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POULTRY ENTERPRISE COMBINATION AMONG SMALL-SCALE FARMERS IN OGUN STATE, NIGERIA: A TECHNICAL EFFICIENCY APPROACH

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ABSTRACT
The need for increase in income level and reduce the income and food poverty necessitated the combination of poultry enterprise among farmers in Nigeria. The study analyzed the technical efficiency of poultry enterprise combination among farmers in Yewa division of Ogun State, Nigeria. Primary data were collected through a multistage process from 80 poultry farmers. The data were analyzed using descriptive, budgetary and stochastic frontier analysis methods. The findings revealed that the farmers are still in their productive age with a mean age of 47 years. The budgetary analysis result showed that poultry farming is a profitable enterprise. The result of the stochastic frontier analysis showed that number of layers, number of broilers and feed are the major determinants of poultry revenue. In addition, age, education and years of experience in poultry production are the determinants of technical efficiency of the farmers. There is need to improve the efficiency of farmers by 31 per cent with the present technology. This study recommends additional unit of birds to address the problem of over-utilization of feed and to improve the efficiency level of the farmers. Lastly, education of poultry farmers need to be strengthened through adult literacy education as education had positive effect on the efficiency of farmers.
Key words: Poultry farmers, enterprise combination, technical efficiency, Nigeria

INTRODUCTION
Malnutrition in human diet has been a major issue being debated worldwide, especially in the developing countries. Cases of poor ill-health condition was associated or traced to inadequate animal protein in their diet. Feeding on food of animal origin is probably the fastest economic and nutritional route to improvement in nutritional status; this is not far from the fact that foods from animal origin have the capability of 35g per capita of animal protein per day (Ojo, 2003). In Nigeria, livestock resources consists of 13,885,815 cattle; 34,453,742 goats; 22.096,602 sheep, 3,406,381 pigs; 104,247,960 poultry (Amos, 2006). From this figure, poultry accounted for 58.2 percent of the total livestock production. This indicates the important place of poultry sub-sector in the livestock sector. The term poultry refers to local and exotic fowls which are raised and fattened for their products, which include eggs, meat and in some cases feathers. Birds that are raised for poultry include fowls, turkey, ducks, and geese, among others. Poultry production consists of two parts: poultry egg production and poultry meat production. In the case of poultry meat production, the production results from body growth, although feed still has dual proportion of the body maintenance and growth. This is because birds have to feed on proper diet to aid egg production. The industry under either egg or meat production has continued to be major livestock industry in South-Western part of Nigeria, where a substantial number of small, medium, and large scale poultry farms are located. Egg production however has continued to record a steady rise because eggs are universally

acceptable and are not discriminated as against some products of other livestock that have religious or social taboos, (Laseinde, 1994). In Nigeria, the need to maintain high income and reduce both income and food poverty necessitated the combination of egg and meat production.

The important of poultry to national economy cannot be over emphasized as it has become popular for the small-holders that have contributed to the economy of the country. In Nigeria, poultry contributes about 15 percent of the total annual protein intake with approximately 1.3kg of poultry products consumed per head per annum. The poultry industry has assumed greater importance in improving employment opportunities and animal food production in Nigeria. An earlier report by Mbanasor (2002) showed that about 10 percent of the Nigerian population is engaged in poultry production, mostly subsistence and small or medium sized farms. It is observed that apart from the provision of direct employment and livelihood to thousands of people, the laying birds industry provide remarkably high quality nutritious food especially animal protein in discrete convenient and hand packets known as eggs. Meat and egg production has evolved as one of the most efficient industries producing food. World chicken production was put at 8 billion per year and records further showed that each person in USA consumes about 15kg of chicken meat and over 300 eggs per year (Ajibefun and Daramola, 2000). In Nigeria however, high price of poultry products has made it impossible for an average Nigerian to eat either meat or egg basically meant for the standard nutrition requirement for protein intake per day or monthly, although exception do occur during festival periods. This is because poultry is highly dependent on grain and other feed ingredients normally utilized by man. They therefore compete directly with man for foods, but grain production in Nigeria is far less than demand. A change in output of maize vis-à-vis its price is immediately reflected in change in output and price of poultry products.

In the past decades, there has been a recorded improvement in poultry production in Nigeria with its share of the Gross Domestic Product (GDP) increasing in absolute terms. CBN (1999) reported that the contribution of poultry egg and meat to the livestock share of the GDP increased from 26% in 1995 to 27% in 1999, an improvement that has been sustained by some salient factors, including use of improved vaccines to curtail birds' mortality rate, reduction in the tariff on imported stocks, and the relative ease of compounding efficient feed using easily available local feed stuffs (Atteh, 2004). As a result of high cost of production, lack of adoption of innovation in poultry by farmers, low profitability due to low feed conversion rate (since a large proportion of the poultry in Nigeria are indigenous birds), it has been observed in recent years that the poultry industry is not playing an effective role in satisfying the demand for animal protein intake by Nigerians. For Nigeria to be able to bridge the gap between demand and supply especially as it relates to animal protein intake, there was the urgent need to examine factors affecting efficiency of enterprise combinations in the poultry industry. This was the major objective of this study carried out among small-scale poultry farmers in Ogun State, Nigeria.

Conceptual Framework of the Production Efficiency

Stochastic elements are incorporated into the stochastic production frontier as a measure of the farm's technical efficiency to capture the farmer's specific random shocks.

The farm technology is represented by a stochastic production frontier as follows:

$$Y_i = f(\beta_i X_i) + \varepsilon_i \quad (1)$$

where Y_i denotes output of the ith firm; X_i is a vector of actual input quantities used by the *i*th farm, β is a vector of parameters to be estimated and ε_i is the composite residual term comprising of a random error term V_i and an inefficiency component U_i (Aigner *et al.*, 1977; Xu and Jeffrey,1998) defined as:

$$\varepsilon_i = V_i - U_i \quad (2)$$

$V_i's$ are assumed to be independently and identically distributed random errors $\left[V_i \approx N(0, \sigma v_v^2)\right]$, and the $U_i's$ are non-negative random variables associated with technical inefficiency in production, which are assumed to be independently and identically distributed and truncated (at zero) of the normal distribution with mean μ and variance, σ^2, that is, $\left[U_i \approx N(0, \sigma_u^2\right]$. The maximum likelihood estimation of equation (1) provides estimators for β and variance parameters, thus:

$$\sigma^2 = \sigma_u^2 + \sigma_v^2 \text{ and } \gamma = \frac{\sigma_u^2}{\sigma^2} \quad (3)$$

Subtracting V_i from both sides of Equation (1) and adjusting for the stochastic noise captured by v_i yields:

$$Y_i - v_i = y_i = f(X_i; \beta) - \mu_i \quad (4)$$

where y_i is the observed output of the ith farm adjusted for the noise disturbance. Hence, equation (3) provides the basis for deriving the technically efficient input vector, and for analytically deriving dual cost function of the production function.

METHODOLOGY

The Study Area

The study was carried out in Yewa division of Ogun State, Nigeria. Yewa division has five out of the twenty (20) Local Government Areas in Ogun State. The division is bounded to the West by the Republic of Benin with which it shares a long stretch of international boundary. It is bounded in the East by Oyo State, Abeokuta-North, Ifo Local Government and in the South by Lagos State. The dominant economic activities of the Yewa people vary from farming to trading. The climatic condition and physical environment have been generally supportive to farming as reflected in the variety and quantity of food and economic crops grown in the area, as well as livestock and fish farming.

Data Collection and Sampling Technique

The data for the study were essentially from primary source with the use of structured questionnaire administered in a multistage process. In the first stage, two (2) LGAs (Yewa North and Imeko-Afon) were purposively selected from the five Local Government Areas in the Yewa division because of the relatively large population of poultry farmers in these two LGAs. The second stage involved the selection of five (5) communities from each of the two selected LGAs. The third stage involved a random selection of eight (8) poultry farmers from each of the farming communities, making a total of 80. Only poultry farmers that combined egg and meat (broiler) enterprises in a single production cycle were covered in this study. Data were collected on the households' socio-economic

characteristics of the poultry farmers as well as on their production activities. Data collection covered an approximated period of one year (precisely 54 weeks), being the time span for the completion of one egg-production cycle by the surveyed farmers. Data for the broiler enterprise was also collected for periods varying between 13 – 17 weeks all within this 1 year approximated period.

Methods of Data Analysis

Data collected were subjected to descriptive, budgetary and stochastic frontier analyses. Budgetary analysis was used to determine the profitability of the combined poultry enterprises, using the gross margin estimate that was expressed as:

$$GM = TR - TVC \quad (5)$$

$$TR = P_i Q_i \quad (6)$$

Where:

TR = Total Revenue from sales of eggs and birds

P_i = Unit price per crate (of eggs) and live birds sold

Q_i = Number of egg crates and live birds sold over the 1-year production cycle

TVC = Total variable cost incurred on the production over the period of data collection. This included cost of stocks, feeding, medication, labour and facility bills.

The relation $\pi = GM - TFC$ was used in determining net profit from the combined enterprise, where TFC (Total Fixed Cost) was computed as *estimated annual depreciation value* of farm assets, mainly poultry pen and cages.

Stochastic Frontier Production

The stochastic frontier model was used to estimate the parameters of the production function and the technical efficiency estimates of the poultry (egg-laying) enterprise, given the intensive (cage) system of production. The production space of the of the poultry farmers was assumed to follow a Cobb-Douglas frontier defined as:

$$\ln Y_i = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + v_i - \mu_i \quad (7)$$

Where:

Y_i = Value of poultry products (egg and birds) in a combined production cycle (in Naira).

X_1 = Stock size (layers)

X_2 = Stock size (broilers)

X_3 = Quantity of Feeds consumed (Kg)

X_4 = Operating expenses (Costs of labour, drugs, transportation and facilities) in Naira.

X_5 = Estimated depreciation costs (in Naira)

v_i = random errors which cover random effects on production outside the control of the decision unit. v_i is assumed to be independent and identically distributed normal random error having zero means and unknown variance N(μ, δ^2).

μ_i = technical inefficiency effects which are the result of behaviour factors which could be controlled by efficient poultry management practices (Xu and Jeffrey, 1998). μ_is are technical inefficiency effects which were assumed to be independent of v_is, defined as:

$\mu i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4$

(8) (4)

Where:

Z_1 = Age of poultry farmer (years)
Z_2 = Year of formal education
Z_3 = Years of experience in poultry production
Z_4 = Gender of farmer (male =1, female otherwise)

The βs and δs are unknown parameters to be estimated. The variances of the parameters δ^2_V and one sided $\delta^2\mu$ and the overall model variance δ^2 are related thus, $\delta^2 = \delta^2_V + \delta^2\mu$
In addition, the farm specific technical efficiency (TE) was estimated by using the expectation of μ_i conditional on the random variable v_i (Battese and Coeli,1988). The technical efficiency of individual farmers is defined in terms of the ratio of their observed output (Y_i) to the corresponding frontier output (Y_i^*) given the available technology as:

$$TEi = Y_i/Y_i^* = f(X_i;\beta) \exp(V_i - \mu_i) / f(X_i;\beta) \exp V = \exp(-\mu_i) \quad (9)$$

Therefore, $0 \leq TE \leq 1$

RESULTS AND DISCUSSION

Socio-economic Characteristics of Poultry Farmers

The distribution of the socio-economic characteristics of poultry farmers is presented in Table 1. Majority (48.8 percent) of the farmers were aged between 41 and 50 years. The mean age of the farmers was approximately 47 years implying that the farmers were still in their productive age for available resources. Also, majority (88.8 percent) of the respondents were male while majorities (86.3 percent) of the respondents were married. This is an indication that the poultry farmers had additional responsibilities to bear, which may have propelled them into enterprise combination with the intention of generating more income. In addition, majority (75 percent) of the farmers have between four and seven household members with a mean size of 6 persons implying additional burden on the farm proceeds, except if a large proportion of this size is available to provide labour in the farm. Only (41.3 percent) of the farmers had attained up to secondary school education, giving indication that this low literacy level may have impact negatively on the profitability and efficiency of the combined poultry enterprise. However, the fact that majority (70 percent) of the farmers had between 11 and 20 years of experience in poultry farming may serve as an antidote to the low literacy level as this is expected to translate to the acquisition of practical knowledge in routine management practice.

Table 1: Socio-economic Characteristics of Poultry Farmers

Variables	***Frequency***	***Percentage (%)***	***Mean***
Age (Years)			
30 or less	9	11.2	
31 -40	21	26.2	
41-50	39	48.8	47.3
Above 50	11	13.8	
Sex			
Male (= 1)	71	88.8	
Female	9	11.2	
Marital Status			
Single	5	6.2	
Married	69	86.3	
Widow	6	7.5	

Household Size (Number)			
3 or less	6	7.5	
4-7	60	75	6
Above 7	14	17.5	
Educational Level			
No formal education	7	8.7	
Primary	10	12.5	
Secondary	33	41.3	
Tertiary	30	37.5	
Farming Experience (Years)			
10 or less	15	18.8	
11-20	56	70.0	16
Above 20	9	11.2	

Source: Computed from field survey data, 2010

Cost and Return Structure to the Combined Poultry Enterprises

The result for the cost and return to poultry production is presented in Table 2. The findings showed that total variable cost constitutes the highest proportion (68.71 percent) of total cost of production. The components of variable costs included cost incurred on feeding, medication and vaccination, labour, water, electricity, transportation and other administrative expenses. Cost of feeding alone accounted for 74.6 percent of the total cost of production implying that feeding is an essential cost variable in poultry production. Fixed inputs identified and depreciated include poultry building, battery cages, machineries, feeding trough, water trough, head pans, heater and brooding nylon. The mean revenue, mean gross margin and mean net farm income are estimated at ₦3,459,885.15, ₦2,666,967.75 and ₦2,396,945.25 respectively. This implies that poultry production is profitable enterprise.

Table 2: Results of Budgetary Analysis

Variables	**Mean Value(₦)**	**Percentage of Total Cost**
Revenue		
Revenue from Sales of Eggs	2,337,443.05	-
Revenue from Sales of Birds	1,122,442.10	-
Total Revenue	***3,459,885.15***	**-**
Variable Cost Items:		
Cost of feeds	476,237	44.8
Labour cost	195,429.7	18.4
Cost of medication	66,892.09	6.3
Other expenses	54,358.64	5.1
Total Variable Cost	*792,917.40*	*74.6*
Depreciation value (Fixed Costs)	*270,018.50*	*25.4*
Total Cost	***1,062,935.90***	***100***
Gross Margin	**2,666,967.75**	
Net Farm Income	**2,396,945.25**	

Source: Computed from field survey data, 2010

Maximum Likelihood Estimates of the Stochastic Frontier Production Function

Results of the Maximum Likelihood Estimates (MLE) of the stochastic frontier production function for the combined poultry enterprise is presented in Table 3. The variance parameters for sigma square and gamma were 0.037 and 0.71, respectively, both of which were significant at the 1% level. The value of sigma square showed a that the data had a good fit to the stochastic model. The gamma parameter indicated the systematic influences that were unexplained by the production function and the dominant sources of random errors. This shows that about 71 percent of the variation in output of the poultry farmers was due to the differences in their technical inefficiency. Therefore, inefficiency effects were present which made significant contribution to the technical efficiencies of the farmers. From the result (Table 3), number of layers (X_1) and broilers (X_2) in stock had positive influence on the total revenue, being significant at 1% and 10%, respectively. Feed intake was found to exert negative significant influence on total revenue at the 1% level, the negative sign giving an indication of over-utilization of feeds in the combined poultry enterprise.

The contribution of farmers' socio-economic characteristics such as age, household size, years of experience in poultry farming, years of formal education and gender to farm inefficiency was also presented in Table 3. The signs of the coefficients of these variables have important policy implications as positive sign implies negative effect on efficiency while negative sign signifies a positive effect on efficiency. Therefore, level of education and year of experience were found to significantly increase the technical efficiency of the poultry farmers (at 5%, 1% and 1%, respectively), while the efficiency of the farmers decreased as they grew older.

Table 3: Maximum Likelihood Estimates of the Poultry Farmers' Production Function

Variables	Coefficient	Standard Error	T-value
Production Function			
Constant	9.152***	1.55	5.89
Number of Layers	0.315***	0.049	6.39
Number of Broilers	0.106*	0.057	1.86
Feed Intake	-0.108***	0.039	-2.77
Operating cost	-0.033	0.049	-0.67
Other cost (depreciation)	0.022	0.121	0.182
Inefficiency Model			
Constant	-0.231**	0.117	-1.98
Age	0.016**	0.0071	2.26
Household Size	-0.008	0.037	-0.22
Education	-0.013***	0.003	-4.37
Poultry Farming Experience	-0.084***	0.0086	-9.78
Sex	-0.201	0.155	-1.3
Diagnostic Statistics			
Sigma square (δ^2)	0.037***	0.013	2.89
Gamma (γ)	0.71***	0.228	3.12

Source: Computed from field survey data, 2010

* implies significant at 1 percent, ** implies significant at 5 percent and *** implies significant at 10 percent.

Technical Efficiency Estimates of Poultry Farmers

The distribution of efficiency estimates of poultry farmers is presented in table 4. Majority (46.3%) of the poultry farmers operated on technical efficiency between 0.51 and 0.70 while about 28.8% of them had technical efficiency between 0.31 and 0.50. The mean technical efficiency was 0.69 leaving a technical efficiency gap of 31% for the farmers to reach the frontier. This is an indication of opportunity for improvement in efficiency which could either increase output or reduce production cost, given the present technology.

Table 4: Frequency Distribution of Efficiency Estimates of Poultry Farmers

Efficiency Range	Frequency	Percentage
Less than 0.30	0	0
0.31-0.50	23	28.8
0.51-0.70	37	46.3
0.71-0.90	16	20
Above 0.90	4	5
Total	80	100
Minimum	0.31	
Maximum	0.92	
Mean	0.69	

*, **, *** implies variable is significant at 10%, 5% and 1%, respectively.
Source: Computed from field survey data, 2010

CONCLUSION AND RECOMMENDATION

The mean age of poultry farmers' estimated approximately at 47 years is an indication that the farmers are still in their productive age. The budgetary analysis result reflected significant profitability in combined poultry enterprise. The stochastic frontier maximum likelihood estimates result revealed significant positive influence of stock size on the output (and invariably, profitability level) in the combined poultry enterprise. Quantities of feeds exert significant influence on the output of poultry farmers. Feed intake was also observed to be over-utilized among the poultry farmers. Also, factors that determined efficiency level of poultry farmers included age, education and years of poultry farming experience. Above all, the mean technical efficiency of 0.69 gives an indication that there is room for improvement by 31 per cent under the present production technology. This study therefore recommended additional unit of birds to address the problem of over-utilization of feeds. Also, education of poultry farmers should be strengthened through adult literacy education as additional level of education will have positive effect on the efficiency of farmers.

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