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Technical Efficiency in Pig Production in Ogun State, Nigeria

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Abstract: This study examines the technical efficiency in pig production among swine farmers in Ogun State, Nigeria. The study was based on primary data obtained in a cross section survey that involved 100 randomly selected pig farmers in Egba and Yew divisions of Ogun State. The data was analysed by both descriptive and Stochastic Production Frontier techniques. It was found out that technical efficiency are influenced by number of sow and feed intake. Both factors have inefficiency reducing effect. Farmers should therefore adopt cost-reducing strategy known as vertical integration; and increase their number of sow and supply the pigs with quality feed so as to foster increased efficiency in swine production.

Key words: Technical efficiency, pig production, farmers, Nigeria

INTRODUCTION

The problem of protein and calories malnutrition had been highlighted as a major factor to the health hazard in developing countries. Despite the considerable efforts made in the past to increase the productivity and output of livestock industry in order to provide a higher per capita consumption of animal protein, the consumption of animal protein is till very low in Nigeria (Onyenweaku and Effiong, 2005). An average Nigerian consume less than 10 g of animal protein per day compared to the 50, 70 and 80 g, consumed per man per day in Europe, America and oceanic countries, respectively (FAO, 1984). Federal Ministry of Agriculture and Rural development (FMARD, 2004), estimated animal protein intake in Nigeria in 2000 at 18 gms/caput/day, which is below the recommended minimum level of 35 gms/caput/day. The main sources of animal protein in Nigeria are fish, poultry, goats, sheep, cattle and pig. Increased pig production in the southern part of the country where majority are Christians and are therefore not forbidden from eating pork can bridge the gap between the current level of animal protein consumption and the recommended minimum level of animal protein required for healthy living. This assertion is attributed to the short gestation period and high level of fecundity and prolificacy of pig coupled with potential for high income generation and high profits.

This study aims at analyzing the technical efficiency and its determinants in pig production in Ogun State, Nigeria.

MATERIALS AND METHODS

The study was conducted in Egba and Yewa divisions of Ogun State. Stratified random sampling technique was employed in the collection of the Primary data utilized in this study. Ogun State consists of 4 divisions namely Egba, Yewa, Ijebus and Remo which form the strata. One hundred pig farms were randomly selected from the 2 strata.

Budgetary analysis was used to examine the profitability of pig farming in the study area.

$$\pi = TR - TC \quad (1)$$

$$TC = TVC + TFC \quad (2)$$

$$GM = TR - TVC \quad (3)$$

$$NI = GM - TFC \quad (4)$$

Where,

Π = Profit.
TR = Total Revenue.
TC = Total Cost.
TVC = Total Variable Cost.
TFC = Total Fixed Cost.
GM = Gross Margin.
NI = Net Income.

Profitability indicators were computed to authenticate the profitability and viability of swine enterprise.

$$\text{Profitability index or return on sale} = \frac{NI}{TR} \quad (5)$$

$$\text{The rate of return on investment (\%)} = \frac{NI}{TC} * 100 \quad (6)$$

$$\text{Rate of return on variable cost (\%)} = \frac{TR - TFC}{TVC} * 100 \quad (7)$$

$$\text{Operating ratio} = \frac{TVC}{TR} \quad (8)$$

Model specification: The stochastic frontier production function was used to analyze technical efficiency and its determinants in pig production, in the study area.

According to Tadesse and Krishnamoorthy (1997) and Ojo (2003), the production technology of the farmers was assumed to be specified by the Cobb-Douglas frontier production function which is defined by:

$$LnYi = Ln\beta_0 + \beta_1 LnX_{1i} + \beta_2 LnX_{2i} + \beta_3 LnX_{3i} + \beta_4 LnX_{4i} + \beta_5 LnX_{5i} + \beta_6 LnX_{6i+} V_i - U_i \quad (9)$$

Where,

Y = Value of Output (₦).
X_1 = Number of sows.
X_2 = Feed intake (kg).
X_3 = Cost of Hired labour (₦).
X_4 = Estimated Household labour cost (₦).
X_5 = Cost of veterinary services (₦).
X_6 = Cost of other intermediate materials (₦).
V_i = Random errors.
U_i = Technical inefficiency effects.

The technical inefficiency effects, U_i is defined by:

$$U_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5I} + \delta_6 Z_{6i} + \delta_7 Z_{7i} + \delta_8 Z_{8i} + \delta_9 Z_{9i} + \delta_{10} Z_{10i} \quad (10)$$

Where,

Z_1 = Farmers age in years.
Z_2 = Farmers gender.
Z_3 = Years of schooling.
Z_4 = Farming experience of farmers (years).
Z_5 = Other occupation of the farmers.
Z_6 = Religion.
Z_7 = Herd size.
Z_8 = Age of sow.
Z_9 = Credit access.
Z_{10} = Farm location.

These were included in the model to indicate their possible influence on the technical efficiencies of the farmers. The βs and δs are scalar parameters that were estimated. The variances of the random errors, δ_v^2 and that of the technical inefficiency effects δ_u^2 and the overall variance of the model σ^2 are related thus: $\sigma^2 = \delta_v^2 + \delta_u^2$ and the ratio $\gamma = \delta_u^2/\sigma_v^2$, measures the frontier which can be attributed to technical inefficiency (Battese and Corra, 1977). The estimates for all the parameters of the stochastic frontier production function and the inefficiency model were simultaneously obtained, using the program frontier version 4.1 (Coelli, 1994).

Two different models, Ordinary Least Square (OLS) and the Maximum Likelihood Estimate (MLE) were estimated. The OLS is a special case of the stochastic frontier production function in which there is restriction and the total variation of output from the frontier output due to technical inefficiency is zero, that is, $\gamma = 0$. The MLE on the other hand, is the general model where there is no restriction, hence $\gamma \neq 0$.

The 2 models were compared for the presence of technical inefficiency effects, using the generalized likelihood ratio test.

RESULTS AND DISCUSSION

The socio-economic characteristics of pig farmers in the study area are presented in Table 1. Most of the sampled pig farmers (79%) are middle aged (30-59 years old), suggesting that the farmers are young and agile with vigour and agility required by pig farming. The result shows that pig farming in the study area is gender biased, as male constitutes 79% of the surveyed respondents which might not be unconnected with the rigour associated with piggery. Majority of the pig farm operators are part-time farmers, combining piggery with other enterprises as well as paid jobs. Large household size and low level of education characterize the pig farmers in the study area.

Cost-return structure for pig production: An average farm in the study area had herd size of about 47 and 5 sows. There are 2 major sources of revenue, the sales of live pig and pork. The cost-return structure is presented in Table 2. Underestimation of accrued revenue was avoided by adding the value of the retained stock of pig. Revenue from the sale of live animal is higher than that which accrued via slaughtered animals. The cost analysis shows that feed cost constitutes the lion share (62%) of the variable cost and 58% of the total cost. The high percentage share of feed is in consonance with the findings of Adesehinwa *et al.* (2000), however, the percentage (58%) is relatively lower than theirs which was estimated as 60-65%. This reduction in the share of

Table 1: Socio-economic charateristics of pig farmers

Characteristics	Frequency	Percentage
Age (Years)		
Below 30	4	4
30-39	14	14
40-49	45	45
50-59	20	20
60abd above	17	17
Sex		
Male	79	79
Female	21	21
Marital status		
Single	7	7
Married	90	90
Widowed	2	2
Divorced	1	1
Household size		
3-Jan.	10	10
6-Apr.	43	43
9-Jul.	38	38
10 or more	9	9
Educational status		
No formal education	4	4
Primary	28	28
Secondary	20	20
Tertiary	48	48
Main occupation		
Farming	45	45
Trading	14	14
Civil service	19	19
Others	22	22

Computed from field survey (2006)

feed cost could have resulted from utilization of non-conventional feedstuff to complement the use of concentrates which was the recommendation of Ikani *et al.* (2001).

The gross margin and net income per farm per year are ₦247, 611.90 and ₦233, 166.79, respectively. The real profit in pig enterprise was obtained by deducting the estimated household labour cost from the net farm income. This is necessary so as to avoid overestimation of the profit realized. Therefore, the real profit per farm in a year was estimated as ₦203, 678.14. This is a relatively high profit level, as it indicates a monthly profit of about ₦17, 000.00 which is far and above the current minimum wage in Nigeria.

The profitability index, the rate of return on investment, the rate of return on variable cost and the operating ratio of the swine enterprise are also presented in Table 2. The profitability index is 0.52 which implies that for every naira sales, 52 kobo was earned while the rate of return on investment and rate of return on variable cost are 108.74 and 216.59% signifying that about ₦1.09 and ₦2.17 accrued to the farmer from every naira invested in swine enterprise and on every naira on variable cost respectively. The operating ratio indicates that the total variable cost is about 45% of the total revenue. In summary, all the profitability indicators show that swine enterprise is profitable in the study area.

Table 2: Cost and return structure for pig production

Characteristics	Mean	Percentage share (%)
Herd size	46.85	
	(3.00)	
Number of sow	4.64	
	(0.30)	
Revenue	**Average (N)**	
Revenue from sale	305704.10	
of live animals	(30137.55)	68.30
Revenue from sale of	29454.00	
slaughtered animals	(10043.62)	6.58
Worth of stock increased	112440.00	
(retained stock)	(7199.14)	25.12
Total Revenue	447598.10	
	(35957.98)	
Variable Cost		
Cost of feed	123996.20	
	(13355.51)	62.00
Cost of veterinary services	12984.00	
	(956.61)	6.49
Wages of Hired labour	40690.00	
	(5396.46)	20.35
Transport cost	6994.00	
	(1035.84)	3.50
Electricity cost	348.00	
	(155.66)	0.17
Repairs and Maintenance	7338.00	
cost	(988.68)	3.67
Cost of water	6456.40	
	(1291.13)	3.23
Cost of other intermediate	1179.60	
materials	(453.98)	0.59
Total variable cost	199986.20	
	(17064.21)	
Fixed Cost		
Depreciation	11929.11	
	(2146.92)	82.58
Rent	531.00	
	(325.92)	3.68
Interest on loan	1985.00	
	(885.76)	13.74
Total Fixed cost	14445.11	
	(2470.66)	
Total Cost	214431.31	
	(17757.16)	
Gross Margin/Farm	247611.90	
	(23938.11)	
Gross Margin/PIG	5268.34	
Net Income/Farm	233166.79	
	(23283.51)	
Net Income/PIG	4961.00	
Estimated Household	29488.65	
Labor Cost	(3447.51)	
Profit/FARM	203678.14	
	(24019.50)	
Profit/PIG	4333.58	
Profitability Analysis	**Value**	
Profitability Index	0.52	
Rate of Return on Investment (%)	108.74	
Rate of Return on variable cost (%)	216.59	
Operating ratio	0.447	

Source: Computed from survey Data 2006 (figures in parentheses are standard error)

Technical efficiency analysis: The predicted farm specific technical efficiencies ranged between 0.20 and 0.92, with a mean of 0.43. This suggests that, in the short run, there

is a scope for increasing pig production by about 57% by adopting the technology and techniques used by the best practiced pig farms and this will increase their income at the existing level of resources and technology. The decile range of the frequency distribution of the technical efficiency is presented in Table 3. It shows that about 55% of the farmers had technical efficiency below 0.40 and about 45% had technical efficiency ranging between 0.40-0.92.

Determinants of technical efficiency: The ordinary least square (OLS) and the maximum likelihood estimates (MLE) of the stochastic frontier production function for pig production in the study area are presented in Table 3. There was presence of technical inefficiency effects in pig production in the study as confirmed by a test of hypothesis for the presence of inefficiency effects, using the generalized likelihood ratio test. The chi square computed is 18.406 while the critical value of the chi square at 95% confidence level and 10 degrees of freedom, χ^2 (0.95,10) is 18.31. The null hypothesis of no inefficiency effect in pig production, $\gamma = 0$ was strongly rejected. Thus OLS model was not an adequate representation of the data. Hence, MLE model was the preferred model for further econometric and economic analysis.

The generalized likelihood ratio (LR) test reported in Table 4 is highly significant. This suggests that there is presence of one sided error component. It means the effect of technical inefficiency is significant and a classical regression model of production function is an inadequate representation of the data.

In both OLS and MLE, only number of sow and feed intake are significant at different probability levels. In the OLS, the two are significant at 1% probability level while they are significant at 10% probability level in the MLE. In the MLE, the number of sow and feed intake have positive and significant effect on the value of output. A 1% increase in the number of sows will increase the value of output by 26% while the same percentage increase in feed intake will increase the value of output by 16%. All other variables have insignificant effect on the value of output. The variance ratio defined as gamma (γ) was estimated as 80.3% suggesting that systematic influences that are unexplained by the production function are the dominant source of random errors and about 80.3% of the variation in pig output among the farmers was due to differences in their technical efficiencies.

The result in Table 4 shows that the signs and significance of the estimated coefficients in the inefficiency model have important implications on the technical efficiency of the farmers. The coefficients of

Table 3: Decile range of frequency distribution of technical efficiency of pig farmers

Decile range	Frequency	Percentage
0.20-0.29	15	15.15
0.30-0.39	39	39.39
0.40-0.49	20	20.20
0.50-0.59	10	10.10
0.60-0.69	5	5.05
0.70-0.79	4	4.04
0.80-0.89	5	5.05
0.90-0.99	1	1.01

Source: Computed From Field Survey 2006. Mean = 0.43, Minimum = 0.20, Maximum = 0.92

Table 4: Estimates of stochastic production frontier by Ordinary Least Square (OLS) and Maximum Likelihood Estimates (MLE) and inefficiency function

Explanatory variables	Parameter	OLS	MLE
General model			
Constant	B_0	4.032	6.247
		(5.360)	(7.167)
Number of sows	B_1	0.508*	0.259***
		(5.189)	(1.884)
Feed intake	B_2	0.272*	0.162***
		(3.529)	(1.935)
Cost of Hired labour	B_3	0.050	0.055
		(1.274)	(1.548)
Household labour cost	B_4	0.031	0.023
		(1.117)	(0.905)
Cost of veterinary services	B_5	0.091	0.081
		(1.455)	(1.221)
Cost of other materials	B_6	0.001	0.013
		(0.048)	(0.982)
Inefficiency model			
Constant	δ_0	0	1.571
			(3.532)
Farmers Age	δ_1	0	0.003
			(-0.012)
Farmers Gender	δ_2	0	0.032
			(0.397)
Years of schooling	δ_3	0	0.0001
			(-0.017)
Farming experience	δ_4	0	-0.026**
			(-2.192)
Other occupation	δ_5	0	-0.058
			(-0.832)
Religion	δ_6	0	-0.012
			(0.122)
Herd size	δ_7	0	0.008**
			(-2.325)
Age of sow	δ_8	0	0.0001
			(0.281)
Access to loan	δ_9	0	0.000001
			(-1.160)
Farm location	δ_{10}	0	0.099
			(1.393)
Diagnosis statistics			
Sigma square ($\sigma^2 = \delta_u^2 + \delta_v^2$)	σ^2	0.100	0.081
			(6.184)
Gamma ($\gamma = \delta_u^2 / \delta_u^2 + \delta_v^2$)	Γ		0.803
			(2.094)
Log likelihood function	Llf	-23.078	-13.875
Likelihood Ratio	LR		18.406

Source: Computed from field survey 2006 (Figs. in parentheses are t values)
*Significant at 1% level, **Significant at 5% level, ***Significant at 10% level

farming experience and herd size significantly and negatively influence technical inefficiency at 5% probability level. This implies that farming experience and herd size have inefficiency reducing effect. This finding is in consonance with the a-priori expectation and the findings of Bamiro *et al.* (2007).

CONCLUSION

Pig farmers in the study area are middle aged with low level of education and large household size. Pig production is a profitable venture; however, the profitability of the enterprise is limited by high cost of production in which the feed cost constitutes the lion share. Technical efficiency are influenced by number of sow and feed intake. Both factors have inefficiency reducing effect. Farmers should therefore adopt cost-reducing strategy known as vertical integration and increase their number of sow and supply the pigs with quality feed so as to foster increased efficiency in swine production.

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