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Economics of Horizontal Integration in Poultry Industry in South-West Nigeria

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Abstract: The broad objective of this study is to analyze the economics of horizontal integration in poultry production in some selected local government areas in south-west, Nigeria. Data was collected from 61 fish farmers, 40 poultry farmers and 53 integrated fish and poultry farms, making a sample size of 154 farmers using purposive-snowball sampling process. Descriptive statistics, gross margin analysis and stochastic cost frontier were employed for data analysis. Analysis of socio-economic characteristics shows that most of the farmers in the study area are males, young within the age range of 30-<60 years and had formal education. Most of the farms are solely owned and some of the farmers are part-time farmers. Analysis of cost shows that feed account for 55.8, 68.2 and 78.9% of variable cost of production for sole fish farming, integrated poultry and fishery as well as sole poultry farming respectively. Followed closely in the same order is the cost of labour which account for 26, 6.4 and 3.7% cost of production respectively. The gross margin analysis shows that horizontally integrated poultry farms have highest gross margin (**x** 1,994,792.88) while the sole fish enterprise records the least gross margin of **x** 556,516.32. This confirms the economic importance of horizontal integration in poultry industry in terms of profitability. The price of eggs, flock size, stocked fingerlings, quantity of feed and cost of intermediate materials are the explanatory variables that influence the production cost while age of the farmers, vertical integration and sole fish farming are the determinants of economic efficiency.

Key words: Horizontal integration, poultry production, economic efficiency

INTRODUCTION

The livestock is an important sub-sector in the agricultural sector of any economy and it plays a very significant role in economic development. It involves raising of animals and processing of animal products for consumption. Livestock production remains a vital component of the farming systems in many developing countries and it is undertaken in a multitude of ways across the globe, providing a large variety of goods and services and using different animal species and different sets of resources, in a wide spectrum of agro-ecological and socio-economic conditions. Livestock provides a lifeline for a large proportion of the world's rural population that lives in the developing world.

On global average for 1997, animal products provided about 16% of the calories in the diet (FAO, 2000), representing around 25% in developed countries and about 12% in developing countries. For proteins over the same period, the proportion was about 37%, being about 56% in developed countries and 29% in developing countries. Meat and other animal products also provide essential fatty acids, vitamins and minerals. However, livestock's economic importance goes beyond direct food production. Skins, fibers, manure (fertilizers or fuel), draught power and capitals are also livestock benefits. Livestock industry is also an employer of labour in large numbers all over the world (Ramsay and Andrews, 1999).

The challenge now is to increase the productivity of livestock and the quality of livestock products and provide access to markets so as to assist in maintaining food security and relieving poverty, while protecting human health. Livestock production is currently undergoing rapid change and this change manifest itself in the growing contribution that livestock makes to satisfying the increasing global demand for high-value food products and in continuous adjustments at level of resource use intensity, size of operations, product orientation and marketing channels.

In Nigeria, the production of food has not increased at the rate that can meet the increasing population. While food production increases at the rate of 2.5%, food demand increases at a rate of more than 3.5% due to the high rate of population growth of 2.83% (FOS, 1996). The apparent disparity between the rate of food production and demand for food in Nigeria has led to myriads of problems which include a food demand-supply gap thus leading to a widening gap between

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domestic food production and total food requirement; an increasing resort to food importation; high rate of increase in food prices and low animal protein intake.

Apart from Nigeria's agriculture not meeting up in its food production to meet the food requirement of the increasing population, its greatest problem is that of inadequate animal protein in the diets of a large proportion of the population especially in the rural areas which constitute over 70% of the population (FMAWRD, 1988). Due to the high nutritional importance of animal protein, successive governments in Nigeria have initiated programmes (such as farm settlement scheme, Agricultural Development Project (ADP) and recently, United Nation Development Programme (UNDP) sponsored livestock programme) with the aim of meeting the FAO recommended 35g per caput of animal protein per day. In Nigeria, poultry contributes just about 15% of total animal protein intake with approximately 1.3 kg of poultry products consumed per head per annum compared with the World Health Organization and Food and Agricultural Organization recommendation of 3.6 kg per head per annum (FAO, 2000).

Still in the pursuit of adequate supply of animal protein, recently in Nigeria, the United Nation Development Programme (UNDP) instituted a livestock production enhancing programme in the country recently with the objectives of:

- Training farmers on improved livestock breeds.
- Training farmers on improved and modern rearing and production methods of livestock.
- Increasing the production of livestock products and consequently farmer's income. Major problems that confront livestock production in Nigeria is high cost of feed and risk associated with unstable prices due to economic instability which, in no small way affects the profitability of livestock enterprises. Bamiro *et al*. (2006) reported that some farmers adopted vertical integration in poultry industry. However, vertical integration will only reduce risk to some extent, but a major outbreak of disease like bird flu might have a detrimental effect on the accrued income, hence the need for the adoption of both vertical integration and horizontal integration in livestock industry.

Horizontal Integration means acquiring activities dealing with similar products, so that synergies accrue and there is a degree of 'sensible' diversification. Poultry production and fishery, poultry fishery, snailery or any other combinations of livestock enterprises are examples of horizontal integration in livestock industry. Market domination and risk reduction, economies of scope and scale are the major motives leading to horizontal integration.

One important problem facing Nigeria economy is the need to increase food production to meet the demand of the country's fast growing population and this significant imbalance between food production and the expanding population has resulted in an ever increasing demand for agricultural products (source of food) and thus a meeting point must be found for sustainability in food production to be attained. Ojo (2003) identified poor storage facilities, pests and diseases and the problem of efficiency of resource utilization as bottlenecks against progressive achievement in agriculture especially in livestock production. Inadequate animal protein intake in the diet of a large proportion of the populace is another problem that needs to be urgently addressed. While it is important to increase production numerically, it is equally important to cut down on avenue of losses if the much needed animal protein is to be made available (in good quality and quantity) to the populace. Risk borne by poultry farmers as a result of non-diversification in production is another bone of contention. In view of this, production efficiency of farmers has important implication for developmental strategies. Capacity balancing issues and decrease flexibility also affect productivity in poultry industry and developing new core competence may be more imaginary than real. Horizontal integration in poultry could however, help to cater for and solve most if not all the above problems.

MATERIALS AND METHODS

This study was based on primary data obtained in a cross section survey of poultry farms, fishery farms and horizontally integrated poultry farms in south-west Nigeria. The south-western part of Nigeria consists of six states, out of which two were randomly selected. The data were collected by personal administration of a set of questionnaire/interview schedule designed to obtain information on socio-economic characteristics of the poultry farmers, fish farmers and operators of integrated poultry farms, the sampled farm characteristics as well as their production and cost data for the 2007/2008 production season.

The study employed a purposive-snowball sampling process to obtain data from poultry farms that horizontally integrates fishery enterprise sole poultry farms and sole fish farms. The process yielded a sample size of 154 farms which consists of 40 sole poultry farms, 61 sole fishery and 53 horizontally integrated poultry farms. We feel that the sample is a fair representation of the poultry industry in the study area.

The study data were analysed by descriptive and quantitative (econometric) techniques. The quantitative analyses entailed specification and estimation of a gross margin and transcendental logarithmic (translog) cost function as a dual to the production function of the poultry farms. The theoretical model underlying the analysis has its foundation in neoclassical theory of cost and duality principles, which represents the implications of optimisation in competitive markets (Dalton *et al*., 1997). Detailed specifications of the theoretical framework are common in literature (e.g. Binswanger, 1974) and are widely used by related studies like Akridge and Hertel (1986) and Dalton *et al*. (1997) among others.

Gross margin analysis:

$$GM = \overset{m}{\underset{j=1}{\text{å}}} P_i q_i - \overset{m}{\underset{j=1}{\text{å}}} C_i X_i \qquad (1)$$

$$TR = \overset{m}{\underset{j=1}{\text{å}}} P_i q_i$$

$$TVC = \overset{m}{\underset{j=1}{\text{å}}} C_i X_i$$

$$NFI = GM\text{-}TFC$$

Where:

GM = Gross Margin (Naira)
P_i = Unit price of output (Naira)
q_i = quantity of output
C_i = unit price of input
X_i = quantity of variable input
TR = Total Revenue (Naira)
TVC = Total Variable Cost (Naira)
NFI = Net Farm Income (Naira)
TFC = Total Fixed Cost (Naira)

Production function techniques were employed in examining the effect of horizontal integration on production efficiency, using the stochastic frontier model.

Model specification: The stochastic production frontier of Cobb-Douglas functional form was employed to estimate the economic efficiency of horizontally integrated poultry farms. One of the widely used methods for assessing economic efficiency difference across production units is the Stochastic Production Frontier approach. The stochastic frontier production function proposed by Battese and Coelli (1995) builds hypothesized efficiency determinants into the inefficiency error component so that one can identify focal points for action to bring efficiency to higher levels. And more recently, empirical applications of the technique in efficiency analysis have been reported by Ajibefun and Abdulkadri (1999); Ojo and Ajibefun (2000) and Ojo (2003). The stochastic frontier production function model for this study is as follows:

$$Y_t = f\,(X\ t;\ \$)\ e^{g} \qquad (1)$$

Where:

Y = The cost of production;
X_a = A vector of input quantities;
\$ = A vector of parameters; and
e = Error term.

Where g is a stochastic disturbance term consisting of two independent elements L and <.
Where:

$$g = L + < \qquad (2)$$

The symmetric component, <, accounts for random variation in output due to the out of control factors, such as weather and diseases. It is assumed to be independently and identically distributed as N~ (0, F^2 <). A one-sided component L≤0 reflects technical inefficiency relative to the stochastic frontier as |N ~ (0, F^2 <) |, i.e. the distribution of L is half-normal. The stochastic production frontier model can be used to analyze cross-sectional data. The frontier of the farm is given by combining (1) and (2):

$$Y = f\,(X_a;\ \$)\ e^{(L\,+\,<)} \qquad (3)$$

Measures of efficiency for each farm can be calculated as:

$$TE = \exp.\ [E\ \{L \mid g\}] \qquad (4)$$

And L in equation (4) is defined as:

$$L = f\,(Z_b;\ *) \qquad (5)$$

Where: Z_b = a, vector of farmer-specific c factors and * = a vector of parameters.
The empirical stochastic cost frontier model that was applied to the analysis of data is specified as follows:

$$\ln Y_{ij} = \$_0 + \$_1 \ln X_{1ij} + \$_2 \ln X_{2ij} + \$_3 \ln X_{3ij} + \$_4 \ln X_{4ij} + V_{ij} - U_{ij} \qquad (6)$$

Where subscripts ij refers to the jth observation of the ith farmer:

In = Logarithm to base e;
Y = Value of farm output
X_1 = Price of fish (Naira)
X_2 = Price of egg (Naira)
X_3 = Flock size
X_4 = Quantity of feed (kg)
X_5 = Labour (Mandays)
X_6 = Cost of Intermediate materials (Naira)

It is assumed that the inefficiency effects are independently distributed and U_{ij} arises by Truncation (at zero) of the normal distribution with mean uij and variance F^2, where uij is defined by the equation:

$$U_i = \delta_0 + \delta_1 \ln Z_{1ij} + \delta_2 \ln Z_{2ij} + \delta_3 \ln Z_{3ij} + \delta_4 \ln Z_{4ij} \qquad (7)$$

Where:

U_i = Economic inefficiency of the ith farmer
Z_1 = Age of the poultry farmer
Z_2 = Gender of the farmer
Z_3 = Years of formal education of the ith farmer
Z_4 = Years of experience of the ith farmer in yam production
Z_5 = Part-time farming D = 1 for full-time farmer or 0 otherwise
Z_6 = Vertical integration; D = 1 for vertically integrated farms or 0 otherwise
Z_7 = Horizontal integration D = 1 for horizontally integrated farms 0 otherwise

The $ and *-coefficients are unknown parameters to be estimated, by the method of maximum likelihood, using the computer program FRONTIER version 4.1.

RESULTS AND DISCUSSION

The socio economic characteristics are presented in the first subsection while the second and the third subsections contain the cost and return structure of the farms and the result of production efficiency analysis respectively.

Socio-economic characteristics of farmers and farm characteristics: The socio-economic variables of the farmers and farm characteristics considered in this study include, age sex, educational status, farming experience, household size, feed type, mode of participation and stock of fingerlings. The results are presented in this order, (a) Socio-economic variables of the farmer and (b) the farm characteristics.

Socio-economic characteristics of farmers: Majority of the farmers in the three categories viz; sole poultry, sole fishery and integrated farming enterprises are males. This might be due to the physical efforts required by this form of livestock enterprises. However, comparing the male involvement in the three enterprises, the result shows that the sole poultry enterprise employed the highest percentage of males followed by integrated poultry farms while the sole fishery enterprise records the lowest male participation. Most of the farmers are within 30-<50 years of age with high level of education. One feature of this result that is conspicuous and worthy of being noted is that there is no one that has no formal education as well as those that have primary education that are involved in the horizontally integrated poultry farming enterprise. This might not be unconnected with the technical know-how requirement of this enterprise. The high level of education couple with years of experience in all the three categories of the enterprises is expected to enhance productivity and efficiency of farmers. Majority of operators of sole poultry farming enterprise (50%) and operators of sole fish farming enterprise (73.8%) are full-timers while most of the farmers (about 53%) that horizontally integrated poultry enterprise with fishery enterprise are into part-time farming. This could be due to huge financial requirement of the integrated farming, however, these modes of participation are likely to enhance productivity in the non-integrated farming enterprises and hamper productivity in horizontally integrated farms. The socio-economic characteristics of the farmers with respect to enterprises are presented in Table 1.

Farm type characteristics: Majority of the proprietors of the three enterprises namely sole poultry, sole fishery and horizontally integrated farms utilized commercial feed. Comparatively, the integrated farms that are expected to adopt vertical integration with respect to feed production records the highest percentage (about 89%) of farms that consumed commercially produced feed. The sole fishery enterprise farms, however, records highest percentage of farms that utilized the combination of privately produced feed and commercial feeds. It is therefore not unexpected that the sole fishery enterprise will enjoy greatest benefits of vertical integration as par feed production. The result shows that most of the farmers operating sole poultry farms are small scale farmers while the horizontally integrated farms are relatively large scale farms, judging from the flock size. Horizontally integrated farms have higher stocking density. About 55% of the farms stocked fingerlings that range between 30001 and above 5000 while a sizable number of sole fish farms (about 80%) stocked between 1001 and 4000 fingerlings. The higher stock density by integrated farms will undoubtedly afford them to enjoy economies of scale.

Budgetary analysis of poultry enterprise, fishery enterprise and integrated poultry and fishery enterprise: Feed consumes the lion share of the total variable cost in all the three enterprises. In sole poultry enterprise, sole fishery enterprise and integrated farms, feed cost accounts for 78.9, 55.8 and 68.2% of the total variable cost of production respectively. The high feed cost in poultry production is in consonance with the findings of Taiwo (1999), Ojo (2003), Adebayo and Adeola (2005). The cost components further shows that cost of birds ranked second in the cost share in both sole poultry farms enterprise and integrated farms. This is consonance with the finding of Bamiro *et al*. (2006) while labour cost is the second largest share in fishery enterprise. Other operating expenses is the least cost share in both non-integrated poultry farms and non-integrated while the least cost share is the cost of

Table 1: Socio-economic characteristic of farmers and farm characteristics

Farm type/ variables	Poultry only		Poultry and fishery		Fishery only	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Sex						
Male	39	97.5	48	90.6	51	83.6
Female	1	2.5	5	9.4	10	16.4
Age (yrs)						
Below 30	5	12.5	3	5.7	0	0.0
30-<40	12	30.0	22	41.5	9	14.8
40-<50	8	20.0	11	20.8	34	55.7
50-<60	9	22.5	9	17.0	8	13.1
≥60	6	15.0	8	15.1	10	16.4
Educational level						
No formal education	1	2.5	0	0.0	4	6.6
Primary	0	0.0	0	0.0	8	13.1
Secondary	11	27.5	7	13.2	14	23.0
Tertiary	28	70.0	46	86.8	35	57.4
Experience	9	22.5	9	17.0	21	34.4
1-5	8	20.0	25	47.2	28	45.9
6-10	9	22.5	4	7.5	12	19.7
11-15	10	25.0	5	9.4	0	0.0
16-20	4	10.0	10	18.9	0	0.0
Above 20	9	22.5	9	17.0	21	34.4
Mode of participation						
Full-time	20	50.0	25	47.2	45	73.8
Part-time	20	50.0	28	52.8	16	26.2

Source: Field survey, 2009

Table 2: Cost and return structure of poultry enterprise, fishery enterprise and integrated poultry and fishery enterprise

Items	POA	PTVC	PFA	PTVC	FOA	PTVC
Variable cost						
Cost of fingerlings stocked		-	49,769.81	1.2	56,908.20	14.4
Estimated cost of buying birds	951,188.46	16.3	929,973.58	22.1	-	-
Cost of feeds	4,602,258.43	78.9	2,867,779.91	68.2	220,580.33	55.8
Wages of labour	214,251.56	3.7	271,065.89	6.4	102,896.96	26.0
Other operating expenses	66,314.73	1.1	89,068.87	2.1	14,803.11	3.7
Total Variable Cost (TVC)	5,834,013.18	-	4,207,658.07	-	395,188.59	-
Total		100.0		100.0		100.0
Revenue						
Worth of eggs produced	7,395,800.85		5,209,969.81			
Worth of fishes produced			992,481.13		951,704.92	
Total value of products	7,395,800.85		6202405.94		951,704.92	
Gross margin	1,561,787.67		1,994,792.88		556,516.32	

Source: Computed from field survey, 2009. POA = Poultry Only Amount (mean), PTVC = Percentage of Total Variable Cost, PFA = Poultry and Fishery Amount (mean), FOA = Fishery Only Amount (mean)

fingerlings in horizontally integrated farms. The cost and return structure for the three categories of farms are presented in Table 2. The result further shows that the adoption of horizontal integration significantly reduced the feed cost by 14%.

The gross margin analysis indicates that the horizontally integrated farms record gross margin of ₦1,994,792.88 which is greater than that of sole poultry farms while the sole fishery enterprise records a paltry gross margin of ₦555,516.32. This is an indicator that the horizontally integrated farms are more economically viable than the sole poultry farms which are in turn more economically viable than the sole fishery enterprise.

Determinants of value of output in non-integrated and horizontally integrated poultry farms: Ordinary Least Square and Maximum Likelihood Estimation techniques were employed in a bid to examine the determinants of value of output. The flock size, number of fingerlings stocked and the worth of intermediate materials are the explanatory variables that significantly influence the value of output in the OLS result while prices of egg and fish, flock size, stock of fish, number of fingerlings as well as the worth of intermediate materials are the explanatory variables that significantly and positively influence the value of output in maximum likelihood estimation regression. The stochastic cost function estimates are presented in Table 4.

Table 3: Production function and inefficiency model results of horizontally integrated farms

Variable	OLS	MLE
Constant	11.412871	11.850318
	(2.2998470)	(11.102335)
lnPEggs	0.83594913	0.91766097***
	(1.0806969)	(4.7053752)
lnPFish	0.12407948	0.066696163
	(1.0510333)	(0.61582349)
lnbirds	0.66581461***	0.16313387***
	(3.2060313)	(5.9585513)
lnfing	0.032566787***	0.041575238***
	(3.63737)	(5.9938897)
lnfeed	0.73016454	0.87428017***
	(1.3778647)	(14.630075)
Lnlabour	0.13610846	0.12518227*
	(0.21859844)	(1.9625223)
lnmat	0.9670638***	0.063754176**
	(3.1510373)	(2.1332312)
Inefficiency function		
Intercept	0	-0.60916049
		(-1.2776952)
Age	0	-0.011313081*
		(-1.7846489)
Gender	0	0.35398364*
		(1.8976901)
Education	0	-0.50055327
		-(0.42357127)
Experience	0	0.017664414
		(1.4929734)
Part time farming	0	-0.13604707
		(-0.99471068)
Vertical integration	0	0.38387925***
		(3.3326525)
Horizontal integration	0	0.4860942
		(1.5523502)
Sole fish farming	0	1.2504735***
		(3.0256993)
Diagnostic statistics		
Sigma- square	0.10807610	0.18322856***
		(6.8280385)
Gamma		0.25842587**
		(2.5977536)
Ln (likelihood)	-43.090078	31.355925
LR test		23.468306
Average = TE		0.85027610

Source: Computed from field survey 2009. Significant at 1%, **Significant at 5% and *Significant at 10%

There is presence of technical inefficiency effects in poultry and fish production in the study area as confirmed by a test of hypothesis for the presence of inefficiency effect using the generalized likelihood ratio test. The null hypothesis of no inefficiency effects in poultry and fish production (i.e. inefficiency = 0) was strongly rejected. Thus, the OLS model was not an adequate representation of the data; hence the MLE model was the preferred model for further economic and econometric analyses.

The coefficients of egg price, flock size and quantity of feed are significant at 1% probability level while the coefficients of workers and worth of intermediate materials are significant at 10% and 5% probability levels respectively. The result further indicates that a 1% increase in the explanatory variables will result in increase in value of output by the coefficients of each variable. For instance, 1% increase in egg price and flock size respectively will lead to 0.92% and 0.16% increase in the value of outputs.

Determinants of production efficiency: The determinants of efficiency are presented in the lower part of Table 3. Age, gender, vertical integration and sole fish farming are the determinants of efficiency. The sign of the coefficient of the age of the farmers is negative, indicating that age has inefficiency reducing effect. This result is not in consonance with a priori expectation but it agrees with the findings of Bamiro *et al*. (2006). The negativity of the coefficient of gender variable indicates that male farmers are more efficient than their female counterparts in the operation of horizontally integrated poultry and fish farms. Vertical integration as a determinant, contrary to expectation has efficiency reducing effect. But sole fish farming has inefficiency reducing effect and unexpectedly, horizontal integration does not have a significant effect on production efficiency.

The predicted farm specific production efficiencies range between 0.04 and 0.99 with a mean of 0.48. The result of the production efficiency estimates presented in Table 5 shows that the non-integrated poultry enterprise has the highest production efficiency (96.8%) while the fishery enterprise records the lowest economic efficiency (68.%). The production efficiency of horizontally integrated poultry and fishery enterprise is lower than

Table 4: Frequency distribution of economic efficiency of non-integrated and horizontally integrated poultry farmers

Deciles range of PE (LPE)	Poultry only Frequency	Poultry only Percentage	Fishery only Frequency	Fishery only Percentage	Poultry and fishery Frequency	Poultry and fishery Percentage
0.50 or less	0	0	6	9.8	0	0.0
0.51-0.60	0	0	19	31.1	0	0.0
0.61-0.70	0	0	12	19.7	0	0.0
0.71-0.80	0	0	2	3.3	0	0.0
0.81-0.90	0	0	14	23.0	4	7.5
Above 0.90	40	100	8	13.1	49	92.5
Total	40	100	61	100.0	53	100.0

Source: Computed from field survey 2009. Mean: Poultry only = 96.8%, Fishery only = 68.7%, Poultry and fishery = 94.9%, Overall mean = 85%, Minimum Eff = 47%, Maximum Eff= 98%, (LPE) = (Level of Production Efficiency)

Table 5: Production efficiency estimates across socio-economic characteristics

Gender	Mean	Std. error of mean
Male	0.8614	0.01388
Female	0.7519	0.04631
Total	0.8500	0.01355
Age group		
Below 30	0.9638	0.00263
30-<40	0.8967	0.01950
40-<50	0.7726	0.02573
50-<60	0.8604	0.03439
60 and above	0.8879	0.02997
Total	0.8500	0.01355
Education level		
No formal education	0.5960	0.09234
Primary	0.6950	0.07419
Secondary	0.8391	0.03204
Tertiary	0.8762	0.01379
Total	0.8500	0.01355
Farming experience		
1-5	0.8418	0.02672
6-10	0.8315	0.02188
11-15	0.7900	0.04232
16-20	0.9607	0.00581
Above 20	0.9421	0.01060
Total	0.8500	0.01355
Bird population		
None	0.6913	0.02090
Below 1000	0.9569	0.00519
1001-2000	0.9596	0.00329
2001-3000	0.9550	0.00806
3001-4000	0.9550	0.00500
4001-5000	0.9517	0.01006
Above 5000	0.9600	0.00378
Total	0.8500	0.01355
Number of fingerlings stocked		
None	0.9680	0.00165
Below 1000	0.8200	0.05803
1001-2000	0.7476	0.03585
2001-3000	0.7755	0.03961
3001-4000	0.7479	0.04051
4001-5000	0.9004	0.02690
Above 5000	0.9342	0.01357
Total	0.8500	0.01355
Mode of participation		
Full-time	0.7900	0.01997
Part-time	0.9344	0.00935
Total	0.8500	0.01355
Type of feed used		
Solely commercial	0.9261	0.00782
Private and commercial	0.7275	0.02618
Total	0.8500	0.01355

that of sole poultry farms but greater than that of sole fishery enterprise. This signifies that non-integrated poultry enterprise is more economically efficient than the horizontally integrated poultry enterprise which is in turn more efficient than non-integrated fishery enterprise. The overall mean efficiency is 85%, indicating substantial efficiencies in poultry and fish production. This signifies that there exist a 15% potential for poultry and fish farmers in the study area to increase their production vis-a vis their income at the existing level of resources and technology.

The distribution of level of production efficiency in Table 5 further shows that 100% of the non-integrated poultry farms have production efficiency that is greater than 90%. While 93% of the horizontally integrated farms have production efficiency that is greater than 90%. This indicates that several of these farms have production efficiency greater than or equal to their respective mean economic efficiency. On the other hand only 34 percent of the non-integrated fishery enterprise have economic efficiency that is greater or equal the mean efficiency of 62.8%.

Production efficiency estimates and socio-economic characteristics: The economic efficiency analysis was considered across the socio-economic variables with the aim of further strengthening the findings and to authenticate the pattern of effect of these variables on production efficiency. The production efficiency estimates across socio-economic characteristics is presented in Table 5. The result shows that horizontally integrated farms operated by females are more economically efficient than those operated by their male counterparts. With respect to age, production efficiency does not follow a regular pattern, for instance farms operated by young folks that are below 30 years of age are the most efficient while the lowest efficiency was recorded by farmers that fall within 40-<50 age brackets, however, decrease in production efficiency with respect to age is in line with the finding of Aihonsu (1999), which he concludes is in agreement with the law of diminishing returns. In the same vein, the efficiency estimates vis-à-vis the experience of the farmers and the bird population do not follow a regular pattern. Production efficiency estimates contrary to expectation, decrease from 84-77% as the years of experience increases between 1 and 15 years and then soars up to 96% for those whose years experience spans between 16 and 20 years and later declines to 94% for farmers that have acquired more than 20 years experience in livestock farming. Furthermore, economic efficiency fluctuates with respect to flock size and number of fingerlings stocked, however, it declines and sometimes constant with increase in flock size/number of fingerlings but the greatest level of efficiency was achieved by farmers with flock size/number of fingerlings that is greater than 5000 birds or 5000 fingerlings. In consonance with *apriori* expectation, the result in Table 5 shows that production efficiency is directly proportional to the level of education. But contrary to expectation, part-time farmers and non-horizontally integrated poultry farms are more economically efficient than the horizontally integrated farms. The high level of efficiency by part-time farmers might be due to accessibility to funds and more sophisticated technology by the reasons of exposure to new innovations at their places of work because most of the part-time farmers are civil servants and workers in higher institutions.

Conclusion: This study assessed and estimated the level of horizontal integration in poultry industry in South-West Nigeria. Data used for analysis were obtained from 40, 61 and 53 non-integrated poultry farms, non-integrated fishery farms and 53 horizontally integrated poultry farms. Most of the farmers are within the economically active age bracket with high level of educational status. Horizontal integration is profitable with a mean gross margin of **x**1,994,792.88. It is 22% and 72% higher than the gross margin of sole fishery farms and sole poultry farms respectively. The value of output in horizontally integrated farms is significantly influenced by the price of egg, flock size and stock density in fish farms as well as mandays of labour. With respect to productive efficiency, the farmers' age has inefficiency reducing effect while vertical integration and sole fish farming have efficiency reducing effect.

On the basis of the findings the following recommendations are suggested:

- As output and profit increase with size of farm and number of products, more farmers should be encouraged to go into integrated farming in order to harness the problem of food insecurity and increase profitability of farmers.
- Government and other agricultural agencies or organizations should ensure that feed cost which accounts for a higher percentage of production cost is considerably reduced in other to reduce total production cost thereby encouraging expansion. Farmers on individual and group basis should endeavour to vertically integrate backward by producing their own feeds.

REFERENCES

Adebayo, O.O. and R.G. Adeola, 2005. Socio-economic factors affecting poultry farmers in Ejigbo Local Govt. Area of Osun State. J. Human Ecol., 18: 39-41.

Aihonsu, J.O.Y., 1999. Optimal laying period for profitable and sustainable egg production. Ife J. Agric., 20: 67-80.

Ajibefun, I.A. and A. Abdulkadri, 1999. An investigation of technical inefficiency of production of farmers under the national directorate of employment in Ondo State, Nigeria. Applied Eco. Letters, 6: 111-114.

Akridge, J.T. and T.W. Hertel, 1986. Multiproduct cost relationships for retail fertilizer plants. Am. J. Agri. Eco., 68: 928-38.

Bamiro, O.M., O.A. Dayo Phillip and S. Momoh, 2006. Vertical integration and technical efficiency in poultry (Egg) industry in Ogun and Oyo States, Nigeria. Int. J. Poult. Sci., 5: 1164-1171.

Battesse, G.E. and T.J. Coelli, 1995. A model for technical inefficiency effects in a stochastic frontier production function for panel data, Empirical Economics, 20: 325-332.

Binswanger, 1974. The measurement of technical change biases with many factors on production. Am. Eco. Rev., 64: 964-976.

Dalton, T.J., W.A. Masters and K.A. Foster, 1997. Production costs and input substitution in Zimbabwe's smallholder agriculture. Agri. Eco., 17: 201-209.

FAO, 2000. The State of World Fisheries and Aquaculture.

Federal Ministry of Agriculture Water Resources and Rural Development (FMAWRRD), 1988. Agricultural Policy for Nigeria, FMARWD publication.

Federal Office of Statistics (FOS), 1996. Poverty in Nigeria. FOS 1996; Abuja, Nigeria.

Ojo, S.O., 2003. productivity and technical efficiency of poultry egg production in Nigeria. Int. J. Poult. Sci., 2: 459-464.

Ojo, S.O. and I.A. Ajibefun, 2000. Effects of Training on labour productivity in Ondo State, Nigeria. J. Sustainable Agri. Environ., 2: 275-279.

Ramsay, G.C. and L. Andrews, 1999. The Role of Livestock in Food Security in the Region. RAP Publication. Bangkok: FAO Regional Office for Asia and the Pacific (in press).

Taiwo, S.A., 1999. Seasonal egg glut: Implications for the poultry industry in southern Nigeria. Proceeding of Nigeria society for Animal production. 26th Annual. Conf., pp: 420-423.