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ORIGINAL RESEARCH ARTICLE

Effect of Adoption of Improved Pig Production Technologies on Households' Food Security of Farmers in Abia State Nigeria

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ABSTRACT

This study assessed the effect of adoption of improved pig production technologies on households' food security of farmers in Abia State Nigeria. It specifically, described the socio-economic characteristics, identified the pig production systems practiced, identified the types of pig breeds reared, ascertained their levels of adoption of pig production technologies, estimated the income realized from pig farming, determined their food security status, and examined constraints to adoption of pig production technologies among farmers in the study area. Multi-stage sampling procedure was used to select 100 and 120 pig farmers. Data were collected using a structured questionnaire and analyzed with descriptive statistics and inferential statistics (multiple regression and simple regression analysis). Farmers had high adoption ($\bar{x}$ = 3.6) of pig production technologies, having a mean annual income of ₦1,04,3000.00, while majority (70.8%) were food secure while 29.2% were food insecure. Farmers were constrained by high cost of improved pigs ($\bar{x}$ = 2.65), poor access to credit ($\bar{x}$ = 2.6), high cost of feed ($\bar{x}$ = 2.4), and poor veterinary services ($\bar{x}$ = 2.33), as they had serious ($\bar{x}$ = 2.1) constraints in adoption of improved pig production technologies. Multiple regression result showed that coefficients for education (0.411**), marital status (0.503**), stock size (0.001**), and extension contact (0.880**) which influenced farmers adoption of improved pig production technologies in the study area. Multiple regression result also revealed that coefficients of age (0.011***), household size (0.167***), stock size (0.003***), and credit access influenced food security status of pig farmers in the study area. Simple regression showed that adoption of improved pig production technologies had effect on the household food security of farmers at 1.0%, while income of farmers had a positive effect on the household food security of farmers at 5.0% in the study area. The study concluded that pig farmers had high adoption of pig production technologies as the adoption and income had effect on farmers' household food security. The study therefore recommended that extension agencies should provide regular training programs on improved pig production technologies, pig farmers should be encouraged to form cooperative to enable them access farm inputs and credit to increase farm income attain food security in the study area.

Key words: Pig production; Improved production technologies; Technology adoption; Household food security; Pig farmers; Agricultural extension; Abia State, Nigeria.

INTRODUCTION

Pig production is an important agricultural activity globally. The global trend in world meat production from 2016 to 2023 has shown that pig meat is an important source of animal protein in human diets. Estimates from Food and Agriculture Organization (FAO) data show pork as the world's most widely eaten meat, accounting for 36% of the world's total meat consumption, surpassing poultry (33%), beef (24%), and goats and sheep (5%). According to

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Ritchie *et al*.,[53] Pork is the most consumed type of red meat in the world and its consumption has steadily increased over the years. In Africa, pig production is one of the avenues through which people are gainfully employed, earn income, meet their animal protein needs, and contribute to global needs through export. Africa contributes 1.67% of global pig meat production.[7] Pigs are widely distributed all over Africa, with more than 70% of its population found in rural communities, where in most cases, the pigs are allowed to scavenge for food. It is a means of livelihood in many parts of Africa, especially for women and youths who are involved in small-scale farming. West Africa has the highest pork production, with Nigeria contributing 65%.[16] Pig production provides an important source of livelihood for small scale farmers. Thus, increasing pig production capacity through technology adoption is crucial in enhancing the food security and income of rural pig farmers in Nigeria. Common breeds reared include Large white, Land race, Duroc, Hampshire, Indigenous pigs, and their crosses, all belonging to the domestic pig species, Sus scrofa domesticus. Farmers operate mainly under the extensive, semi-intensive, and intensive production systems with semi-intensive being common among small holder farmers.

Technology could be described as the application of scientific knowledge to solve problems, enhance efficiency, and improve outcomes.[31] Pig production technologies refer to the set of modern practices, tools, and innovations applied in the breeding, feeding, housing, health management, and marketing of pigs to increase productivity, efficiency, and profitability in pig farming.[32] These technologies are used to improve growth rates, reproduction, disease resistance, and overall sustainability of pig production. Among these technologies are as follows: Improved pig breeds for better growth and reproduction, modern housing systems (e.g., concrete-floored pens with proper ventilation and drainage), balanced feeding regimes and formulated rations, routine vaccination schedules to prevent major pig diseases, deworming and ectoparasite control, biosecurity measures such as controlled access and disinfection, waste management systems for proper disposal and reuse of pig manure, record keeping and use of mobile apps or farm software for management, and artificial insemination and reproductive technologies.[35]

Pig production technologies not only enhance growth rates but also increase feed conversion, reduce disease outbreaks, and enable farmers to carry out their pig farming business efficiently. In Abia State, most pig farmers manage their pig farms using technologies such as vaccination, deworming, ectoparasite control, and the use of improved housing systems. The use of pig production technologies has led to significant improvement in the output of rural pig farmers in Nigeria. It has supported early disease detection, reduced mortality, and ensured food security and a more stable income for the farmers.[17]

Food security refers to the availability, accessibility, and utilization of food that meets dietary needs for an active and healthy life.[50] Small-scale pig farming contributes to food security by providing households with a reliable source of animal protein, income for purchasing food, and manure for crop production. The relatively short gestation period and high prolificacy of pigs enable farmers to achieve quick turnovers, ensuring a steady food supply and financial stability. In addition, their highly prolific nature and fast feed conversion make them highly efficient livestock for boosting meat production and household nutrition within a short time. With the increasing demand for pork and its by-products, pig farmers benefit from a ready market, which, in turn, improves their household food security and income.[42]

Nevertheless, socio-cultural beliefs and other factors significantly influence pig production in Nigeria.[18] In many communities, pigs are culturally valued as a source of traditional ceremonies and social status, which encourages their rearing but sometimes limits commercialization due to cultural restrictions on pig consumption among certain groups.[14] On the health front, pig farmers face challenges such as the prevalence of zoonotic diseases like African pig fever and pig flu, which threaten herd health and productivity, necessitating improved veterinary services and biosecurity measures.[34] Furthermore, climate change impacts pig production through increased heat stress, reduced water availability, and changes in feed crop yields, which affect pig growth and reproduction. Adaptation strategies such as improved housing, better feed management, and disease control are essential for sustaining pig farming under changing environmental conditions.[18]

The income from pig production in Abia State is further driven by the increasing demand for pork and its by-products. With a growing population and a rising preference for animal protein, pig farmers benefit from a ready market for their products. Pork consumption is popular across various communities, and many farmers sell their pigs directly to consumers, restaurants, and meat processors, ensuring a stable cash flow. In addition, the sale of piglets to other farmers for breeding and expansion further boosts income levels, enabling pig producers to reinvest in their businesses and improve their production capacity.[30] Beyond the direct sale of pigs and pork, pig farming also provides additional revenue streams for farmers. The manure from pig farms serves as an organic fertilizer, which is highly valuable for crop production, reducing the cost of chemical fertilizers. Some farmers sell pig manure to crop producers, creating an additional source of income. Moreover, by-products such as pig fat and bones are used in industries for the production of animal feed, soap, and other valuable commodities, further increasing the financial benefits of pig farming.

Abia state has a significant population of small holder farmers who depend on livestock production as part of their livelihood. Food security exists when individuals and households have regular physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and preferences for an active healthy life.[30] They researchers' found out that level of use of technical information among pig farmers was low.

The problem, therefore, is that despite the potential of improved pig production technologies to increase productivity, income, and access to animal source food, it remains unclear whether and to what extent their adoption has improved the household food security of pig farmers in Abia State. Lack of empirical evidence on the effect of adoption of improved pig production technologies and food security confront policymakers, agricultural extension personnel, and development agencies who may find it difficult to design appropriate interventions aimed at improving pig production and reducing household food insecurity.

This study, therefore, seeks to examine the effect of adoption of improved pig production technologies on the household food security of farmers in Abia State.

i. What are the socio-economic characteristics of pig farmers?
ii. What are the various pig production systems used by farmers?
iii. What are the types of pig breeds reared by farmers?
iv. What are the levels of adoption of pig production technologies by farmers?
v. What is the income realized from pig farming among farmers?
vi. What is the food security status of pig farmers?
vii. What are the constraints to adoption of pig production technologies by pig farmers in the study area?

The broad objective of the study examined the effect of adoption of improved pig production technologies on households' food security of farmers in Abia State Nigeria.

The specific objectives were to:

i. describe the socio-economic characteristics of pig farmers;
ii. identify the pig production systems practiced by farmers;
iii. identify the types of pig breeds reared by farmers;
iv. ascertain the levels of adoption of pig production technologies by the farmers;
v. estimate the income realized from pig farming among farmers;
vi. determine the food security status of farmers; and
vii. Examine constraints to adoption of pig production technologies among farmers in the study area.

The following hypotheses were tested:

- $H0_1$: There was no significant relationship between socio-economic characteristics of farmers and adoption of pig production technologies among farmers in the study area.
- $H0_2$: There was no significant relationship between the socio-economic characteristics of pig farmers and their households' food security in the study area.
- $H0_3$: Adoption of pig production technologies does not have significant effect on food security status of the farmers in the study area.
- $H0_4$: There was no significant relationship between income from pig farming and their households' food security in the study area.

This finding benefited small-scale pig farmers, policy makers, and researchers. For rural pig farmers, this study will provide insights into the profitability of pig production and the factors affecting their income. The study also highlighted key constraints faced by rural pig farmers, enabling them to make informed decisions on resource allocation, disease control, and marketing strategies to enhance their financial well-being.

Policymakers also benefited significantly from this research as it provides evidence-based recommendations for improving the pig farming sector in Abia State. By estimating the food security status of the farmers and identifying the major income constraints of rural pig farmers, the study will guide the development of policies that support access to credit, extension services, affordable feed, and improved market structures.

This finding has helped to improve or add to the existing knowledge in the field of Piggery as well as agricultural financing agencies. For students and researchers, this study served as a valuable academic resource for further exploration of pig production and food security dynamic.

METHODOLOGY

The study was carried out in Abia State. The State is located in the south eastern part of Nigeria. It lies on the Longitude 7^0 23˙ and 8^0 02˙ East of the equator and Latitudes 5^0 47˙ and 6^0 12˙ North of the Greenwich Meridian. The climate is tropical and humid all the year. Annual rainfall ranges from 2000 mm to 2500 mm, temperature ranges within 22°C and 31°C. The state is bounded to the north and northeast by Anambra, Enugu and Ebonyi States, to the west by Imo State, to the south east by AkwaIbom and Cross River States and to the south by Rivers State.

The population of this study comprised all farmers engaged in pig production in Abia State, Nigeria.

A multistage stage random sampling procedures were adopted to ensure a representative selection of pig farmers across the state. In the first stage, purposive random sampling was used to select two extension blocks from Umuahia, Aba, and Ohafia agricultural zones based on evidence from Orji (2021), which identifies these blocks as the major hubs of pig production in the state. The blocks are Uzuakoli and Isuikwuato blocks (Ohafia zone), Obingwa and Ukwa West blocks (Aba zone), and Ikwuano and IsialaNgwa North blocks (Umuahia zone).

In the second stage, purposive random sampling was used to select two cells from each of the three chosen extension blocks, giving a total of 12 cells for the study. Finally, 10 pig farmers were randomly selected from each cell, resulting in a total sample size of 120 respondents.

Primary data and secondary sources were used for this study. Data collection involved the use of a structured questionnaire, which were administered to pig farmers in the selected locations in the study area.

To ensure effective and accurate data collection, three enumerators, one for each agricultural zone were recruited. These enumerators had a 1-day intensive training workshop on questionnaire administration, ethical considerations, and field protocols.

Secondary information was sourced from unpublished reports such as conference proceedings, seminars, annual reports, conference proceedings, journals, internet, and newsletters and among others.

Data from the study were analyzed with descriptive statistics, such as frequency counts, percentages, and mean scores. Multiple regression analysis and simple linear regression analyses were adopted to test the hypotheses. Specifically, all the objectives were realized using descriptive statistics such as percentages, frequency counts, and mean scores, while hypothesis 1 and 2 were tested using multiple regression analysis, hypothesis 3 and 4 was tested with simple liner regression analysis.

The questionnaire was subjected to both face and content validation to ensure that the research instrument accurately measures the intended variables and yields credible data. Face validity was established by presenting the draft questionnaire to experts to assess whether the items appear to be appropriate and relevant for the target population. Content validity was assessed to determine the extent to which the questionnaire adequately covers all aspects of the constructs under investigation. The instrument was reviewed by some academic staff in the Department of Agricultural Extension and Rural Development, Michael Okpara University of Agriculture, Umudike. These experts evaluated the

clarity, relevance, coverage, and appropriateness of each item in relation to the study objectives. Based on their professional feedback, necessary modifications made to refine the instrument.

The reliability of a measuring instrument is its ability to give consistent result. Reliability is therefore the extent to which the instrument for data collection gives the same results if administered times several under similar conditions. To ensure reliability, 20 copies of questionnaire were administered to 20 pig farmers outside the study area on two occasions and at a space of 2 weeks interval. To test for the reliability of the study instrument, Cronbach Alpha method was adopted which measures the internal consistency of test instrument. The reason for adopting Cronbach Alpha is because the research questionnaire was structured in a multiple Likert scale format of which Cronbach Alpha is consistence in testing its reliability. The Cronbach Alpha was computed using the Statistical Packages for Social Sciences version 20. The coefficient of correlation of 0.875 confirmed that the instrument is good enough to realize the set objectives.

1. Objective I: Socio-economic characteristics of pig farmers.

The variables were measured as follows:

   a. Age (in years)
   b. Sex: (Male = 1, Female = 0)
   c. Marital status: (a) Married = 1, Otherwise = 0
   d. Household size (number of persons feeding from the same pot)
   e. Stock size (number of pigs)
   f. Highest educational qualification (No of years spent in school).
   g. Years of production experience (number of years spent on farming (years)
   h. Access to credit (accessing credit measured in Naira)
   i. Extension Contacts: (Number of extensions visits to the farmer in the past 1 year).
   j. Cooperative membership = (number of years spent as a member).

2. Objective II: Identifying the pig production systems practiced by farmers.

This objective was operationalized by asking the farmers to indicate among the 11 listed pig production systems that they practice with response options of "Yes" and otherwise "No."

3. Objective III: Identifying the types of pig breeds reared by farmers.

This objective was operationalized by asking the farmers to indicate among the 11 listed types of pig breeds that they rear with response options of "Yes" and otherwise "No."

4. Objective IV: Ascertain the levels of adoption of pig production technologies by the farmers.

This objective was realized by listing out 11 pig production technologies and each respondent were asked to indicate the stage he/she was in the adoption scale. The five steps were as follows; aware = 1, interest = 2, evaluation = 3, trial = 4, and adoption = 5. This followed the works of; Nwaobiala *et al*.[38]; Nwaobiala *et al*.[37]

The mean scores were computed for each adoption statement by adding the weights of 5 + 4 + 3 + 2 + 1 = 15/5 = 3.0.

The following decision rule were used and categorized as follows;

- 1.0–1.49 = Awareness stage of the technology.
- 1.50–1.99 = Interest stage of the technology
- 2.0–2.49 = Evaluation stage of the technology
- 2.50–2.99 = Trial stage of the technology
- 3.0 and above = Adoption of the technology.

5. Objective V: Estimate the income realized from pig farming among farmers

This objective was measured by estimating the income of farmers in the study using frequencies and percentage and its mean scores derived.

6. Objective VI: Determination of the food security status of farmers

The households were classified into food secure and food insecure households, using the food security index. The food security index formula is given by:

$$Fi = \frac{\text{per capital food expenditure for ith household}}{\frac{2}{3}\,\text{mean per capital food expenditure of all households}}$$

Where Fi = Food security index

When Fi > 1= Food secure i^{th} household

Fi < 1= Food insecure i^{th} household.

A food secure household is therefore those whose per capita monthly food expenditure fall above or

is equal to two-thirds of the mean per capita food expenditure. On the other hand, a food insecure household is that whose per capita food expenditure falls below two-third of the mean monthly per capita food expenditure (Oluwayemisi and Oluwakemi, 2016). In addition, the number of food secure/ insecure households in the state was determined by taking the frequency of the food secure/insecure households. The headcount ratio (H) of food security was calculated to measure the percentage of the population of households that are food secure/ insecure. The headcount index formula is given by;

$$\text{Headcount index (H)} = M/N$$

Where M = number of food secure/insecure households

N = the number of households in the sample

7. Objective VII: Examine constraints to adoption of pig production technologies among farmers in the study area.

This was measured by providing a list of nine constraint items to the respondents. They were asked to state the severity of each constraint items to them and they were supplied with response options of "strongly agree," "agree," "disagree," and "strongly disagree." Response option "strongly agree" was assigned a score of 4; "agree" 3, "disagree" 2, and "strongly disagree" were assigned 1. Respondents' mean scores were computed for each of the statements by adding the weight 3 + 2 +1 = 6 and dividing by 3 to give 2.0.

The following decision rules were used;

Mean scores of between

- 1.0–1.49 = low constraint
- 1.50–1.99 = moderate constraint; and
- 2.0 and above = high constraint.
- Hypothesis 1: There is no significant relationship between socio-economic characteristics of farmers and adoption of pig production technologies among farmers in the study area.

This hypothesis was tested using multiple regression analysis.

The four functional forms of regression model, namely, linear, semi-log, exponential, and cobb-Douglas were tried. The best fit was chosen as the lead equation based on its conformity with econometric and statistical criteria such as the magnitude of R^2, F-ratio, and number of significant variables.

The four functional forms are expressed as follows;

i. Linear function:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + ei \quad (1)$$

ii. Semi-log function:

$$Y = L_n \beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + \beta_6 L_n X_6 + \beta_7 L_n X_7 + \beta_8 L_n X_8 + \beta_9 L_n X_9 + \beta_{10} L_n X_{10} + ei \quad (2)$$

iii. Exponential function:

$$L_n Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + ei \quad (3)$$

iv. Cobb-Douglas function:

$$L_n Y = L_n \beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + \beta_6 L_n X_6 + \beta_7 L_n X_7 + \beta_8 L_n X_8 + \beta_9 L_n X_9 + \beta_{10} L_n X_{10} + ei \quad (4)$$

Where,

Y = Levels of pig improved production technologies (mean scores)

X_1 = Sex (male = 1, female = 0)

X_2 = Age (Number of years)

X_3= Household size (Number of household members)

X_4= Level of education (Number of years spent in school)

X_5= Marital status (Married = 1, otherwise = 0)

X_6 = Farming experience (Number of years in pig production)

X_7 = Stock size (Number of pigs)

X_8 = Extension contact (number of visit)

X_9 = Credit access (access = 1, non-access = 0)

X_{10} = Cooperative membership (years)

ei = Error term.

- Hypothesis 2: There is no significant relationship between the socio-economic characteristics of pig farmers and their households' food security in the study area.

This hypothesis was tested using multiple regression analysis.

The four functional forms of regression model, namely, linear, semi-log, exponential, and cobb-Douglas were tried. The best fit was chosen as the lead equation based on its conformity with econometric and statistical criteria such as the magnitude of R^2, F-ratio, and number of significant variables.

The four functional forms are expressed as follows;

i. Linear function:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + ei \quad (5)$$

ii. Semi-log function:

$$Y = L_n \beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + \beta_6 L_n X_6 + \beta_7 L_n X_7 + \beta_8 L_n X_8 + \beta_9 L_n X_9 + \beta_{10} L_n X_{10} + ei \quad (6)$$

iii. Exponential function:

$$L_n Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + ei \quad (7)$$

iv. Cobb-Douglas function:

$$L_n Y = L_n \beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + \beta_6 L_n X_6 + \beta_7 L_n X_7 + \beta_8 L_n X_8 + \beta_9 L_n X_9 + \beta_{10} L_n X_{10} + ei \quad (8)$$

Where,

Y = Households' food security (Food secured pig farmers = 1, non-food secured pig farmers = 0)

X_1 = Sex (male = 1, female = 0)

X_2 = Age (Number of years)

X_3 = Household size (Number of household members)

X_4 = Level of education (Number of years spent in school)

X_5 = Marital status (Married = 1, otherwise = 0)

X_6 = Farming experience (Number of years in pig production)

X_7 = Stock size (Number of pigs)

X_8 = Extension contact (number of visit)

X_9 = Credit access (access = 1, non-access = 0)

X_{10} = Cooperative membership (years)

ei = Error term.

- Hypothesis 3: Adoption of pig production technologies does not have significant effect on food security status of the farmers in the study area.

This hypothesis was tested using simple linear regression model.

The model is stated thus:

$$Y = b_0 + b X + ei \ldots \quad (9)$$

Where:

Y = Adoption of improved pig production technologies (mean score)

X = Food security status (as defined in equation 3.1)

e = error term.

- Hypothesis 4: There is no significant relationship between income from pig farming and their households' food security in the study area.

This was tested using simple linear regression analysis.

The model is stated thus:

$$Y = b_0 + b X + ei \ldots \quad (11)$$

Where:

Y = income from pig farming (in Naira)

X = Food security status (As defined in equation 1)

e = error term.

RESULTS AND DISCUSSION

The selected-socio-economic characteristics of the pig farmers considered in this study were age, sex, marital status, household size, educational status, occupational status, membership of social organization, access to credit, and extension contact. The results in Table 1 showed that the majority of the pig farmers (83.3%) were male, while only 16.3% were female. This indicates a clear dominance of males in pig farming in the study area. The dominance of males could notably be attributed to the strenuous, and energy-sapping nature of pig farming which most women may not be able to cope with, hence making it more suitable for males. This is in line with Nwobodo *et al.*,[39] Pig participate substantially in various aspects of pig production and marketing. The dominance of males may be associated with their greater access to productive resources, capital, land, and decision/ making opportunities within the farming system. Production in Nigeria is predominantly undertaken by male farmers, although women also and Okezie *et al*.[47] which also showed dominance of males in pig farming. The involvement of some women in this enterprise is also an indication that women are now venturing into enterprises that are presumed to be meant for men.

The results in Table 1 showed that 28.3% of the pig farmers in the study area were between the ages of 41 and 50 years, 25.8% were between 51 and 60 years while 20.0% were between the ages of 31 and 40 years. A mean age of approximately 47 years was recorded among the pig small farmers in the study area. This shows that the pig farmers were relatively young, are in their very active and energetic age.

Table 1: Distribution of respondents according to their selected socio-economic characteristics in the study area (n=120)

Variables	Frequency	Percentage	Mean ($\bar{x}$)
Sex			
Female	20	16.7	
Male	100	83.3	
Age (years)			
21–30	17	14.2	47 years
31–40	24	20.0	
41–50	34	28.3	
51–60	31	25.8	
61–70	14	11.7	
Marital status			
Married	102	85.0	
Single	4	3.3	
Divorced/separated	14	11.7	
Household size (numbers)			
1–3	10	8.3	6 persons
4–6	69	57.5	
7–9	32	26.7	
10–12	9	7.5	
Level of education (years)			
No formal education	3	2.5	12 years
Primary education	32	26.7	
Secondary education	49	40.8	
Tertiary education	36	30.0	
Years of experience			
1–5	43	35.8	10 years
6–10	45	37.5	
11–15	14	11.7	
16–20	15	12.5	
21–25	3	2.5	
Major occupation			
Farming	63	52.5	
Trading	29	24.2	
Civil service	10	8.3	
Artisanry	18	15.0	
Extension contact (numbers)			
No contact	59	49.2	
Monthly	6	5.0	
Fortnightly	54	45.0	
Weekly	1	0.8	
Access to credit			
Yes	8	6.7	
No	112	93.3	
Cooperative membership			
Yes	104	86.7	
No	16	13.3	

Source: Field Survey, 2025

Hence, will be able to undertake the strenuous and rigorous tasks involved in pig farming. In line with this finding, Ezeibe *et al*.,[21] showed a mean age of 48 years among pig producers, suggesting that pig farming is a viable livelihood for middle-aged individuals who can manage the physical demands and financial risks of the enterprise.

The results in Table 1 also showed that majority of the pig farmers (85.0%) were married. This has positive implication. The pig farmers have greater tendency of having more children and family members, which may provide the labor needed for the pig farm enterprise. This is in conformity with the findings of Nwobodo *et al*.[39] and Ajala and Adesehinwa[11] which also reported majority of pig farmers being married.

Household size is important because it determines the supply of family labor. The result in Table 1 showed that the larger proportion (57.7%) of the pig-farming households consist of 4–7 household members, 26.7% had 4–6 household members, while 8.3% had 1–3 household members. A mean household size of six persons was recorded in the study, implying a moderately large household size. This has both positive and negative implications. According to Ezeibe *et al*.,[21] a large household provides labor for tasks such as feeding, pen cleaning, and piglet care. However, large households might also exert pressure on household food needs, possibly affecting food security, as noted by Okoli *et al.* (2024).

The distribution of the respondents based on their education qualification as presented on Table 1, showed that about 40.8% of the pig farmers had secondary education as their highest educational qualification, while 30.0% of them had tertiary education as their highest educational qualification. While only 2.5% had no formal education. This connotes high literacy of the pig farmers in the study area. According to Apus and Nwachukwu (2014), the more educated the rural households are, the more readily they can adopt innovations that will lead to increased output.

The result of the distribution of the pig farmers based on their years of experience in pig farming as presented on Table 4.1, showed that majority of the pig farmers (73.3%) had years of experience between 1 and 10 years, while about 26.7% of the pig farmers had years of experiencing pig farming

above 10 years. The mean years of experience of approximately 10 years further buttress this finding. According to Kalu *et al*.,[29] farmers with many years of experience would have acquired better understanding on both technical and economic issues associated with any productive enterprise that they are involved in.

The distribution of the pig farmers according to their major occupation, as shown in Table 4.1, showed that more than proportion of the pig farmers (52.5%) had farming as their major occupation, 24.2% were majorly into trading, while 15.0% were artisans. The findings support the age long notion that farming is the major occupation of most rural dwellers. This is in line with Onu and Maduka,[52] who posited that farming is the major occupation and source of income for rural dwellers in developing countries of the world.

The results in Table 1 revealed that 49.2% of the pig farmers had no extension contact, 45.0% had extension contact fortnightly, while 5.0% had extension contact monthly. This shows that about half proportion of the pig farmers had extension contact. Access to extension services increases awareness of improved pig production technologies. According to Okezie *et al*.,[48] frequent contact with extension agents enhances knowledge of better feeding, breeding, and housing practices. Ezeibe *et al*.,[21] also found that extension contact significantly improved productivity and income among pig farmers.

The results in Table 4.1 showed that majority of the pig farmers (93.3%) had no access to credit, while only 6.7% had received credit. According to Oladoyin,[49] lack of access to credit facilities constitutes a constraint in purchasing raw materials and other enterprise inputs. Access to credit is regarded as one of the key elements in raising productivity.

From the results in Table 1, majority (86.7%) of the pig farmers were members of cooperative society, while 13.3% do not belong to corporative society or any formal organization. Okoli *et al*. (2024) found that group participation enhanced the farmers' bargaining power and technical knowledge, which, in turn, improved production outcomes.

Result in Table 2 shows the results of the production systems used by the pig farmers in the study area.

The results showed that the majority (95.8%) of the pig farmers employ intensive production systems, while 4.2% use semi-intensive systems. The utilization of intensive management systems in the study area ensures that pigs are confined in well-ventilated buildings where they are well-fed and cared for, which reduces disease infestation and ensures high productivity. This finding aligns with Adebiyi and Oluwatosin (2024),[4] who reported that intensive pig farming is increasingly dominant in peri-urban and rural areas of Nigeria due to land constraints, biosecurity concerns, and the need for higher productivity per unit area. The use of good pig production systems will ensure greater productivity, which translates to higher income and improved household food security among pig farming households.[24]

The result in Table 3 shows the results of the pig breeds reared by pig farmers in the study area.

The results showed that the majority (72.5%) of pig farmers reared crossbreeds, 20.0% reared local breeds, while 7.5% reared exotic breeds. This indicates minimal use of primitive or local pig production systems in the study area. The preference for crossbreeds suggests an intentional strategy to combine the hardiness of local breeds with the superior growth rates of exotic breeds. According to Fasanya *et al*.,[25] crossbred pigs exhibit better feed conversion ratios and disease resistance compared to pure local breeds, making them more suitable for smallholder intensive systems. The use of improved breeds will ensure greater productivity, which translates to greater income and improved household food security.[44]

Table 2: Distribution according to the production systems used by the pig farmers in the study area (*n*=120)

Pig production systems	Frequency	Percentage
Intensive	115	95.8
Extensive	0	0
Semi-intensive	5	4.2
Total	120	100

Source: Field Survey, 2025

Table 3: Distribution according to the production systems used and pig breeds reared by the pig farmers in the study area

Breed of Pigs reared	Frequency	Percentage
Local breeds	24	20.0
Exotic breeds	9	7.5
Cross breeds	87	72.5
Total	120	100

Source: Field survey, 2025

Table 4: Level of adoption improved pig production technologies among pig farmers in the study area

S. No.	Pig production technologies	Awareness	Interest	Evaluation	Trial	Adoption	Mean ($\bar{x}$)	Decision
1	Housing and pen improvement	4 (4)	4 (8)	0 (0)	1 (4)	111 (555)	4.76	Adoption
2	Waste management and sanitation practices	22 (22)	5 (10)	1 (3)	12 (48)	80 (400)	4.03	Adoption
3	Feeding practices (balanced diet)	3 (3)	29 (58)	0 (0)	29 (116)	59 (295)	3.93	Adoption
4	Breeding management practices	27 (27)	3 (6)	1 (3)	9 (36)	80 (400)	3.93	Adoption
5	Vaccination and routine veterinary care	22 (22)	5 (10)	0 (0)	28 (112)	65 (325)	3.91	Adoption
6	Use of improved boars	7 (7)	35 (70)	2 (6)	6 (24)	70 (350)	3.81	Adoption
7	Disease monitoring and biosecurity measures	32 (32)	12 (24)	1 (3)	19 (76)	56 (280)	3.46	Adoption
8	Water supply management	24 (24)	28 (56)	2 (6)	8 (32)	58 (290)	3.40	Adoption
9	Record-keeping of production data	43 (43)	6 (12)	0 (0)	12 (48)	59 (295)	3.32	Adoption
10	Use of medication and growth promoters	41 (41)	17 (34)	0 (0)	6 (24)	56 (280)	3.16	Adoption
11	Artificial insemination	61 (61)	42 (84)	3 (15)	3 (12)	9 (45)	1.81	Adoption
	Grand mean						3.59	Adoption

Source: Field Survey, 2025

Table 4 shows the distribution of the pig farmers according to their level of adoption of improved pig production technologies in the study area.

The figures in parenthesis are the percentages are frequencies multiplied by Likert nominal values.

The results in Table 4 showed that pig farmers adopted improved pig production technologies ($\bar{x} = 3.59$) in the study area. Among the technologies, housing and pen improvement ($\bar{x} = 4.76$), waste management and sanitation practices ($\bar{x} = 4.03$), feeding practices ($\bar{x} = 3.93$), and breeding management practices ($\bar{x} = 3.93$) were the most adopted. Artificial insemination ($\bar{x} = 1.81$) was the least adopted, with its mean below the benchmark of 3.0, indicating very low adoption. The low adoption of artificial insemination could be due to its technical complexity, lack of farmers' familiarity, lack of skilled personnel, poor awareness, and the high cost associated with the technology. Artificial insemination requires specialized skills and proper handling procedures, which many rural pig farmers may not possess. This conforms with the findings of Adebayo *et al*.,[2] who posited that despite the advantages of artificial insemination, adoption remains low in rural Nigerian pig production systems due to limited awareness, high costs, inadequate extension services, and a shortage of trained AI technicians. Similarly, Ogunsola and Famakinwa[43] noted that AI adoption in sub-Saharan African pig systems is further constrained by unreliable access to quality semen and poor record-keeping infrastructure. The distribution of the pig farmers in accordance with their income status is shown in Table 5 below.

Table 5: Distribution of respondents according to estimation of income status of the pig farmers in the study area

Income (N)	Frequency	Percentage
≤200000	13	10.8
201,000–400,000	17	14.2
401,000–600,000	29	24.2
601,000–800,000	17	14.2
801,000–1000,000	19	15.8
Above 1000,000	25	20.8
Mean ($\bar{x}$)	1,043,000.00	

Source: Computed from Field Survey, 2025

The results in Table 5 showed that the mean annual pig income and standard deviation of the pig farmers were given as N1,043, 000.00. Furthermore, 24.2% of farmers earned between ₦401,000–600,000, while 20.8% earned above ₦1,000,000. The result indicates that pig farming constitutes an important source of livelihood and income generation among rural households in the study area. Pig production is widely recognized as a profitable livestock enterprise due to pigs' fast growth rate, high reproductive capacity, and efficient feed conversion ability.[26] The substantial income realized by some of the farmers may be attributed to their adoption of improved management practices and technologies, which enhance productivity and reduce mortality.

This finding aligns with Onah *et al*.,[51] who showed that small-scale pig farming can earn substantial incomes for rural households, especially where feed costs, experience, and capital access are well-managed. In addition, Oyewole and Salau (2024) reported that pig farming contributes significantly to rural livelihoods in Southwest Nigeria, often

serving as a primary savings and investment vehicle for women and youth.

The high income generated from pig farming has important implications for poverty reduction and improved household welfare. Increased income enables farmers to meet household needs such as feeding, education, healthcare, and reinvestment into agricultural production.

Result in Table 6 showed the results of the food security status of the pig farmers in the study area before and after the adoption of pig production technologies.

The result in Table 6 showed that majority (70.8%) of the pig farming households were food secure, while 29.2% were food insecure. The improved food security of the pig farmers could be attributed to their adoption of the improved pig production technologies. The adoption of these technologies is expected to improve productivity, which will translate to higher income from pig production, and ultimately culminate to improved household food security.

According to the FAO,[26] livestock production plays a key role in improving household food security by providing animal protein, income, employment opportunities, and financial stability. Pig farming particularly contributes to household nutrition and income diversification because pigs reproduce quickly and can be sold easily during financial emergencies. The finding is also consistent with Adeowale *et al*.,[6] who reported that adoption of improved livestock technologies significantly improves household food security among rural farming households through increased productivity and income generation. Therefore, increased adoption of improved pig production technologies could serve as an important strategy for enhancing food security and reducing poverty among rural households.

Result in Table 7 showed the results of the constraints to use of improved pig production technologies among pig farmers in the study area.

Table 6: Determination of food security status of rural pig farming households in the study area

Food security status	Frequency	Percentage
Food secure	85	70.8
Food insecure	35	29.2
Total	120	100

Source: Field survey, 2025

Figures in parenthesis are frequencies multiplied by Likert nominal values.

The results in Table 7 revealed that major constraints affecting the adoption of improved pig production technologies was high cost the of improved pigs ($\bar{x}$ = 2.65), poor access to credit ($\bar{x}$ = 2.56), feed unavailability/high cost ($\bar{x}$ = 2.47), and poor veterinary services ($\bar{x}$ = 2.33). The high cost of improved breeds makes them unaffordable for many smallholder pig farmers who operate with limited capital. Consequently, many farmers continue to rely on less productive local breeds that they can afford. High interest rates, lack of collateral, and bureaucratic loan processes hinder access to credit. In line with this finding, Akinbode and Oluwole[13] stressed that most pig farmers struggle to secure institutional loans, limiting their ability to expand herd size or invest in improved infrastructure such as pens and biosecurity measures.

Feed constitutes the largest proportion of production costs in pig farming, and rising feed prices significantly reduce profitability. High feed costs prevent farmers from providing required quality and quantity. According to Eze *et al*.,[24] escalating feed costs remain one of the greatest challenges facing pig producers in Nigeria, particularly due to fluctuations in the prices of maize and soybean meal used in feed formulation. Similarly, Nwosu and Ugwumba[40] found that feed costs account for 60–70% of total pig production costs in sub-Saharan Africa, making feed price volatility a critical constraint that forces farmers to reduce rations or substitute with lower-quality alternatives. Poor veterinary services also hinder technology adoption and productivity. Limited access to veterinary personnel, drugs, and diagnostic services increases disease prevalence and mortality among pigs. Inadequate veterinary care can discourage farmers from investing in improved technologies because of the associated production risks.[3]

Other significant constraints included high cost of maintenance ($\bar{x}$ = 2.17), pest/disease outbreaks ($\bar{x}$ = 2.12), inadequate credit facilities ($\bar{x}$ = 2.11), and high labor cost ($\bar{x}$ = 2.08).).

Hypotheses Testing

Hypotheses 1: There is no significant relationship between socio-economic characteristics of pig

Table 7: Constraints to the adoption of improved pig production technologies among pig farmers

S. No.	Constraints	Very serious	Serious	Not serious	Mean (x̄)	Standard deviation
1	High cost of improved pigs	85 (255)	28 (56)	7 (7)	2.65	0.589
2	Poor access to credit	80 (240)	27 (54)	13 (13)	2.56	0.683
3	Feed unavailability/high cost	74 (222)	29 (29)	17 (17)	2.47	0.733
4	Poor veterinary services	58 (174)	44 (88)	18 (18)	2.33	0.726
5	High cost of maintenance	37 (111)	66 (132)	17 (17)	2.17	0.653
6	Pest/disease outbreaks	37 (111)	60 (120)	23 (23)	2.12	0.7
7	Inadequate credit facilities	46 (138)	41 (82)	33 (33)	2.11	0.807
8	High labor cost	33 (99)	64 (128)	23 (23)	2.08	0.681
9	Lack of technical knowledge/training	15 (45)	82 (164)	23 (23)	1.93	0.561
10	Inadequate water supply	12 (36)	73 (146)	35 (35)	1.81	0.598
11	Erratic power supply	11 (33)	50 (100)	59 (59)	1.60	0.653
13	Poor infrastructure (roads, electricity, etc.)	10 (30)	41 (82)	69 (69)	1.51	0.648
14	Climate change issues	9 (27)	29 (58)	82 (82)	1.39	0.626
	Grand mean				2.06	

Source: Field Survey, 2025

farmers and adoption of improved pig production technologies.

The result in Table 8 shows the multiple regression analysis result of the relationship between selected socio-economic characteristics of the pig farmers and adoption of improved pig production technologies in the study area. The semi-log function was chosen as the lead based on the econometric parameters such as high magnitude of co-efficient of determination and F-ratio as well as the number of significant variables. The coefficient of determination value of 0.711 implies that 71.1% of the variations in adoption were explained by the socioeconomic characteristics included in the model. The significant F-ratio at 1% probability level indicates that the model provided a good fit to the data and that the explanatory variables jointly influenced technology adoption among the pig farmers. The regression result revealed that education, marital status, stock size, and extension contact significantly influenced the adoption of improved pig production technologies in the study area.

The coefficients of education (0.411**) was positive and significant at 5% probability level, indicating that adoption of improved pig production technologies increased with higher levels of education among the pig farmers. Education enhances farmers' ability to access, process, and utilize information relating to improved technologies and management practices. Educated farmers are generally more innovative, better informed, and more willing to adopt modern agricultural technologies because they can better evaluate the associated benefits and risks. This finding agrees with the study of Adeola *et al*.,[5] who reported that educational attainment significantly improves livestock farmers' adoption of improved production technologies due to enhanced decision-making ability and access to agricultural information. Similarly, Obinna and Onu[41] reported that education enhance farmers' awareness, access to market as well as enhances extent of use of improved goat production technologies.

The coefficients of marital status (0.503**) was also positive at 5% probability level, implying that married farmers were more likely to adopt improved pig production technologies than unmarried farmers. Married individuals often have larger household responsibilities and greater economic commitments, which may encourage them to adopt productivity-enhancing innovations to improve household welfare and income. This finding is consistent with the report of Ezeh *et al*.,[20] who observed that married farmers tend to adopt improved agricultural technologies more readily due to their increased household obligations and desire for economic stability.

The coefficients of stock size (0.001**) was positive and significant at 5% probability level. This suggests that farmers with larger herd sizes were more likely to adopt improved pig production technologies. Farmers operating on a larger scale are usually more

Table 8: OLS regression estimates of the relationship between socio-economic characteristics of the pig farmers and adoption of improved pig production technologies

Variables	Linear	Exponential	Semi-log+	Cob Douglas
Constant (X_0)	2.167 (4.097)***	0.8547 (5.233)***	2.607 (2.347)**	0.938 (2.388)**
Sex (X_1)	0.239 (1.105)	0.054 (0.816)	0.137 (0.617)	0.027 (0.397)
Age (X_2)	0.002 (0.344)	0.001 (0.424)	0.164 (0.526)	0.060 (0.622)
Household size (X_3)	0.024 (0.587)	0.007 (0.556)	0.072 (0.283)	0.021 (0.267)
Education (X_4)	0.031 (1.545)	0.009 (1.530)	0.411 (2.043)**	0.120 (1.829)*
Marital status (X_5)	0.503 (2.062)**	0.162 (2.171)**	0.503 (2.019)**	0.158 (2.057)**
Years of experience (X_6)	−0.003 (−0.155)	−0.003 (−0.529)	0.004 (0.023)	0.013 (−0.255)
Stock size (X_7)	0.003 (1.859)*	0.125 (1.715)*	0.001 (2.075)**	0.039 (1.729)*
Extension contact (X_8)	0.492 (5.768)***	0.134 (5.134)***	0.880 (5.439)***	0.240 (4.801)***
Credit access (X_9)	−9.995E008 (−0.181)	−7.381E-009 (−0.044)	0.000 (−0.019)	0.001 (0.084)
Cooperative membership ($X1_0$)	−0.210 (−0.866)	−0.063 (−0.847)	−0.198 (−0.809)	−0.061 (−0.813)
R-square	0.695	0.648	0.711	0.658
Adjusted R-square	0.640	0.588	0.656	0.597
F-ratio	10.119***	8.813***	10.409***	8.903***

Source: Computed from Field Survey, 2025. *, ** and *** are significant at 10.0%, 5.0% and 1.0% levels of probability respectively. + = lead equation. Figures in parentheses are *t*-values. Decision: H_0 rejected

commercially oriented and financially capable of investing in innovations such as improved housing, feeding systems, and veterinary services. According to Ibrahim *et al*.,[28] livestock farmers with larger herd sizes are more likely to adopt modern production technologies because they possess greater financial resources and stand to gain more from productivity improvements.

Extension contact (0.880**) was positive and highly significant at 1% probability level, indicating that increased interaction with extension agents significantly enhanced farmers' adoption of improved pig production technologies. Extension services play a critical role in disseminating information, providing technical guidance, and creating awareness about improved farming practices. Farmers who maintain regular contact with extension agents are more exposed to innovations and are therefore more willing to adopt improved technologies. This finding corroborates the report of Adebayo *et al*.,[1] who noted that extension contact significantly influences technology adoption among livestock farmers through improved access to information, training, and advisory services.

Based on these findings, the null hypothesis which states that there is no significant relationship between selected socio-economic characteristics of pig farmers and their adoption of improved pig production technologies in the study area was rejected at 5% level of significance.

Hypothesis 2: There is no significant relationship between socio-economic characteristics of pig farmers and their households' food security.

Result in Table 9 shows the multiple regression analysis result of the relationship between socio-economic characteristics of the pig farmers in the study area and households' food security in the study area. Among the functional forms estimated, the exponential function was selected as the lead equation because it recorded the highest coefficient of determination (R^2 = 0.657), significant F-ratio (12.278), and more statistically significant variables. The coefficient of determination (R^2 = 0.657) implies that 65.7% of the variations in household food security were explained by the socioeconomic characteristics included in the model. The significant F-ratio at 1% probability level further confirms the overall fitness and reliability of the regression model. The result showed that age, household size, stock size, and credit access significantly influenced household food security among pig farmers in the study area.

The coefficients of age (0.011***) was positive and highly significant at 5% probability level, indicating that household food security increased with farmers' age. Older farmers are often assumed to possess more farming experience, better managerial ability, and stronger social networks, which may improve productivity and income generation. This finding agrees with Adesina *et al*.,[9] who found that farming

Table 9: OLS regression estimates of the relationship between selected socio-economic characteristics of the pig farmers and their households' food security

Variables	Linear	Exponential+	Semi-log	Cob Douglas
Constant (X_0)	1.816 (4.146)***	0.597 (2.418)**	0.621 (2.546)**	0.026 (2.040)**
Sex (X_1)	0.287 (1.527)	0.112 (1.053)	0.277 (1.366)	0.095 (0.829)
Age (X_2)	0.016 (2.810)**	0.011 (3.182)***	0.738 (2.624)**	0.465 (2.931)***
Household size (X_3)	−0.224 (6.332)***	−0.167 (−8.367)***	−1.386 (−6.073)***	−1.015 (−7.878)***
Education (X_4)	0.017 (0.990)	0.015 (1.538)	0.048 (0.241)	0.077 (0.685)
Marital status (X_5)	0.4332 (0.21)	0.0111 (0.41)	0.0150 (0.19)	0.5321 (0.26)
Years of experience (X_6)	−0.008 (−0.531)	−0.001 (−0.176)	0.007 (0.046)	0.006 (0.073)
Stock size (X_7)	0.005 (3.197)***	0.003 (3.416)***	0.135 (2.084)**	0.102 (2.781)**
Extension contact (X_8)	0.065 (0.888)	0.003 (0.078)	0.162 (1.109)	0.034 (0.407)
Credit access (X_9)	1.576E006 (3.370)***	1.169E−006 (4.427)***	0.054 (2.260)**	0.044 (3.314)***
Cooperative membership (X_{10})	0.236 (1.125)	0.162 (1.371)	0.024 (0.107)	0.026 (0.211)
R-square	0.545	0.657	0.503	0.616
Adjusted R-square	0.492	0.612	0.444	0.567
F-ratio	8.443***	12.278***	7.170***	10.473***

Source: Computed from field survey, 2025. *, ** and ***are significant at 10.0%, 5.0% and 1.0% levels of probability respectively. + = lead equation. Figures in parentheses are *t*-values. Decision: H_0 rejected

experience and age positively influenced household food security among rural livestock farmers because older farmers tend to diversify income sources and possess better coping strategies.

The coefficient for household size (−0.167***) was negative and highly significant at 1% probability level. This implies that food security decreased as the household size increased. This is as expected as the consumption of foods tend be higher for those with large family than those with smaller ones. In line with this finding, larger households tend to place greater pressure on available household resources, thereby increasing consumption expenditure and reducing per capita food availability. This finding is consistent with the report of Oke *et al*. (2023) who reported an inverse relationship between household size and food security status. In other words, larger household size was associated with poorer food security outcomes. This is due to the fact that larger households may not be able to meet up with the consumption need of each household member, and the available food income is rationed among the household members, thus leading to higher food insecurity.

The coefficients of stock size (0.003***) was positive and highly significant at 1% probability level, indicating that farmers with larger pig stock sizes were more food secure. Larger herd sizes generally translate into higher farm income, improved savings, and greater purchasing power, thereby enhancing households' ability to meet their food needs. This finding corroborates the study of Yusuf *et al*.,[54] who reported that livestock asset ownership positively influences household food security by improving income generation and resilience against economic shocks.

Credit access (1.169E-006***) was positive and highly significant at 1% probability level. This implies that access to credit improved household food security among the pig farmers. Access to credit enables farmers to procure production inputs, adopt improved technologies, expand production, and withstand financial constraints during difficult periods. Adequate credit also enhances farmers' investment capacity and productivity, ultimately improving household welfare and food security. This finding aligns with the report of Okeke *et al*.,[46] who observed that access to agricultural credit significantly improved food security among smallholder livestock farmers through increased investment in productive activities.

Consequently, the null hypothesis stating that there is no significant relationship between socio-economic characteristics of pig farmers and household food security was rejected at 5% significance level.

Hypothesis 3: There is no significant relationship between adoption of improved pig farming and their household food security in the study area.

Result in Table 10 shows the simple linear regression analysis of the effect of adoption of improved pig production technologies on household food security of pig farmers in the study area.

From the Table 10, the coefficient of determination ($R^2 = 0.290$) indicates that 29.0% of the variations in food security were explained by the adoption of improved pig production technologies. The significant F-ratio (8.941) at 1% probability level indicates that the model adequately explained the relationship between technology adoption and household food security.

The coefficient of adoption of improved pig production technologies (0.223) was positive and significant at 1% probability level. This implies that household food security increased as farmers adopted more improved pig production technologies. Adoption of improved technologies such as improved feeding, disease management, breeding practices, and housing systems enhances productivity, reduces mortality, and increases farmers' income, which subsequently improves households' access to food. This finding agrees with Adesomoju *et al*.,[10] who reported that adoption of improved livestock production technologies significantly enhanced food security among rural households by increasing productivity and farm income. Similarly, FAO[27] emphasized that improved livestock technologies contribute substantially to sustainable food systems, improved nutrition, and rural household welfare.

Therefore, the null hypothesis stating that adoption of improved pig production technologies has no significant influence on household food security was rejected at 5% level of significance.

Hypothesis 4: There is no significant relationship between income from pig farming and their households' food security in the study area.

Result in Table 11 presents the simple linear regression analysis of the relationship between income from pig production and households' food security in the study area.

The coefficient of determination ($R^2 = 0.327$) indicates that 32.7% of the variation in food security was explained by income from pig production. The F-ratio of 6.145 which was significant at 1% shows the goodness-of-fit of the model.

From the Table, the coefficient of income (1.202E-007) was positive and significant at 5% probability level, indicating that household food security improved as income from pig production increased. Increased income enables households to purchase sufficient and nutritious food, access healthcare services, and invest in productive assets. Farmers with higher income are also more capable of adopting improved production technologies that further enhance productivity and welfare. This finding is consistent with the study of Ojo *et al*.,[45] who reported that increased livestock income significantly improved food accessibility and reduced vulnerability to food insecurity among rural households. Similarly, Akinbile *et al*.[12] noted that livestock enterprises serve as important sources of income and food security for rural households in developing countries.

Hence, the null hypothesis which states that there is no significant relationship between the income from pig production and households' food security in the study area was therefore rejected at 5% alpha level.

Table 10: Simple linear regression estimates of the adoption of improved pig farming technologies on household' food security of farmers in the study area

Variables	Coefficients	Standard error	t-value
Constant	0.700	0.278	2.518**
Adoption of improved pig production technologies	0.223	0.074	2.990***
R-square	0.290		
Adjusted R-square	0.183		
F-ratio	8.941		

Source: Computed from Field Survey, 2025. Key: ** and ***Significance at 5% level of probability, + = Lead Equation and the values in bracket are the t-value. Decision: H_0 rejected

Table 11: Simple linear regression estimates of the relationship between income from pig production and households' food security

Variables	Coefficients	Standard error	t-value
Constant	1.375	0.099	13.872***
Income	1.202E-007	0.000	2.036**
R-square	0.327		
Adjusted R-square	0.261		
F-ratio	6.145		

Source: Computed from Field Survey, 2025. ** and ***Significance at 5% level of probability, + = Lead Equation and the values in bracket are the t-value. Decision: H_0 rejected

CONCLUSION

The study concluded that pig farmers mostly used intensive management system in their pig

production, and cross breeds were mostly reared by the farmers and had high adoption of pig production technologies. Education stock size and extension contact influenced pig farmers' adoption of improved pig production technologies in the study area. However, age, household size, stock size, and credit access influenced food security status of pig farmers in the study area. Adoption of improved pig production technologies had effect on the household food security of farmers, while income had a positive effect on the household food security of farmers in the study area.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Giving the poor access to credit, there is need to provide mechanisms for accessing credits by rural pig farmers, through establishment of more micro credit/financial scheme within rural communities so as to ensure easy access to credit facilities, enlightening the farmers on credit facilities available to them, and linking the farmers to appropriate financial institutions to provide adequate capital for farm investment.
2. The government through the state extension agency should provide regular training program for the pig farmers to create awareness and deepen the capacity of the farmers on the technology like artificial insemination, to increase its awareness and adoption among the farmers.
3. The smallholder pig farmers should be encouraged and supported to increase their scale of production so as to ensure increased income and greater influence of their production on their households' food security.
4. The government should provide subsidized inputs (Feeds and Medication) to pig farmers in the state to increase their dwindling stock and prevent farmers from quitting the enterprise as observed from the field.
5. The State Government Policies in livestock breeding should include management and improved sanitary conditions should be advocated for to eradicate disease outbreak in pig farms to reduce losses.

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