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COMPARATIVE ANALYSIS OF PRODUCTION EFFICIENCY OF GOVERNMENT-ASSISTED AND UNASSISTED PIG FARMERS IN LAGOS STATE

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ABSTRACT

This study comparatively examined the efficiency of pig production among government-assisted and non-assisted farmers in Lagos State, Southwest, Nigeria. The study was based on primary data obtained in a cross-section survey of 120 pig farmers, 60 each drawn purposively from among the government-assisted (GAPF) and unassisted pig farmers (UAPF) in the state. The data were analysed by descriptive, budgetary and econometric (Stochastic Production Frontier) methods. The study revealed that, most of the pig farmers (67.7% of GAPF and 95.0% of UAPF) are men. Majority of the pig farmers (65.0% of GAPF and 55.0% of UAPF) are within 30 - 50 years age bracket; with as much as 83.3% of GAPF and 60.0% of UAPF, having no more than six years of experience in pig farming. However, most (95.0% of GAPF and 75.0% of UAPF) of the pig farmers had some tertiary education. Budgetary analysis revealed that an average GAPF incurred a total cost of N987,682 in producing N1,360,050 worth of pigs with a net farm income of N372,368 yielding 33.67% rate of returns on their investment during the 2008/2009 production season. His UAPF counterpart incurred a total cost of N727,860 in producing N938,000 worth of pigs with a net farm income of N210,140 yielding 31.73% rate of returns on during the same production season. The technical, allocative and overall economic efficiency estimates computed based on estimated Stochastic Production and Conditional Revenue Frontier models of the two categories of pig farmers revealed that GAPF are generally more efficient (with mean technical, allocative and overall economic efficiency index of 0.66, 0.68 and 0.48, respectively) than their UAPF counterparts (with mean technical, allocative and overall economic efficiency index of 0.53, 0.60 and 0.35, respectively). The differences in the production efficiency of the two categories of farms were found to be as a result of the institutional and infrastructural support received by GAPF which is not available to the UAPF.

Keywords: Production efficiency, pig production, Government-assisted farmers, Un-assisted farmers, Lagos State, Nigeria

INTRODUCTION

Food is a basic necessity of life, the importance of which is seen in its basic roles as a means of sustenance for healthy and productive livelihood. Foods of animal origins are excellent sources of high quality nutrients, especially proteins, minerals and vitamins. In Nigeria, domestic livestock production falls short of demand with a large chunk

of the nation's foreign exchange spent annually on importation of livestock and livestock products among other food commodities. In most cases, however, the combine supply through domestic production and importation are still not enough to meet domestic demand, leaving the citizens with a rather low level of animal protein consumption, while evidence in UNDP (2007) shows problems associated with nutritional imbalance and malnutrition have become very rampant among the populace.

Over the years, Nigerian Governments have been coming up with different policies and programmes targeted at reducing the supply -demand gap in livestock production. So far, three major phases of Livestock development policy have emerged in Nigeria since the nation's Independence in 1960. In the first phase spanning between 1960 and 1969, the Federal Government's focus on Livestock Development was centred mainly on research. During the second phase spanning the period between 1970 and 1985, the Federal Government became increasingly and directly involved in Livestock production and promotional activities. The third phase, which began with the Structural Adjustment Programme (SAP) period from 1986, focused on Government's withdrawal from direct Livestock production to promotional activities like, policy formulation, research, training and manpower development. In addition to these, some special programmes and strategies were drawn up to focus on the fiscal and monetary measures for livestock production (Bincan, 1990). One of such was ecological specialization to enhance production under proven comparative advantage of production and marketing of different Livestock species. The second strategy was sedenterization, with emphasis on permanent land allocation to nomadic Pastoralists. The third strategy emphasized livestock feeds production through various support programmes like storage, improved conservation and exploitation of alternative feed ingredients while the fourth Programme focused on input supply assistance to private Entrepreneurs.

In spite of the above policies and programmes, livestock production in Nigeria still falls critically short of requirements. Available statistics shows that animal protein consumption among Nigerian (estimated to be 7.41g/person/day in 2005; FAOSTAT, 2009) is barely about 15% of the total protein requirement (Dafwang, 1995; Onyenweaku and Effiong, 2005). As a result, as much as 9% of the populace were reported to be undernourished while 29 percent of children under the age of five years were reported to be underweight in 2005 (UNDP, 2007). The fact that the nation's population growth rate has been at an average 2.37 percent per annum in recent times (FAOSTAT, 2009), while outputs in the livestock subsector at an average of 2 percent per annum, points to the fact the situation may become worse in the future unless there is drastic re-orientation aimed at increasing output in the livestock sector.

It is a recognition of the above facts, and the assumption that for farmers to become efficient in their input use and increase their productive capacities, they need to be supplied the required inputs to enhance their efficiencies, that the Lagos State Government established the pig estate in Lagos through which institutional and infrastructural supports are given to the participating pig farmers. This study seeks to assess the effects of this intervention, by comparing the costs, returns, profitability and production efficiency (technical, allocative and economic

efficiencies) of the Government-assisted and unassisted pig farmers in the state.

METHODOLOGY

The Study Area

The empirical setting for this study is Lagos State of Nigeria. Lagos State lies between latitudes 6°22'N and 6°42'N and longitudes 2°42'E to 4°20'E. It is bounded in the North by Ogun State and in the East by Ondo State, sharing an international boundary of about 45km with the Republic of Benin, while the vast, deep blue Atlantic Ocean, about 180 kilometre-long southern limit. Although the total land area is just about 3,577 sq. km, Creeks, Lagoons and Estuaries constitute nearly 500 sq. km (22% of the total land area). According to the NPC (2006), the State has a population of over nine (9) million inhabitants (9,685,781). Presently, Lagos State is the most urbanized state in the country with about 81 percent of the people living in the urban areas.

The climate of the area follows the tropical pattern with bi-modal rainfall peaks in July and September and the season running from March to November of every year. The vegetation and the soil types support the cultivation of Cassava, Yam, Maize, and legume crops apart from the different Livestock enterprises and fisheries. While Lagos is reputed as the commercial nerve centre of Nigeria, farming remains the dominant occupation of the majority of the people in rural Lagos.

The Gberigbe pigs Estate, Ikorodu in Lagos State was established in the year 2000 for the purpose of sustaining food and livestock production in the State. The Estate covers a total land area of 40 hectares, which was allocated to two hundred (200) pig farmers, with each of the allottees allocated three plots of land at N40, 000.

Data Collection and Sampling technique

The study was based on primary data obtained by questionnaire administration in a cross-section survey of government assisted and unassisted pig farmers in Lagos State. The survey respondents were selected by stratified random sampling technique, with the registered pig farmers in the state divided into two strata – Government Assisted Pig Farmers (GAPF) and the Un-assisted Pig Farmers (UAPF). The GAPF operate within the Gberigbe Pig Estate in Ikorodu, while the UNPF are scattered around the state. An independent simple random sample of 60 pig farmers were drawn from each of the two groups, giving a total of 120 pig farmers included in the study. Data collected from the respondents include their socio-economic characteristics as well as the farms' resource use, cost, outputs and returns during the 2008/2009 production season. Other data relates to the investment structure and constraints faced in pigs production, among others.

Data Analysis

The study data were analysed by a combination of descriptive, inferential and econometric techniques. Descriptive techniques including frequency tables and percentages were used to analyse the socio-economic characteristics of respondents, such as age, gender, years of experience in pig farming, educational levels, etc. Budgetary techniques were employed to analyse the costs, returns and profitability of operations of the two categories of pig farms. Stochastic production and conditional revenue frontiers were also specified and estimated with the associated technical, allocative and overall economic efficiency following similar methodologies used by Chavas *et al.* (2005). Specific details of the analytical techniques are as

follows:

Gross Margin and Budgetary Analysis

Various indices of costs, returns and profitability of operation of the GAPF and UAPF were computed as follows:

TC= TVC+ TFC …… (1)

GM= TR-TVC …… …. …….. (2)

NI = GM- TFC ……. ……..…….. (3)

where:

TC = Total Cost (N)

TVC = Total Variable Cost (N)

TFC = Total Fixed Cost (N)

GM = Gross Margin (N)

NI = Net Income (N)

Profitability Indices

Profitability index = $\frac{\text{Net Income (NI)}}{\text{Total Revenue (TR)}}$ ……...(4)

The rate of Return on investment (%) = $\frac{\text{Net Income (NI)}}{\text{Total Cost (TC)}} \times 100$ ……...(5)

Rate of return on variable cost (%) = $\frac{\text{Total Revenue (TR) - Total Fixed Cost}}{\text{Total Variable Cost (TVC)}} \times 100$ …… (6)

Operating Ratio = $\frac{\text{Total Variable Cost (TVC)}}{\text{Total Revenue (TR)}}$ …….. (7)

Stochastic Production Frontier and Production Efficiency Estimates

The stochastic Production Frontier approach was used to estimate the Technical, Allocative and Economic Efficiencies of the two categories of farmers in pigs production in the study area. The farms' technology is represented by a Stochastic Production Frontier defined as:

$Y = f(X; \beta) + VU$ …….. (8)

Where Y is the output (kg of life pigs produced), X is the vector of input quantities including number of breeding stock, number of family labour, number of hired labour employed, quantity of feeds supplied (metric tons), and cost of other intermediate inputs – water, veterinary services, transportation etc. (N). β is a vector of parameters to be estimated, and (V-U) is the composite error term. V is assumed to be independently and identically distributed $N(\mathbf{0}, \sigma^2_v)$ random errors, while U is assumed to be a non-

negative random variable associated with technical inefficiency in production and is also assumed to be independently and normally distributed half-normal with mean, μ and variance, σ^2_u ($\mu \sim N(\mu, \sigma_u^2)$).

The Technical Efficiency estimation is given by the mean of the conditional distribution of inefficiency term Ui given ε_i; and defined by:

$$E(U_i|\varepsilon_i) = \frac{\sigma_u \sigma_v}{\sigma}\left[\frac{f(\varepsilon_i \lambda/\sigma)}{1-f(\varepsilon_i \lambda/\sigma)} - \frac{\varepsilon_i \lambda}{\sigma}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

where, $\lambda = \sigma_u/\sigma_v$, $\sigma^2 = \sigma^2_u + \sigma^2_v$, while f and F represents the standard normal density and cumulative distribution function respectively evaluated at $\varepsilon_i \lambda/\sigma$. The farm specific Technical Efficiency (TE) is defined in terms of observed output (Y_i) to the corresponding frontier output (Y_i*) as:

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{E(Y_i \mid u_i, X_i)}{E(Y_i \mid u_i = 0, X_i)} = E\left[\exp(-Ui/\varepsilon)\right] = \exp(-U) \quad \ldots\ldots\ldots\ldots\ldots \quad (10)$$

The TE takes values within the interval zero and one (i.e., between 0 and 1), where, 1 indicates a fully efficient farm.

As pointed out by Chavas et al. (2005) if the output Y in the Stochastic Production Frontier in equation 8 is defined in monetary value or worth of the output rather than physical quantities, and Price of the output P is included in the vector of explanatory variables, X, we have a conditional revenue frontier, while the associated efficiency measure as defined in equation 10 becomes an index of overall economic efficiency. Thus, in this study, a stochastic production frontier as well as a conditional revenue frontier were specified and estimated, together with the associated technical and overall economic efficiency (TE and EE respectively) indices for each farmer using the Frontier 4.1 econometric software. The corresponding allocative efficiency indices were then computed as follows:

$$AE_i = \frac{EE}{TE} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (11)$$

Test of Differences of two Means

To verify if significant differences exists in the TE, AE and EE of the GAPF and the UAPF, student's t-test of differences between two means were conducted. The calculated t-values were obtained as follows:

$$t_{cal} = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

where:

$\overline{X_1}$ = mean efficiency for assisted pig farmers

$\overline{X_2}$ = mean efficiency for non-assisted pig farmers

S_1^2 = sample variance for the assisted pig farmers

S_2^2 = sample variance for the non-assisted pig farmers

n_1 = number of assisted pig farmers

n_2 = number of non-assisted pig farmers

The null hypothesis of no difference between the two means is rejected where $t_{cal} > t_{1-\alpha, n1+n2-2}$ otherwise we fail to reject the null hypothesis.

Determinants of Production Efficiency

To identify factors influencing production efficiency in pig production the following production efficiency model was specified and estimated by the Tobit regression procedure:

$PE_{ij} = f(Z_{1i}, Z_{2i}, ..., Z_{ki})$

where:

PE_{ij} is the index of the j^{th} type of the production efficiency (j=Technical, Allocative and Economic Efficiency) of the i^{th} pig farm

Z_1 is a dummy variable that takes on the value of 1 for GAPF and 0 for UAPF

Z_2 is the Farm Size (number of breeding stock)

Z_3 is the Age of farmers (years)

Z_4 is the gender of the farmer, 0 if Male and 1 if Female

Z_5 is the farmer's education level (years of formal schooling)

Z_6 is farmer's experience in pig farming (years)

Z_7 is the volume of credit accessed (N)

Z_8 is the frequency of extension contact (number of times/year)

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

The socio-economic characteristics of the sampled government assisted and unassisted pig farmers in Lagos state are presented in Table 1. As shown in the table, majority of both categories of farmers (58.3% of the GAPF and 65% of the UAPF) are within the age of 40 and 60 years, with age 40-50 being the modal age groups in both cases. The pig farmers (67.7% of the GAPF and 95.0% of the UAPF) are predominantly the male folks, with female-folks being more represented in the government assisted group (33.3%) than they are among the general population of unassisted pig farmers in the state.

Both categories of the pig farmers are predominantly Christians (96.7 of the GAPF and 80% of the UAPF), majority of which (83.3 of the GAPF and 60% of the UAPF) embarked on pig farming within the last six years. Majority of both categories of pig farmers (83.3% of the GAPF and 65% of the UAPF) had some form of tertiary education, with as much as 33.3% of the GAPF and 25.0% of UAPF having been educated up to Bachelor Degree (B.Sc.) level. About half of the pig farmers (48.3% of the GAPF and 50.0% of the UAPF) are into pig farming as a coping strategy for retirement.

Table 1: Socio-economic Characteristics of Pig Farmers in Lagos State

Socioeconomic Variables	Government –assisted Farmers		Government –assisted Farmers	
	Frequency	%	Frequency	%
Age (Years)				
30-40	18	30.0	12	20.0
41-50	21	35.0	21	35.0
51-60	14	23.3	18	30.0
Above 60	7	11.7	9	15.0
Total	60	100	60	100
Gender				
Female	20	33.3	3	5.0
Male	40	67.7	57	95.0
Total	60	100	60	100
Household Size (No.)				
1-3	12	20.0	9	15.0
4-6	42	70.0	21	35.0
7-9	6	10.0	24	40.0
10-12	-	-	3	5.0
≥ 13	-	-	3	5.0
Total	60	100.0	60	100.0
Education				
SSCE Certificate	3	5.0	15	25.0
Diploma Degree	19	31.7	12	20.0
NCE Degree	4	6.7	6	10.0
Higher Diploma Degree	7	11.7	6	10.0
B.Sc. Degree	20	33.3	15	25.0
Others	7	11.7	6	10.0
Total	60	100.0	60	100.0
Experience in Pigs Production (Years)	29	48.3	15	25.0
1-3	21	35.0	21	35.0
4-6	-	-	6	10.0
7-9	5	8.3	12	10.0
10-12	5	8.3	6	10.0
≥ 13	60	100.0	60	100.0
Total				
Religion				
Christianity	58	96.7	48	80.0
Islam	-	0.0	-	0.0
Others	2	3.3	9	20.0
Total	60	100.0	60	100.0
Motivation for Pigs production				
Major occupation	22	36.7	21	35.0
Unemployment	9	15.0	9	15.0
Retirement	29	48.3	30	50.0
Total	60	100.0	60	100.0

Source: Field Survey (2009).

In summary, the results on Table 1 suggests the government assisted project as at the time it was initiated 10 years ago (i.e., in 2000) tends to accommodate more women (33.3%), youths (65%) and university graduates (33.3%) as well as the unemployed. The women, youths and university graduates among the unassisted farmers were 5, 55 and 25% respectively.

Costs, Returns and Profitability of Pigs Production

Table 2 presents the results of budgetary analysis aimed at evaluating the costs and returns to pig production among the government assisted and unassisted pig farmers in Lagos state, while Table 3 summarises the associated profitability indicators. The government assisted pig farmers (GAPF) had an average of 90 pigs on their farm as at the time of the survey visit while an average unassisted pig farmer had 60 pigs. As shown in Table 2, the gross output of an average pig GAPF, including sales revenue, value of goods at home and estimated value of the change in their stock during the 2008/2009 production season was valued at an average ₦1,360,050.00, while that of the average UAPF was ₦930,000.00. These were produced at a total cost of ₦987, 682.00 and ₦727,860 respectively, yielding a net farm income of ₦372,368.00 per annum for an average GAPF and ₦210,140.00. As shown in Table 2, the bulk of pigs produced by the two categories of farmers were sold as life pigs with the UAPF disposing a larger chunk (80.6%) of their products in this form than the GAPF (66.5%). In terms of the cost structure, results on Table 2 shows that feed cost constituted 42.5% of the total variable cost (TVC) of the GAPF and 46.4% of TVC of the UAPF. This evidence is in line with the findings of Adesehinwa *et al*. (2000), in which the cost of feeds in animal production was estimated at 40-65%.

Evidence from profitability analysis as shown on Table 3 suggests that the GAPF performed slightly better, on the average, than the UAPF, with the rate of return on investment (ROI) of the GAPF estimated to be 33.67% as against 31.72% for an average UAPF. The profitability index was found to be 0.345 for an average GAPF and 0.324 for an average UAPF. This implies that for every Naira of pig sales, an average GAPF earned N0.35 as profit while his counterpart in the UAPF cohort earned N0.32 as profit.

Production Frontiers of Pig Farm in Lagos State

Table 4 presents the results of the Stochastic Production Frontier (SPF) estimated for the two categories of pig farms in the study area, while Table 5 presents estimates of the conditional revenue frontiers. The SPF serves as the basis for technical efficiency index estimation while the conditional revenue frontier is the basis for estimation of the overall economic efficiency index estimation. As shown on both tables, estimates of the variance parameter (γ) for both the GAPF and UAPF in the two sets of frontier models were significantly different from zero at $p<0.01$. The likelihood ratio test of the null hypothesis that the one-sided error term (U) is zero is also rejected at $p<0.01$. Therefore, the appropriate specification of the production system of the pig farmers is the stochastic production frontier estimated by the Maximum Likelihood method and not the OLS. This also implies that significant production inefficiency exists in the production system of both categories of farms.

Among the explanatory variables (inputs) in the SPF estimated (Table 4), cost of intermediate inputs and hired labour were not significant even at $p<0.10$ in the SPF of both categories of farms and household labour in

Table 2: Costs and Returns Structure of Pig production

Description	Government Assisted Pig Farms		Unassisted Pig Farms	
	Amount	Share (%)	Amount	Share (%)
Average Herd Size	90		60	
Revenue (N)				
Sales of live pigs	904,500.00	66.5	756,000.00	80.6
Sales of slaughtered pigs	187,500.00	13.8	75.000.00	7.9
Estimated value of change in Stocks	228,050.00	16.8	84,000.00	8.9
Value of home consumption	40,000.00	2.9	23,000.00	2.5
Total Revenue	1,360,050.00	100	938,000.00	100
Variable Costs				
Feeds	378,740.00	42.5	305,460.00	46.4
Veterinary Services	50,250.00	5.6	11,300.00	1.7
Hired Labour	150,000.00	16.8	85,000.00	12.9
Transport	95,500.00	10.7	42,500.00	6.5
Electricity	45,000.00	5.1	34,600.00	5.3
Repairs & Maintenance	50,750.00	5.7	29,250.00	4.4
Cost of Water	20,000.00	2.2	40,000.00	6.1
Cost of Medication	55,000.00	6.2	45,000.00	6.8
Estimated cost of Family Labour	45,000.00	5.1	65,000.00	9.9
Total Variable Cost (N)	890,241.00	100	658,610.00	100
Fixed Cost				
Depreciation	65,200.00	66.9	48,116.00	69.5
Rent	32,241.00	33.1	21,134.00	30.5
Total Fixed Cost	97, 441.00	100	69,250.00	100
Total Cost	987,682.00		727,860.00	
Gross Margin	469,809.00		279,390.00	
Net Farm Income	372,368.00		210,140.00	

Source: Field Survey (2009).

Table 3: Profitability of Pig Production

Profitability Measures	Government-assisted Pig farmers	Unassisted Pig Farmers
Profitability index	0.345	0.324
Rate of Return on Investment (%)	33.67	31.72
Rate of Return on Variable cost (%)	141.8	131.9
Operating Ratio	0.655	0.702

Source: Field Survey (2009).

Table 4: Estimated production frontiers of pig farms in Lagos State

Variables	Unassisted pig farms		Government –assisted pig farms	
	OLS	MLE	OLS	MLE
Intercept	2.54***	2.82**	4.278***	4.562 **
	(3.14)	(3.82)	(2.791)	(2.384)
No. of Breeding stock	0.220***	0.320***	0.393***	0.441***
	(4.60)	(5.505)	(3.04)	(4.268)
Quantity of Feeds (Metric tons)	0.140 ***	0.230***	0.462 ***	0.487***
	(7.07)	(6.45)	(3.56)	(3.98)
No. of Family Labour	-0.144**	-0.086**	-0.225	-0.223
	(-1.82)	(-1.88)	(-0.120)	(-1.410)
No. Hired Labour	0.232	0.208	0.0318	0.037
	(0.078)	(0.065)	(0.112)	(90.285)
Cost of Intermediate Inputs	-0.045	-0.133	0.080	0.098
	(-1.09)	(-1.345)	(0.562)	(0.382)
$\gamma = \frac{\sigma_u^2}{\sigma^2}$	-	0.674**	-	0.7520**
		(28.12)		(8.93)
$\sigma 2$		0.824***		0.832***
		(3.41)		(4.12)
Log Likelihood ratio		-55.323		-65.02
LR test of one sided error (df=2)		28.51***		31.39***

Source: Computed from Survey Data (2009).
NOTE: Figures in parentheses are t-values associated with each estimate.
***, ** and * imply the coefficient is significant at 1%, 5% and 10% levels, respectively.

Table 5: Estimated conditional revenue frontiers of pig farms in Lagos State

Variables	Unassisted pig farms		Government –assisted pig farms	
	OLS	MLE	OLS	MLE
Intercept	14.86*	15.34***	17.45***	17.35 **
	(1.79)	(5.61)	(2.61)	(2.384)
Selling Price of Pigs (N/kg)	0.24***	0.32***	0.29**	0.28***
	(3.64)	(2.76)	(2.19)	(9.52)
No of Breeding stock	0.82***	0.60**	0.83***	0.82***
	(4.86)	(2.45)	(3.37)	(3.57)
Quantity of Feeds (Metric tons)	0.15**	0.17**	0.21 ***	0.22***
	(1.98)	(2.16)	(6.64)	(7.97)
No. of Family Labour	-0.04	-0.05	-0.02	-0.02
	(-1.16)	(-0.88)	(-0.34)	(-0.33)
No. Hired Labour	0.15	0.18	0.04	0.04
	(0.28)	(0.57)	(0.30)	(0.22)
Cost of Intermediate Inputs	0.05*	0.06*	0.04**	0.08***
	(1.79)	(1.97)	(2.08)	(6.01)
$\gamma = \frac{\sigma_u^2}{\sigma^2}$	-	0.97***	-	0.72***
		(56.1)		(9.76)
$\sigma 2$	0.32	0.42**	0.43	0.38***
		(1.94)		(3.45)
Log Likelihood ratio	-47.64	-45.15	-55.73	-65.02
LR test of one sided error (df=2)		48.76***		56.45***

Source: Computed from Survey Data (2009).
NOTE: Figures in parentheses are t-values associated with each estimate.
***, ** and * imply the coefficient is significant at 1%, 5% and 10% levels respectively

the SPF of the UAPF. Stock size and feed quantity were both significant at $p<0.01$ in both the SPF of the GAPF and UAPF, showing that these are the main inputs determining the outputs in pig production. One percent increase in stock (feed) of the GAPF was revealed to be associated with 0.32% (0.23%) increase in output of the UAPF and 0.44% (0.49%) increase in output of the GAPF.

The evidence in respect of the conditional revenue frontiers (Table 5) is not substantially different from those in Table 4 in terms of the influence of most of the explanatory variables except the cost of intermediate inputs (transportation, water, etc) which was revealed to be significant ($p<0.10$) in the conditional revenue frontiers but insignificant in the SPF models. This suggests that increased expenditure on intermediate materials, which is dominated by cost of fuel and transportation, is associated with increase in revenue. This is most likely so because products of farms that tend to take their products to long distance markets are more likely to command higher prices just as their transport costs would be higher than farms that tends to sell their products within the farm. Results on Table 5 also shows that a one percent increase in the selling price of pigs produced by a farm is associated with 0.32% increase in revenue of the UAPF and 0.28% of revenue of the GAPF.

Production Efficiency in Pigs Production and the Determinants

One of the objectives of this study has been to estimate and compare the production efficiency (technical, allocative and overall economic efficiency) of GAPF and UAPF in Lagos. This was undertaken by specifying and estimating the SFP and conditional revenue frontier models earlier presented, with the technical and economic efficiency indices respectively obtained as parts of the outputs of the Frontier 4.1 econometric software used in estimating the model following the theoretical framework in Chavas *et al.* (2005) The allocative efficiency index for each farmer was computed bearing in mind that EE = TE x AE. The results are summarised on Table 6, while the result of Tobit regression models examining influence of various factors on production efficiency of the pig farms are summarised in Table 7. Please note that while a joint estimation of the SPF and technical inefficiency model following Battese and Coelli (1999) could be used to explain technical inefficiency in production as suggested by a reviewer, the estimation method impose allocative efficiency (which is a major interest in this present study). Thus, a two stage estimation procedure in which the various efficiency indices were first generated and then run against as set of explanatory variable in the second state following Chavas *et al.* (2005) was preferred and thus adopted in this study.

In general, evidence on Table 6 shows that an average GAPF in the state recorded greater technical (0.66), allocative (0.68) and overall economic (0.48) efficiency than his UAPF counterpart, whose technical, allocative and economic efficiency was estimated to be 0.53, 0.60 and 0.35, respectively. These results however, suggest that the income of two categories of farms could be significantly improved if factors affecting the efficiency of their operations are clearly understood.

Table 7 indicates that the main factors that significantly influence production efficiency of the pig farmers include their location ($p<0.01$), farm size ($p<0.01$), age ($p<0.10$)

Table 6: Distribution of technical, allocative and economic efficiency of GAPF and UAPF

Production Efficiency Level	Government Assisted Pig Farms						Unassisted Pig Farms					
	Technical Efficiency		Allocative Efficiency		Economic Efficiency		Technical Efficiency		Allocative Efficiency		Economic Efficiency	
	No	%	No	%	No	%	No	%	No	%	No	%
0.00 - 0.20	4	6.7	2	3.3	7	11.6	4	6.7	3	5.0	18	30.0
0.21-0.40	4	6.7	2	3.3	16	26.7	17	28.2	4	6.7	25	41.6
0.41-0.60	19	31.7	12	20.0	16	26.7	20	33.3	23	38.3	8	13.3
0.61-0.80	17	28.2	25	41.7	16	26.7	10	16.6	24	40.0	9	15.0
0.81 – 1.00	16	26.7	19	31.7	5	8.3	9	15.0	6	10.0	-	-
Mean	0.66		0.68		0.48		0.53		0.60		0.35	
Maximum	0.92		0.92		0.84		0.90		0.90		0.79	
Minimum	0.12		0.09		0.01		0.18		0.26		0.05	

Source: Computed from Survey Data (2009).

Table 7: Tobit Regression Model of Production Efficiency in Pig Production

Variables	TE model	AE model	EE model
Intercept	0.479***	0.546***	0.283***
	(4.095)	(4.942)	(2.32)
Estate (dummy variable)	0.305***	0.259***	0.296***
	(5.471)	(4.925)	(5.117)
Farm Size	-0,005***	-0.004***	-0.005***
	(-3.109)	(-4.328)	(-4.443)
Age of farmers	0.003*	0.003*	0.003
	(1.699)	(1.685)	(1.361)
Gender of farmers Female= 1	-0.057*	-0.053*	-0.067*
	(-1.672)	(-1.685)	(-1.709)
Years of Schooling	-0.005	-0.004	-0.002
	(-0.814)	(-0.841)	(-0.350)
Farming Experience	0.002	0.002	0.003
	(0.362)	(0.312)	(0.559)
Access to Credit	-0.006	-0.047	-0.08
	(-1.068)	(-0.934)	(-1.426)
Extension Contact	-0.023	-0.039	-0.022
	(-0.640)	(-1.170)	(-0.600)

Source: Computed from Survey Data (2009).
NOTE: Figures in parentheses are t-values associated with each estimate.
***, ** and * imply the coefficient is significant at 1%, 5% and 10% levels, respectively.

and gender ($p<0.10$) of the pig farmers. An average farm that is located within the pig estate was revealed as having 0.30, 0.26 and 0.29 unit of technical, allocative and economic efficiency index higher than its counterpart operating outside the pig estate. This is most likely a reflection of their greater access to both institutional and infrastructural support, and the fact that the concentration of these pig farms within the same geographical location makes it possible for them to easily share ideas, and procure inputs with greater ease than their counterparts that are in different locations within the State.

Evidence on Table 7 also reveals that all indices of production efficiency of the pig farms tend to decline with increase in farm size, which suggests that on the average, large farm operates at lower efficiency levels than small farms. Contrary to evidence in many previous studies (e.g., Belbase and Grabowski, 1985), which suggests that education has positive influence on efficiency levels, results on Table 7 reveals that increase in education and even extension contacts have no significant influence on production efficiency of the pig farmers. This goes against *a-priori* expectations, even though similar evidences were provided in Bravo-ureta and Evenson (2004).

Thus, it questions the relevance of the extension information and formal education received by the farmers, with reference to the usefulness in pig production. It would appear, therefore, that there is a need to refocus the content of extension information and formal education being provided to members of farm households in Lagos (and Nigeria in general) towards ensuring they are targeted at meeting felt needs, and solving problems, in agriculture.

One other important evidence in the results presented on Table 7 relates to the influence of gender on production efficiency of the pig farmers. An average female farmer in the sample was revealed as being less efficient than her male counterpart. While the reason for this is not clearly evident from the results of this study, it is not unlikely that the tendency for discrimination along gender line would play some role in making the women farmers less efficient than their male counterpart.

CONCLUSION

This study assessed the impact of Lagos State Government's intervention in the piggery sub-sector of the state agriculture by establishing a pig estate where about 200 pig farmers were settled and supported with relevant infrastructure and institutions on pig production in the state. This was undertaken by comparatively assessing the costs, returns, profitability of operation and production efficiency of the pig farmers with another comparable set of unassisted pig farmers. Evidence in the study revealed an average farmer in the pig estate raised more pigs (120) than his counterpart that was not supported (60). The profitability of his operation is also slightly higher (33.67%) than that of an average farmer outside the pig estate (31.73%), while the level of his technical, allocative and overall economic efficiency (0.66, 0.68 and 0.48, respectively) are significantly higher ($p<0.01$) than those of an average pig farmer operating outside the pig estate (0.53, 0.60 and 0.35, respectively).

The study also found that factors such as farm size (number of sow units) gender, and age of the farmers are important determinants of their production efficiency. The study, thus, concluded that (a) establishment of the pig estate has impacted positively on pig production in the State; and (b) significant inefficiency exists in the pig production system in the State. It thus recommends increased provision of more institutional and infrastructural support to erstwhile unsupported pig farmers. It also recommends the needs to make formal education and extension services more relevant to farmers felt needs, and reduce the tendency for discrimination along gender line.

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