmers from which data were collected using well-structured questionnaire and oral interview. The estimated technical efficiency of urban broiler farmers ranged between 88.0% and 98.0% with a mean of 95.0%. The educational level, farming experience, access to credit, extension contact and membership of cooperative society were the determinants of technical efficiency of urban broiler farmer. Improving farmers' access to education, credits, among others, would enhance farmers' technical efficiency for the sustainability of urban broiler production.

INTRODUCTION

In most developing countries, agriculture was primarily a rural based activity. But, because of growing demand for food and job, compelled many urban dwellers to embark on urban farming to satisfy their food demands and provide income to better their welfare (Umo, 2005). Urban agriculture in Nigeria, World Bank (1990) was reinforced by the aftermath of structural adjustment programme, including rise in food prices, unemployment and inflation which declined the average real income of both urban and rural dwellers.

In Nigeria, poultry accounts for about 30.28% of the total livestock production. In terms of production in Africa, Nigeria ranks the highest with a total of 190 million chickens between 2009-2011 (Kughur *et al*, 2012). Broiler, a sector of poultry constitutes more than 18% of animal proteins consumed in urban area with more than 28% also produced in the urban area (FAO, 2006). A host of factors may explain why broiler is endeared to both the producers and consumers, such as super-efficient converter of feed to meat, large number of birds requiring small space (Eleke, 2005), marketable at different ages (Agwu and Duru, 2010), ease of operation, gives quickest turnover, the meat is palatable, easily digestible and low production cost per unit relative to other livestock (Ojo, 2004).

However, low production and productivity have characterized this sub sector and in effect limit its role in economic development. Inyang (1995), Ngoka (1998) and Isika, *et al.* (2007) cited scarcity and high cost of feed, lack of capital, poor breeds of chicks, high cost of drugs and medication, pests and diseases, poor marketing and management problems as limiting factor in attaining self-sufficiency among broiler farmers. Considerable efforts have been directed exclusively on broiler rearing (Omoruoyi *et al*, 1998; Ngoka, 1998) and marketing (Agwu and Duru, 2010) but information on technical efficiency of broiler production in the study area is lacking.

Technical efficiency is the achievement of maximum potential output from a given inputs under a given technology (Onyenweaku and Effiong, 2006). Estimation of the level of technical efficiency helps to determine if the deviation in technical efficiency from frontier output is due to specific factor or external random factor. Specifically, the objectives of this study were to determine the level of technical efficiency, estimate elasticity and return to scale and the constraints to broiler production.

MATERIALS AND METHODS

The study was conducted in Enugu urban in Enugu State, Nigeria. Enugu is located within the following coordinates; North $6^0$64' and $5^0$59'N and $6^0$53' and $5^0$56'E. It has temperature range of 28 – 31^0C, relative humidity of 58 – 62% and annual rainfall of 1200mm – 2500mm (Ike, 2009). Enugu with

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coal deposit was the headquarter of former eastern region during colonial era (1957 – 1960), later East Central State (1967 – 1973). Enugu later became the capital of former Anambra State (1976 – 1995) and presently Enugu State (1995 – till date). Enugu State is inhabited by people from various tribes and races within and outside Nigeria including, public/civil servants, businessmen and women, company workers, farmers, artisans and petty traders. Enugu urban has high population figure of 1.8 million people (NPC, 2007). This could be because of many civil servants in the neighbouring states around Enugu State still operate from the metropolitan and as well as lots of unemployed youths seeking for job in the federal and state ministries, parastatals and private business.

Multistage random sampling technique was employed in the selection process. In the 1st stage, six (6) layouts (Ogui New Layout, Achara Layout, Abakpa, Uwani, Gariki and Coal Camp) out of 10 were randomly selected. In the 2nd stage, from the lists of broiler farmers provided by agricultural extension agent and local leaders, twenty (20) broiler farmers were selected from each of the layouts. This makes a total of one hundred and twenty boiler farmers for the detailed study. Data were collected using well structured questionnaire and oral interview to collect information bothering on socioeconomic characteristics of the farmers and prices of inputs and outputs. Descriptive statistics such as percentage response was used to determine the farmers' socioeconomic characteristics and the constraints to broiler production. The technical efficiency was analysed using stochastic frontier production function model. The theoretical framework of the stochastic frontier production is specified as follows:

$$Y_i = f(X_{1i}\beta \exp (Vi - U_1), 1 = 1,2n \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

Where Y_i = output of the i^{-th} farm, X_i = vector of input quantities used by the i^{-th} farm, β = is 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 variation in output due to the factors beyond the control of the farmers e.g weather, diseases outbreak, measurement error while the term U_1 is the 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 $N(0,\sigma^2)$ independent of the U_i, which are assumed to be non-negative truncation of the No, ,$\eth^2$) distribution. The stochastic frontier was independently proposed by Aigner *et al.* (1977) and Meeusen and Vander Broeck (1977). Technical efficiency of an individual farmer is defined in terms of the ratio of the observed output to the corresponding frontier output, given available technology (Onyenweaku, and Effiong, 2006).

Technical efficiency

$$TE = {}^{Y^*}/_{Y} = F(x_1\beta) \exp (V_1 - Ui) F(x_{1i}\beta) \exp (V) = \exp Vi \ldots \quad \ldots \quad (2)$$

Where Y = observed output and Y^ = the frontier output. The parameter of the stochastic frontier production function are estimated using maximum likelihood method.

Empirical Model

For this study, the production technology of broiler farmers in Enugu urban is assumed to be specified by the Cobb Douglas production function defined as follows:

$$\ln Q = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3 \ln x_3 + \beta_4 \ln x_4 + \beta_n \ln x_n + V_1 U_1 \quad \ldots \quad \ldots \quad (3)$$

where Q = value of output of farmers (₦), X_1 = broiler chicks (No), X_2 = feeds use (kg), X_3 = labour inputs (manday), X_4 = drug and medication (litres), X_5 = water required (liters), X_6 = capital depreciation (₦), V_i = Error term not under the control of the farmer, U_i = error term under the control of farmer, β_0 = intercept, β_1 - β_2 = parameters to be estimated.

The socioeconomic determinants of the technical inefficiency was simultaneously modelled and defined by

$$U_i = a_0 + a_1 m_1 + a_2 m_2 + a_3 m_3 + a_4 m_4 + a_5 m_5 + a_6 m_6 + a_n m_n + e \quad \ldots \quad \ldots \quad (4)$$

Where m_0 = intercepts; m_1 -m_5 = coefficient to be estimate; a_1 = age of the farmer (yrs); a_2 = farm size (No); a_3 = household size (No); a_4 = educational level (yrs); a_5 = farming experience (yrs); a_6 = access to credit (N); a_7 = extension contact (No); a_8 = membership of cooperative (dummy).

To estimate the model and separate inefficiency U_i, some assumptions about the distribution, i.e., V_1 N(O, α^2) while U_i has a half normal distribution i.e. U_1 = (O, α^2). The estimate for all the parameters of the Stochastic Frontier Function and inefficiency wee simultaneously obtained using the program frontier version 4.1 (Coelli, 1996).

RESULTS AND DISCUSSIONS

The mean statistics of urban poultry farmers are shown in table I. On the average, a typical urban broiler farmer was 37.2 years old with 10.3 years of education, 10 years of urban broilers production experience with average stock size of 21.4 birds. The mean household size was 6 persons with average annual income of ₦62,284 and mean output of 420 birds for four months.

The maximum livelihood estimates (M/E) of the stochastic frontier production parameters for urban broiler farmers is presented in table 2. The total variance (σ) was 0.8701 which was significantly different from zero at 1% level. This implies goodness of fit of the model and the correctness of the specified distribution assumption of the composite error term. The variance ratio parameter was estimated at 0.6027 which was also statistically significant at 1% probability level, indicating that 60.2% of the total variation in broiler output was due to technical inefficiency.

Table 1: Mean socioeconomic statistics of Enugu urban broiler farmers

Variable	Mean value
Age of urban broiler farmer (yrs)	37.2
Educational level (yrs)	10.3
Farming experience	10
Farm size (ha)	21.4
Household size	6
Annual income (₦)	₦62,284
Output	420

Source: Field Survey, 2010

The coefficient of the broiler chick feed, labour inputs and drug and medication had the desired positive signs and were statistically significant at 1.0% probability level. The implication is that the more broiler chicks used, the more the mature broiler's accruing to the farmers, ceteris paribus. The estimated coefficient of feed was negative and statistically significant at 1% probability level. This infers that one percent increase in feed used, l lead to -2.067 percent decrease in total farm income. The coefficient (0.2536) of labour input was positive and statistically significant at 1% probability level. This implies that one percent increase in labour input resulted to 0.2536 percent increase in the revenue of the broiler farmer. Drug and medication had positive coefficient (0.0042) and significant at 5% risk levels, which implies that 5 percent increase in drug and medication increased the revenue of farmers through reduction in the mortality rate of the birds by 0.0042 percent. The estimated coefficient (0.0145) of water use was positive and statistically significant at 10%, implying the direct relationship between the variable and the farmers' output.

Table 2: Estimated stochastic production function for broiler farmers in Enugu urban

Production Factor	Parameter	Coefficient	Standard error	t-ratio
Constant term	β_0			
Broiler chicks	β_1	2.319	0.437	5.425***
Feed use	β_2	-2.067	0.549	-3.766***
Labour input	B_3	0.2536	0.0681	3.7243***
Drug and medicine	β_4	0.0042	0.0018	2.326**
Water requirement	β_5	0.0145	0.0075	1.9266*
Capital depreciation	β_6	0.0520	0.0227	-2.2916
Diagnostic statistics				
Total variance	q^2	0.8701		
Variance ratio	γ	0.6027		
Likelihood ratio test				
Los log likelihood				

Source: Field Survey, 2010
*** = significant at 1%
** = significant at 5%
* = significant at 10%

The maximum likelihood estimate of the determinants of technical inefficiency of urban broiler farmers is presented in table 3. Educational level showed positive relationship with technical efficiency and statistically significant at 1% risk level. This result is consistent with Okoye and Onyenweaku (2007) who opined that educated farmers are expected to be more receptive to improved farming techniques. Farming experience was positive and significant at 1%. This agrees with apriori expectation. Farmers with long years of farming experiences tend to combine their resources better in an optimal manner. Ewuziem *et al.* (2010) finding confirmed this assertion. Credit access was negative and significant at 5% risk level, which is contrary to apriori expectation. The diversion of loan to non-agricultural uses is the critical reason for the behaviour of the variable. Onyenweaku *et al* (2010) confirmed to this finding. Extension contact was positive and significant at 5%. Onyenweaku and Nwar (2005) finding is in confirmation to this assertion. This implies that the more extension contact, the broiler farmer has the more likelihood of his/her achieving decreased technical inefficiency. Membership of organization was positive and significant at 10% probability level. The effect of membership organization has been variously found to be positive with technical efficiency (Dung *et al.*,, 2010; Eze and Akpa, 2010).

The distribution of the technical efficiency estimates obtained from the stochastic frontier is presented in table 4. The result shows that 83.3% of the urban broiler farmers operated at efficiency level greater than 80%. The mean technical efficiency of the farmer is 95%. This figure compares favourably with 93% reported by Eze and Akpa (2010). In short run, there is opportunity for increasing broiler production in Enugu urban by 5%, by adopting innovations employed by the best practices in broiler farming. The maximum technical efficiency is 98%. The level of technical efficiency in this study implies that opportunities still exist for increasing productivity and income through efficient use of resources among urban broiler farmers in Enugu urban.

The implication of the mean technical efficiency (95%) is that an average broiler farmer requires 30.6% cost saving to attain the status of the most efficient broiler farmer among the sampled best 10 category while the least farmer would need 10.2% cost saving to become the most efficient urban broiler farmer among the worst 10 sampled farmers.

The elasticity and return to scale for broiler production in Enugu urban is shown in table 5. The regression coefficient in the Cobb Douglas stochastic production frontier function are the elasticities and their sums indicate the return to scale (Hazarika and Subramanian, 1999). The return to scales (production elasticities) has a function coefficient of 1.4782. This implies that broiler production farmers production plan is elastic, hence the farmers are in stage two of production function phase. This could be as a result of high and positive coefficient of feed with low and positive coefficient of depreciation. This implies that broiler farmer in Enugu urban optimally utilize their scare resource, particularly feed in their production process.

Table 3: Estimated determinant of technical inefficiency in broiler farmers in Enugu urban

Determinants	Parameter	Coefficient	Standard Error	t-ratio
Age of farmer	a_1	-0.0099	0.0394	-0.2512
Farm size	a_2	0.0928	0.0636	1.4148
Household size	a_3	0.0143	0.0049	2.9184
Educational level	a_4	2.9577	0.4013	7.36***
Farming experience	a_5	0.6912	0.0912	7.5759***
Access to credit	a_6	-0.1023	0.1963	0.5211
Extension contact	a_7	-0.0520	0.0227	-2.2916**
Membership of organisation	a_8	0.0145	0.0075	1.9266*

Source: Computed from Field Survey, 2010
*** = significant at 1%
** = significant at 5%
* = significant at 10%

Table 4: Distribution of technical efficiency indices of broiler farm in Enugu urban

Technical Indices	Efficiency	Frequency	Percentage
0.00	0.20	0	0
0.21	0.40	0	0
0.41	0.60	0	0
0.61	0.80	20	16.7
0.81	1.00	100	83.3
Total	120		100.0

Maximum technical efficiency = 0.98
Minimum technical efficiency = 0.88
Mean technical efficiency = 0.95
Mean of best 10 farmers = 0.05
Mean of worst 10 farmers = 0.88

Source: Computed from field survey, 2010

Table 5: Elasticity and return to scale for broiler production in Enugu urban

Production inputs	Elasticity
Feeds	1.3471
Broiler chicks	0.0682
Labour	0.0421
Farm size	0.0077
Depreciation	0.0131
Return to scale	1.4782

Source: Field Survey data, 2010

Table 6: Constraints to broiler production

Constraints	Percentage
High cost of medication	68
Problems of adulterated drug	62
Scarcity of raw material	48
Poor breeds	82
Unavailability of drug and vaccine	47
High mortality	72
Low patronage during glut	63
Bird flu	14
High cost of feed	65
Poor access to credit	86
Pests and diseases	54

Furthermore, on the individual production input elasticity showed that change in the broiler chick, labour, size of farm land and capital employed by 1 unit brought about a change in opposite direction of 0.0682, 0.0421, 0.0077 and 0.0131 in the output of broiler respectively. In the same way, a unit change in feeds intake brought about a change in opposite direction of 1.3471 in the output of broiler

Table 6 shows the constraints to broiler production. Most of the farmers interviewed encountered the problem of poor access to credit. This could be emanated from the inability of the farmers to provide the necessary collaterals as demanded by lending agencies and as well as high interest rate of loan (Ume *et al*, 2008). 82% of the farmers complained of poor breeds of broiler chicks. Ngoka (1998) reported that the poor performance of these breeds are highly economical, as not only missing the market target but also wastage of space, labour and finance with minimal profit. 72% of the farmers reported high mortality of broiler especially during transportation and rearing. The consequence of high mortality is reduced income which is tantamount to low savings and low investment (Kughur, *et al*, 2012).

CONCLUSION AND RECOMMENDATIONS

The result of this study showed that the technical efficiency of broiler farmers in Enugu urban of Enugu State is high. The individual levels of technical efficiency ranged between 88% and 98% with mean of 95%, this implies that there are opportunities for improving the productivity and income of the broiler farmers in Enugu urban by increasing their farm level resource use efficiency.

The important determinants of technical efficiency among broiler farmers were; educational level, farming experience, access to credit, extension contact and membership of organization. To address inefficiency in broiler producers, the following policy options are suggested:

i. Improving farmers' access to education through adult education programme and mass mobilization.
ii. Access to credit through micro-credit institutions and other lending organization
iii. Farmers are advised to form cooperative to ensure easy access to credit acquisition, improved inputs and capacity building.
iv. Experienced farmers and even new entrants are encouraged into broiler business by providing them with essential and improved productive inputs at reduced cost.
v. Extension contact with farmers should be encouraged through adequate motivations and provision of mobility.

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