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Resource Use and Technical Efficiency of Small Scale Poultry Farmers in Enugu State, Nigeria: A Stochastic Frontier Analysis

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Abstract: The study examined the factors that affect poultry production among small scale poultry farmers in Enugu State, Nigeria. Thirty six respondents were sampled from a list of poultry farmers derived from Enugu State Agricultural Development Programme Office. The Cob Douglas stochastic production function was used to determine factors that affect poultry output as well as the factors that affect the technical efficiency of poultry production. Farm size ($p = 0.05$), capital input ($p = 0.01$), labour input ($p = 0.05$), quantity of feed used ($p = 0.05$) as well as drugs and veterinary services ($p = 0.05$) were the major factors that determined poultry output while age of farmer ($p = 0.05$), production systems ($p = 0.1$), farming experience ($p = 0.1$) and educational status ($p = 0.1$) determined the technical efficiency of poultry production. The mean technical efficiency of poultry production by small scale poultry farmers in Enugu State, Nigeria is 62%, implying that there are yet about 38% of chances for improvement on the technical efficiency of production. Given the existing technology of the poultry farmers, proper management that bears in mind the use of improved breeds and increased education of the poultry farmers on current techniques of production are policy measures that could help improve on the technical efficiency of poultry production in the study area.

Key words: Poultry production, stochastic frontier, technical efficiency, factors, Enugu State

INTRODUCTION

The poultry industry in Nigeria has undergone a significant transformation since the early fifties, from a backyard, peasant and primitive household-oriented husbandry of indiscreet breeds of semi-wild chickens, to the cash-oriented, modern and large scale poultry which dot our country-side and urban centres today. It can be said that poultry keeping has become a business in Nigeria. The estimate of livestock resources as reported by Rim, 1993 indicate that there are 103 million indigenous poultry and 15 million commercial (exotic) poultry in the country. It is therefore clear that much needs to be done to accelerate the transformation to commercial poultry husbandry and sustain the interest of present and intending modern poultry farmers in Nigeria.

The food and Agriculture Organization of the United Nations (FAO) stipulates a daily requirement of 65 gm to 75 gm of total protein out of which 40% or 36 gm should be derived from animal protein. Currently, the estimated per caput animal protein consumption is about 17 gm which indicates a shortfall. The shortfall can be corrected through maximum use of available resources to foster the production of livestock. This will in turn lead to an increase in total output of animal and food products such that the generality of the populace would have adequate protein intake. This will improve the nutritional status of children and other groups who are most vulnerable to malnutrition which can lead to permanent damage of the mental faculties and physique. Nigeria is still trailing behind with the current low animal protein intake per head per day of 10 g compared to FAO recommended 36 g (FMAWR, 2008). This scenario has not changed over time and the steady rise in population throughout the world presupposes a great need for increased protein food resources and enhancing of biological value of different products.

Poultry offers the greatest scope of increasing the quantity and quality of animal protein. Poultry meat and eggs account for about 30% of total livestock output in Nigeria of which eggs account for over 80% (Evbuomowan, 2005). Commercial poultry is well established in the country with substantial infrastructure (poultry houses, feed mills, hatcheries and processing plants) already on ground. However, most of these items became idle for reasons associated with high cost of strategic inputs and working capital as well as competition from cheap imports. The embargo placed on the importation of poultry products in 2002 by the Federal Government is aimed at encouraging local production. The challenge therefore, is how to produce poultry products at sustainable levels in order to bridge the protein supply gap in the nearest future.

The early government agricultural programmes emphasized poultry farming and contained substantial subsidies in day-old chicks and feeds. This attracted millions of peasant farmers, civil servants, professionals and entrepreneurs into poultry farming at small, medium and large scales. Following changes in governments and government policies, particularly during the structural adjustment programme, the huge subsidies in the agricultural sector were withdrawn and many poultry farmers closed down in the face of rising costs of stock and raw materials.

The crucial role of efficiency in increasing agricultural output has been widely recognized by researchers and policy makers alike (Nwaru, 2005; Ike and Inoni, 2006; Ike, 2008; Okoye, 2006). Indeed, considerable efforts have been devoted to the analysis of farm level efficiency in developing countries. An underlying premise behind most of the work of efficiency is that if farmers are not making efficient use of existing technologies, then efforts designed to improve efficiency would be more cost-effective than introducing new technologies as a means of increasing agricultural output (Effiong, 2005; Ike, 2008). The focus of this study is on the current levels of technical efficiency of small scale poultry farms in Enugu state, Nigeria. It specifically sought to ascertain the socioeconomic characteristics of small scale poultry farmers as well as determined the technical efficiency of small scale poultry farms with a view to analysing the determinants of its technical efficiency.

MATERIALS AND METHODS

Theoretical framework: Several techniques have been developed for the measurement of production efficiency (Farrel, 1957). The two most popular approaches for efficiency measurement were the parametric stochastic frontier and non-parametric mathematical programming approach popularly referred to as the Data Envelopment Analysis (DEA) (Aigner *et al*., 1977; Meeusen and Van den Broeck, 1977; Charnes *et al*., 1978). The stochastic frontier production frontier function was independently proposed by Aigner *et al*. (1977) and Meeusen and Van den Broeck (1977). Research has proved that estimation by the stochastic frontier production function makes it possible to find out whether the deviation in technical efficiencies from the frontier output is due to farm specific factors or due to external random factors (Igwe, 2004; Onyenweaku *et al*., 2005; Okoye, 2006).

The stochastic frontier model according to Aigner *et al*. (1977) can be generally represented as:

$$Y_i = f(X_i;B) \exp(V_i-U_i) \text{ where } I = 1,2,...n \quad (1)$$

Where:

Y = Output of the ith farm
X_i = Vector of functions of actual input quantities used by the ith farm
B = Vector of parameters to be estimated
$V_i - U_i$ = The composite error term

Vi accounts for random error not under the control of the farmers while Ui is the non-negative random variable associated with technical inefficiency.

In the context of the stochastic frontier equation above, the technical efficiency defined as the ratio of the observed output to the corresponding frontier output conditional on the levels of inputs used by the farmer is mathematically expressed as:

$$TE = Y_i/Y_i^* \quad (2)$$

$$= f(X_i;B) \exp(V_i-U_i) / f(X_i;B) \exp(V_i) \quad (3)$$

$$= \exp(-U_i) \quad (4)$$

Where:

Y_i = Observed value of output and
Y_i^* = The frontier output

The frontier production function is estimated by the Maximum Likelihood Technique. Any farmer who is fully technically efficient will have the value of one. Thus farmers having value lying between zero and one are described as being technically inefficient.

Table 1: Maximum Likelihood Estimate (MLE) for fish production using pond

Factors	Parameters	Coefficients
Production factors		
Constant term	β_0	-10.9427 (6.4857***)
Farm size	β_1	0.3012 (2.8240**)
Capital input	β_2	0.5196 (5.6405***)
Size of initial stock	β_3	0.9470 (0.3334)
Labour input	β_4	1.1067 (2.7357**)
Feed intake	β_5	0.5025 (1.5835*)
Drugs and veterinary services	β_6	0.1328 (2.4666**)
Efficiency factors		
Constant	b_0	-0.6585 (-0.6974)
Age of farmer	b_1	0.3667 (1.8029*)
Production system	b_2	-0.1289 (-2.2411*)
Household size	b_3	0.1256 (0.1961)
Farming experience	b_4	-0.5795 (2.2921*)
Level of education	b_5	0.1073 (2.0562*)
Gender	b_6	-0.0055 (-0.1045)
Extension contact	b_7	-0.1644 (1.3425)
Membership of cooperative	b_8	0.6532 (0.2237)
Sigma-squared	σ^2	0.2627 (1.4353)
Gamma	γ	0.4845 (1.3033)
Log likelihood function		-22.1480

Table 2: Percentage distribution of efficiency levels of pond fish producers

Range	Frequency	Percentage
0.21-0.30	3	8.34
0.31-0.40	9	25.02
0.41-0.50	2	5.56
0.51-0.60	2	5.56
0.61-0.70	6	16.68
0.71-0.80	3	8.34
0.81-0.90	3	8.34
0.91-1.00	8	22.24
Total	36	100.00

Study area: Enugu State, south-east of Nigeria, is one of the thirty six states constituting the Nigeria Federation. The state was carved out from the old Anambra State in August 27, 1991. Enugu state derives its name from the capital city, ENUGU which literally means 'Top of the Hill'. The capital city is the oldest urban area and political capital of the former Eastern Nigeria.

The state is situated on the highlands of Nsukka, Udi and Awgu hills and the rolling low lands of the Idodo River Basin to the East and the Oji River Basin to the West. The state is bounded by six other states with which it shares common boundaries. It spreads southwards to the boarders with Abia state and Northwards to Benue state. Other states that share common boundaries with Enugu state include Ebonyi, Imo. Kogi and Anambra states. Apart from a chain of low hills running through Abakaliki in neighboring Ebonyi state to Nsukka in the East and the Southwards through Enugu and Awgu, the rest of the state is made up of low land criss-crossed by numerous streams and rivulets of which the major ones are the Adada, Oji, Ekulu and Ajalli Rivers.

The state is composed of seventeen local government areas divided into three agricultural zones of Nsukka, Enugu and Awgu zones. It has a population of 3,257,278 made up of 1.62 and 1.63 million males and females respectively (NPC, 2006). The state's population density is two and a half times the national average.

Enugu state has a rich agricultural land as a result of its location within the tropical forest and savanna belts. About 85% of the populations are farmers growing food crops such as rice, cassava, maize, yams, cocoyam, banana and a variety of fruits and vegetables. Cash crops such as oil palm and cashew are produced in large quantities. Such animals as goat, sheep, pig, poultry and cattle are also domesticated mainly at small scale level.

Data collection and analysis: Data collection involved the use of questionnaire complimented with interview schedule. A list of registered poultry farmers from Enugu State Agricultural Development Programme (EADP) constituted the sampling frame. A multistage sampling procedure was adopted in sample selection. 12 local government areas LGAs) were selected (4 from each of the three agricultural zones of the state). Three small scale poultry farmers were randomly selected from each of the 12 LGAs and this gave a total of 36 small scale poultry farmers that were utilized for the study. The frontier 4.1 was used for the analysis.

The model adopted for analysis was the Cob Douglas production frontier having been proven by researchers to be the best for agricultural production studies. The implicit form of the model is specified as:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, (V_i - U_i) \quad (5)$$

Where:

Y = Value of Output measured in naira
X_1 = Farm size (number of birds)
X_2 = Capital input in naira
X_3 = Initial stock (number of day old chicks)
X_4 = Labour input in hours
X_5 = Feed intake in kilogrammes
X_6 = Cost of drugs and veterinary services in naira
V_i = Symmetric error term accounting for random variations in output due to factors beyond the farmer
U_i = Non-negativity random variable representing economic inefficiency in production relative to the stochastic frontier

$$\text{Exp}(-Ui) = b_0 + b_1Z_1 + b_2Z_2 + b_3Z_3 + b_4Z_4 + b_5Z_5 + b_6Z_6 + b_7Z_7 + b_8Z_8 + e \quad (6)$$

Where:

Z_1 = Farmer's age in years
Z_2 = Household size
Z_3 = Production system (Dummy: Intensive = 1; Semi intensive = 0)
Z_4 = Gender (Dummy: Male = 1; Otherwise = 0)
Z_5 = Educational level in years
Z_6 = Farm experience in years
Z_7 = Extension contact in numbers
Z_8 = Membership of Cooperatives
b_0 = Constant
$b_1 - b_8$ = Parameters to be estimated
e = error term

RESULTS AND DISCUSSION

Determinants of poultry output: Farm size was significant at 5% level and positive in sign as expected. This means that farmers who stock higher number of birds were producing more than those with smaller farm size. As the stock size increases, the space where the birds are housed is also expected to increase. Capital input variable was also significant and positive in sign. As more capital is invested in the poultry business, there is increased poultry production by farmers. Capital input significantly determined output at 5% level in the study area. The more infrastructural facilities available to the farmer, the higher would his/her output become. For instance, for a farmer who owns a feed mill, his technical efficiency of production is expected to increase. Similarly, farmers who own a motor vehicle such as pickup van would be technically efficient as their transportation need of the farm is met with ease and so increased technical efficiency is expected.

Labour input also affected poultry production. A significant level of 5% observed in the study area among small scale poultry farmers indicated that labour activities necessarily determine increased poultry output. Feeding and sorting activities constitute labour activities required to achieve increased output in poultry production.

Drugs and veterinary services variable determined poultry production at 5% level. The sign of the estimated variable was positive. Drugs and veterinary services are required for the proper and healthy growth of the birds so as to reduce the rate of mortality.

However, feed intake was not as highly significant as was expected. It was significant at 10%. Poultry production is more than giving the birds adequate food requirement. It entails ensuring that a poultry friendly environment needed for their survival is also not compromised.

Factors affecting technical efficiency of fish production: Age of farmers, production system, farming experience and level of education of the farmers are among the factors that affected technical efficiency of poultry farms in the study area. Age of farmer variable was significant at 10% level and negatively signed. This implies that age of the farmer is negatively related to inefficiency, hence it impacts positively to the technical efficiency of farmers. The negative relationship of age with inefficiency corroborates Nwaru (2005) and Ike (2008) who also recorded negative relationships in their separate studies.

Similarly, production system was significant at 10% and also negative. This implies that farmers who rear birds through the intensive system were more technically efficient than those who operate the extensive system.

Farming experience and level of education variables respectively were negative on their effect on inefficiency and was significant at 10%. It is expected that as the years go by, a farmer's level of technical efficiency increases. This has been reported in the earlier works done by Ike and Inoni (2006) and Ike (2008).

Education on the other hand is expected to increase efficiency. The more educated the farmer becomes the more equipped he is to make the best of the technology available to him for increased technical efficiency. The importance of education to increasing technical efficiency of production has been observed by Igwe (2004) and Onyenweaku *et al*. (2005).

Conclusion: Data collected from thirty six sampled small scale poultry farmers showed that poultry production in the study area is influenced by farm size, capital input, labour input quantity of feed used as well as drugs and veterinary services. Age of farmer, production system, farming experience and education level of the poultry farmers are among the variables that determined the technical efficiency of the farmers. Thus, poultry farming as a growing industry in Enugu State can be improved upon by educating the farmers through the available extension services which could help equip the farmers on the knowledge of efficient use of their resources given the available technology among others. In this way, technical efficiency of the farmers could be improved upon.

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