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Original Research Article

Profitability and Technical Efficiency of Pig Production in Nigeria: the Case of Ekiti State

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Abstract

The study examined the profitability and technical efficiency of pig production in Ekiti State, Nigeria. A multi-stage sampling technique was employed in the selection of 80 pig farmers. Primary data were collected through structured questionnaire from the selected pig farmers. The data obtained from the farmers were analysed using descriptive statistics, cost benefit analysis and stochastic frontier production function. Findings revealed that majority (82.5%) of the respondents were male, 40% were within the active age of 35–46 years that can effectively withstand the rigors and stress involved in pig production, 76.25% were married with a mean household size of 6people. The cost and return analysis showed that, in one production year, the gross margin was ₦694,592($3,484.44), while the rate of return on investment was ₦0.34 and the Cost Benefit Ratio (CBR) was 1.34 indicating that the enterprise is profitable since BCR is greater than 1. The result of stochastic frontier production function revealed that herd size ($P < 0.05$), quantity of feed ($P < 0.01$), capital ($P < 0.01$) and labour ($P < 0.05$) increase technical efficiency of the respondents, while inefficiency in the study area was reduced by age of the respondents ($P < 0.1$), educational level ($P < 0.01$), household size ($P < 0.05$), farming experience ($P < 0.01$) and breed of pig ($P < 0.1$) reared by the respondents. The mean technical efficiency was 0.86. Although the pig farmers exhibit high technical efficiency in the study area, efficiency could still be increased by 14% through better use of available resources given current state of technology which could be achieved through farmers' specific factors like age, education and farming experience.

Keywords: profitability; technical efficiency; pig production; socio-economic characteristics; management practices; stochastic frontier analysis.

INTRODUCTION

One of the greatest problems confronting about 140 million Nigerians (NPC, 2006) today is lack of adequate protein intake both in quality to feed the nation's ever-growing population. This situation calls for urgent redress through re-orientation in livestock production in order to free its citizens from the pangs of hunger and malnutrition. Despite the shortfall in protein intake and the imminent need to raise productivity, production of pigs in Nigeria has remained low (Osondu et al., 2014). The aftermath effect of serious deficiency in the amount of protein intake is that people's health is adversely affected; especially the mental capability, labour productivity and eventually, the overall national economic growth (Okoruwa and Olakanmi, 1999).

Pig (*Sus scrofa*),which is one of the sources of animal protein in Nigeria are monogastric animals with a high rate of productivity, and have the ability to utilize a host of agro-industrial by-products and crop residues, with little or no processing and at minimal cost (Tewe and Adesehinwa, 1995; Igwe et al., 2013). The pig industry in Nigeria is an important arm of the livestock sub-sector in the overall agricultural sector (Ezeibe, 2010). This assertion derives from the fact that porcine production, among other species has a high potential to contribute to high economic gain in three ways. First, the pigs have high fecundity, high feed conversion efficiency, early maturity, short generation interval and relatively small space requirement (Ezeibe, 2010). Secondly, they are multipurpose animals providing about 40% of meat in the world market, cooking fats and bristles. Pig is equally important for agro-based industries like feed mills for provision of bone and blood which are used for production of bone meal and blood meal respectively, which are good source of calcium in animal nutrition(Ogunniyi and Omoteso, 2011).

In addition, pig's manure is an excellent fertilizer for enriching poor soils and provision of biofuel for cooking. Its skin is also useful for light leather production (Babatunde and Fetuga, 1990). Thirdly, it is produced under a variety of production systems ranging from simple backyard piggery, pigs living on garbage belts to family operated farms or large scale integrated pig industries with sophisticated biosafety measures (Ezeibe, 2010). Pig production has been

seen as a remedy to protein inadequacy due to certain attributes which pigs possess that are not in other domestic livestock. Among these are their fast growth rate which is only slightly exceeded by the best, carefully managed broilers, their prolificacy which is unsurpassed by that of any other animal species except the birds, their very good efficiency of feed utilization which brings better returns per units of inputs than most other animals and the quality of their meat which is both tender and more nutritive in terms of the contents of protein and the B-vitamins than those of other animals (Ogunniyi and Omoteso, 2011).

Despite these attributes, production of pigs in Nigeria has remained low. Nigeria has a large population of Muslims who constitute the majority of most States of the North-West and North-East zones as well as other zones in Nigeria. Also, with the growth of Islamic fundamentalism, opposition to pig production is very significant and may not favour profitable pig production due to their religious belief (Umeh et al., 2015). Other factors that have militated against pig production in Nigeria include disease outbreak, inadequate technical assistance in the form of extension services, inaccessibility of pig farmers to credit facilities, lack of adequate supply of genetically sound breeders, high cost of feed, poor infrastructure facilities, the fear of inadequate market for piggery products, the absence of pig product processing industry in Nigeria, and the belief that pigs are dirty and constitute a health hazard. This is absolutely untrue for pigs that are produced under modern intensive production techniques since under suitable modern husbandry pigs can be very clean animals (Ajala et al., 2007). In the light of the above, this study seeks to describe the socio-economic characteristics as well as management practices employed by pig producers in the study areas; estimate the profitability of pig production; and determine pig production efficiency in the study area.

MATERIALS AND METHODS

Study area, sampling techniques and data collection

The study was carried out in Ekiti State, Nigeria. Ekiti State was created on 1st October, 1996. Its capital is Ado-Ekiti. It is located between latitude $7^0 25'$ and $8^0 05'$N and between longitudes $4^0 45'$ and $5^0 46$E. The state is made up of 16 Local Government Areas and a total land mass of 6,353 square kilometres. The 2006 census determined the population at 2,737,186. The two prominent climatic seasons in the area include the rainy season, lasting from April to October and the dry season lasting from November to March. Temperature ranges between 21 °C and 28 °C with high humidity.

A multistage sampling technique was adopted for the selection of pig producers in the study area. In the first stage, Ikere and Ado Local Government Areas were purposively selected because of prominence of pig farmers in the areas. In the second stage, four communities were randomly selected from each Local Government Area using the list of communities available in the LGAs as sampling frame. The third stage involved the random selection of ten pig farmers from each of the chosen communities making a total of 80 pig farmers using the list of pig farmers available with the village extension agent (VEA) as sampling frame. Primary data were collected through structured questionnaire from the selected pig farmers. The data obtained from the farmers were analysed using descriptive statistics, cost benefit analysis and stochastic frontier production function.

Data analysis techniques

Descriptive statistics: descriptive statistics such as frequencies, mean, standard deviations and percentages were employed to describe the socio-economic characteristics of the pig farmers such as age, sex, educational level, experience, income levels, etc. This was analysed using statistical package for social science (SPSS) version 20

Cost benefit analysis: This was used to estimate farm net revenue for pig production. Theoretically, net revenue (NR) is the total revenue (TR) less the total cost (TC);

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

Total cost is the addition of the entire variable cost (VC) and fixed cost (FC) items;

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

Total revenue is the total amount of money that a farmer received from the sale of stock;

$$TR = \Sigma PxQx \quad (3)$$

$$\text{Gross margin (GM)} = TR - TVC \quad (4)$$

$$\text{Net farm income (NFI)} = GM - TFC \quad (5)$$

The rate of return is a performance measure used to measure the amount of return on an investment relative to the investment cost. It is given by:

$$\text{Rate of Returns (ROR)} = NR/TC \quad (6)$$

$$\text{Gross Ratio (GR)} = TC/TR \quad (7)$$

$$\text{Benefit cost ratio (BCR)} = TR/TC \quad (8)$$

P ..... price per pig
Q ..... quantity of pig sold

Pig production is profitable if its BCR ≥ 1. The higher the BCR, the more profitable the pig production business is. Depreciation was calculated using the straight line method.

The stochastic frontier production function model: The SFPF model used by Parikh and Shah (1994), which was derived from the composed error model of Aigner et al. (1977), Meeusen and Broeck (1977), and Forsund et al. (1980) was applied in the analysis of data. The Cobb-Douglas production function was linearized in the form:

$$\ln Yi = \beta 0 + \beta 1 \ln X1 + \beta 2 \ln X2 + \\ + \beta 3 \ln X3 + \beta 4 \ln X4 + \beta 5 \ln X5 + Vi - Ui \quad (9)$$

Where:
InYi ....Natural Logarithm of Y;
Yi .....Pig output (kg);
X1 .....Herd size (No of pigs);
X2 .....quantity of feed (kg);
X3 .....Capital;
X4 .....Labour (man/days);
X5 .....cost of medication (₦)

Vi = represent random disturbances cost due to factors outside the scope of the farmers which is assumed to be identically and normally distributed with a mean of zero (iid) and constant variance of V~N (o, σ2v) and independent of U Ui = non-negative random variable associated with technical efficiency in production, and is assumed to be independently identically and normally distributed. U~N (o, σ2u) where the conditional mean μ is assumed to be related to farm and farmers-related socioeconomic characteristics.

The inefficiency model is specified as:

$$Ui = \delta 0 + \delta 1 D1 + \delta 2 D2 + \delta 3 D3 + \delta 4 D4 + \\ + \delta 5 D5 + \delta 6 D6 + \delta 7 D7 + \delta 8 D8 \quad (10)$$

Where:
Ui..... Inefficiency model;
D1.... Age (years);
D2.... Sex (1-male, 0- female);
D3.... Educational level (years);
D4.... Household Size (Number of people);
D5.... Pig rearing experience (years);
D6.... Management system (1 if intensive, o if otherwise);
D7.... Breed of pig (1 if exotic, 0 if local);
D8.... Extension contact;
δ..... Parameters to be estimated.

A prori expectation: Output of pig production is expected to be influenced positively by quantity of feed intake, herd size, labour, and cost of drugs and vaccines while sex, level of education, household size, pig rearing experience, management system and the farmer's choice of pig breeds are expected to have negative effects on the technical inefficiency. Age of the farmer is expected to have a positive effect on technical inefficiency.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

Socio-economic characteristics of the sampled pig farmers were presented in Table 1. It is evident from the table that most (40%) of the sampled pig farmers in the study area were within the age range of 36–45 years, 16.3% were below 35 years while 26.3% fell within 46–55 years and 14 farmers representing 17.5% were above 55 years of age. The mean age was 43.2 years. This implies that most of the farmers were young and agile and therefore, able to cope with the stressful nature of pig production. This result is corroborated by the work of Durno and Stuart (2005) who stated that the risk bearing abilities and innovativeness of a farmer, his mental capacity to cope with the daily challenges and demands of farming business decreases with advancing age. Majority (82.5%) of the farmers were males, while 17.5% were females. This indicates that men were more involved in pig production than females in the study area. This finding is in consonance with those of Umeh et al. (2015) who stated that men who are relatively stronger are mostly involved in pig production and also suggested that sex may increase technical efficiency as male producers who often are the head of the family, who are energetic to procure and administer production inputs are the majority of pig farmers in the study area. Females in this study area also contributed to labour in light farm operations such as serving of feed and water, and cleaning of the piggery as corroborated by Osondu et al. (2014). The study also reveals that majority (76.3%) of the pig farmers were married, 2.5% were single, 10% were widowed, while 11.3% were divorced. This high marital status is likely to boost the availability of family labour in the study area.

The distribution of the respondents by size of their household shows that a larger percentage (47.5%) had between 5 and 7 people in their households, 25% had between 8 and 10 people, while 11.3% had more than 10 people as their household size. The mean household size was 6 people. This large household size may translate to reduction in the cost of hiring labour. The break-down of the pig farmers' literacy level reveals that only 8.8% had no formal education whereas the remaining 91.3% had formal education ranging from primary to tertiary education. The average number of years spent in school of 14.8 years implies that the pig farmers were highly educated and this will have positive consequences on their capacity to exploit latent opportunities in the pig production and also support them in the adoption of improved technologies. This is corroborated by the findings of Adetunji and Adeyemo (2012) who reported a mean time of schooling of 13 years in their study. Ajieh and Okuwuolu (2015) also reported that majority of the pig farmers in Delta state are literates. Furthermore, the distribution of

Table 1. Distribution of Respondents by Socio-economic Characteristics (N = 80)

Variable	Frequency	Percentage	Mean	S.D.
Age (Years)				
≤ 25	5	6.25		
26–35	8	10		
36–45	32	40	43.24	7.716
46–55	21	26.25		
>55	14	17.5		
Sex				
Male	66	82.5		
Female	14	17.5		
Marital Status				
Single	2	2.5		
Married	61	76.25		
Widowed	8	10		
Divorced	9	11.25		
Household size (No of people)				
≤ 4	13	16.25		
5–7	38	47.5	6	2.173
8–10	20	25		
>10	9	11.25		
Educational Level (Years)				
No formal education (0)	7	8.75		
Primary (6–12)	18	22.5	14.81	5.934
Secondary (13–18)	35	43.75		
Tertiary education (>18)	20	25		
Pig Rearing experience (Years)				
1–5	5	6.25		
6–10	19	23.75		
11–15	29	36.25	11.04	6.739
16–20	16	20		
>20	11	13.75		

Source: Field Survey, 2016

the respondents by pig rearing experience reveals that 30% of the sampled respondents had between 1 and 10 years pig rearing experience, 56.3% had between 11–20 years while 13.8% had more than 20 years of experience. The mean pig rearing experience in the study area was 11.04 years which suggests that respondents had considerable years of pig production experience in the study area.

Pig management practices

The management practices of the pig farmers are presented in Table 2. The table reveals that majority (52.5%) of the pig farmers practised semi-intensive management system, 42.5% practised intensive system in which the pigs were confined in a clean pigsty and a balanced food given to them at the right time. Also watering, veterinary services and skilled labour were also provided for the pigs, while 5.0% practised extensive system of pig production. According to Ezeibe (2010), the extensive system is characterized by high mortality rate, absence or minimal health care and improper housing and feeding. This has led to poor production and improvement of the pigs and also encourages spread of disease, low fecundity and low meat yield (Ugwu, 1996). According to Karrol and Krider (2001), free ranging/extensive system of pigs is considered as one of the risk factors for porcine cysticercosis. The table also reveals that 70% of the sampled pig producers have received training on pig production by government agencies and private individuals involved and knowledgeable about pig production whereas 30% have not. The implication of this is that the trained farmers will be better equipped and perform better than those without training. The distribution of breeds of pig produced reveals that majority (57.5%) of the respondents produced crossed breeds, 27.5% produced exotic breeds, while 15.0% produced local breeds. Also, the mean herd size of 63

Table 2. Distribution of Respondents by Management Practices (N = 80)

Variable	Frequency	Percentage
Management/Housing System		
Intensive system	34	42.5
Semi-intensive system	42	52.5
Extensive system	4	5.0
Training on pig production		
Yes	56	70.0
No	24	30.0
Breeds of pig		
Local breeds	12	15.0
Crossed breeds	46	57.5
Exotic breeds	22	27.5
Herd size		
1-50	11	13.8
51-100	43	53.8
101-150	17	21.3
>150	9	11.3
Type of Labour		
Family	33	41.3
Hired	27	33.8
Both	20	25.0
Type of feed		
Concentrates	22	27.5
Household waste	48	60.0
Both	10	12.5
Sources of fund		
Personal savings	39	48.8
Friends and relatives	13	16.3
Bank loans	7	8.8
Cooperatives	21	26.3
Extension contacts		
Yes	61	76.3
No	19	23.8

Source: Field Survey, 2016

pigs implies that pig production in the study area is on small scale level.

The distribution of the respondents by type of labour employed shows that 41.35% employed family labour, 33.8% employed hired labour, while 25.0% employed both family and hired labour. Furthermore, findings on source of funding pig production in the study area revealed that most (48.75%) of the respondents finance their business from personal savings, 16.3% source their capital from friends and relatives, 8.8% from banks, while 26.3% from cooperative society. This study agrees with Adekunle and Ajani (1999), and Ogunniyi and Omoteso (2011) who found that the source of capital of livestock farmers was either from friends and relatives or from their personal savings, which mostly comprised of retained profits made from previous earnings. The table further reveals that 61% of the sampled pig farmers had contact with extension workers while 19% had no contact with extension workers within the last one year in the study area.

Average cost and returns of pig production in one year

Table 3 presented detail information on the costs, returns and profitability of pig production in the study area. The average total cost of production as shown in Table 3 was ₦1,629,353. ($8,173.70) *per annum*, out of which ₦1,495,408 ($7,501.76) representing 92.64% were variable costs and ₦133,945.44 ($671.94) were fixed costs. The average total revenue per annum was ₦2,190,000 ($10,986.20). The average gross margin was ₦694,592 ($3,484.44) and the net farm income per respondent was ₦560,646.56 ($2,812.50). The rate of return on investment in the study area was 0.34. This

Table 3. Average Cost and Returns of Pig Production in ₦/Year

Cost/Return	Amount (₦)	% of TC
Total Revenue (TR)	**2,190,000**	
Variable cost		
Cost of stocking	30,078.35	1.55
Feed	1,336,527.98	79.70
Labour	70,000	3.10
Medication	23,801.67	1.47
Transportation	10,000	0.62
Other costs	25,000	0.93
Total variable cost (TVC)	1,495,408	92.64
Fixed cost		
Rent on land	22,780	
Maintenance cost	5,000	
Depreciation	105,745	
Interest on loans	420.44	
Total fixed cost (TFC)	133,945.44	
TC = TFC + TVC	**1,629,353.44**	
GM = TR – TVC	694,592	
NFI = GM – TFC	560,646.56	
NR = TR – TC	560,646.56	
ROR = NR/TC	0.34	
BCR = TR/TC	1.34	
GR = TC/TR	0.74	

Source: Computed from field survey data, 2016

implies that every ₦1 invested in the pig business yielded 34K as profit. The benefit cost ratio (BCR) of 1.34 shows that pig production is a profitable business in the study area since it is greater than one. The gross ratio of 0.74 implies that 74K is spent for every one naira gained in the business. Thus, pig production is a profitable venture in the study area as indicated by the various profitability ratio techniques employed in the analysis.

Technical efficiency of pig producers in the study area

Table 4 presents the maximum likelihood estimates (MLE) of the parameters in the stochastic frontier model. The estimate of the sigma-square is significantly different from zero at one percent level, attesting to the goodness of fit and correctness of the specified distribution assumption of the composite error term. The variance ratio (gamma) estimated to be 0.889 is statistically significant at 1% suggesting that the systematic influences that are unexplained by the production function are dominant sources of error. That is, the technical inefficiency effects are significant in the stochastic frontier model and that the traditional production function with no technical inefficiency effect is not an adequate procedure in this regard. In other words, the presence of technical inefficiency among the sample farmers explains about 89% variation in the output level of pig.

The result of the production function showed that most of the inputs meet the *a priori* expectations and statistically significant at different levels except for the cost of medications. The coefficient of herd size is positive and significant at 5%. Therefore, a 1% increase in the number of pigs will increase output level by 0.013%. The coefficient of quantity of feed is also positive and significant at 1% level. The large coefficient of feed (0.442) confirms the importance of concentrates in pig production. The production elasticity with respect to capital invested is positive and significant at $P < 0.01$. The 0.064 elasticity of capital suggests that a 1% increase in the capital invested in pig production will increase output by 0.064 percent. The coefficient of labor is also positive and significant at $P < 0.05$ showing the importance of labor in pig production. The large elasticity (0.503) of labour is an indication that pig production is highly laborious. This is in consonance with the findings of Udoh and Etim (2011) and Nsikak-Abasi et al. (2014).

Determinants of technical inefficiency in pig production

The result of the inefficiency model in Table 4 shows that the estimated coefficient of age was negative and significant at $P < 0.10$. This implies that technical

Table 4. Maximum likelihood estimates for the parameters of the stochastic frontier production function for pig production

Variables	Parameter	Coefficients	T-ratio
Constant	β_0	35463.3	7.83***
Herd size	β_1	0.013	2.09**
Quantity of feed	β_2	0.442	3.17***
Capital	β_3	0.064	2.98***
Labour (man-days)	β_4	0.503	2.33**
Cost of medication	β_5	0.073	1.339
Inefficiency Model			
Constant	δ_0	0.218	1.861*
Age (years)	δ_1	–0.165	–1.923*
Gender (1 – male, 0 – female)	δ_2	0.102	0.173
Educational level (years)	δ_3	–0.075	–4.364***
Household size	δ_4	–0.153	–2.481**
Farming experience (years)	δ_5	–0.192	–3.197***
Management system	δ_6	–0.011	–0.043
Breed of pig	δ_7	–0.196	–1.731*
Extension contact	δ_8	0.039	0.055
Sigma-squared	σ^2	0.820	4.32***
Gamma		0.889	4.698***
Log likelihood function			–42.51

Source: Computed from field survey data, 2016 ***Significant at 1% ** 5% *10%

inefficiency declines with age suggesting that the older farmers are more technically efficient than the younger farmers. This is also corroborated by the result on pig rearing experience which is also found to decrease technical inefficiency as it was negative and significant at 1%. This suggests that specialization is developed over time leading to improved production methods and higher efficiency. This finding is in agreement with those of Nsikak-Abasi et al. (2014), that pig farmers with more years of farming experience will have more technical skills in management and thus higher efficiency than younger pig farmers. Etim and Edet (2014) opined in their own study that increased experience in agricultural production may also enhance critical evaluation of the relevance of better production decisions including efficient utilization of productive resources. The result also revealed that technical inefficiency in the study area decreases with increase in the respondents' level of education. This implies that pig farmers who are educated achieved higher level of technical efficiencythan the uneducated ones in the study area. Finding agrees with Umeh et al. (2015) who submitted that education is important for achieving effective utilization of inputs in pig production in Nigeria. The result further revealed that technical inefficiency effects in pig production in the study area declines with increase in the respondents' household size ($P < 0.05$) and contact with extension workers ($P < 0.10$).

Distribution of Respondent by Technical Efficiency

Table 5 presents the individual technical efficiencies of the sampled pig farmers obtained using the estimated stochastic frontier model. The predicted technical efficiencies differ substantially among the farmers, ranging between 0.64 and 0.97. The mean technical efficiency was estimated to be 0.86. This implies that pig producers in the study area were producing at about 86 percent of the potential production level, indicating that the production level was about 14% below the frontier. According to a recent study by Etim and Udoh (2014), this is an indication of product wastage due to inefficiency of resource use by the pig producers. The result also suggests that technical efficiency in pig production in the study area could be increased by 14% through better use of available resources given current state of technology which could be achieved through farmers' specific factors like age, education and farming experience.

Elasticities and Return to Scale (RTS) for Pig Farmers in the study area

The Return to Scale (RTS) value for the function is estimated to be 1.095 (Table 6). This was found to be greater than unity, indicating increasing return to scale. Hence, the farmers can be said to operate in stage 1 (irrational stage) of production. This implies that pig production in the study area is yet to operate at optimum scale of production. Hence, there is need for

Table 5. Efficiency Distribution of Pig Farmers

Efficiency level	Frequency	Percentage
≥ 0.70	5	6.3
0.71–0.75	8	10.0
0.76–0.80	12	15.0
0.81–0.85	53	66.3
> 0.85	2	2.5
Minimum Efficiency	0.64	
Mean Efficiency	0.86	
Maximum Efficiency	0.97	

Source: Computed from field survey data, 2016

improvement such as better equipment and using more variable inputs to boost production. This finding agrees with studies by Ogunniyi and Omoteso (2011).

CONCLUSION

This study was conducted to measure the profitability and technical efficiency of pig production in Ekiti State, Nigeria. The study revealed that majority of the sampled respondents were males, married and within the economically active age group. Based on the value of benefit and efficiency indicators, it can be concluded that pig production in the study area is economically rewarding, profitable and efficient. Although there is room for improvement, it is capable of creating employment, augmenting income and improving the standard of living of the people.

- Based on the findings of the study, the following policy recommendations are made: Adequate training programme on pig production should be organized for pig farmers in the study area to familiarize them with innovations in pig production.
- Pig production in the area is male-dominated. Women need to be encouraged to participate in pig production in the area as a means of augmenting their income and improve their standard of living.
- Pig producers should be organized into formidable groups such as cooperative society to enjoy economies of scale in the purchase of inputs such as feeds, drugs and vaccines.

Table 6. Elasticities and Return to Scale (RTS) for Pig Farmers in the study area

Variable	Elasticity
Herd size	0.013
Quantity of feed	0.442
Capital	0.064
Labour	0.503
Cost of medication	0.073
Return to scale (RTS)	1.095

Source: Computed from field survey data, 2016

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