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RESEARCH ARTICLE

Farm Income, Food Security and Constraints to Adoption of Climate - Smart Technologies among Pig Farmers in Abia State Nigeria

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ABSTRACT

This study assessed the income, food security and perceived constraints to adoption of climate-smart technologies among Pig farmers in Abia State Nigeria. It specifically estimated the income realized from pig farming, determined their food security status, and examined constraints to adoption of climate-smart technologies among pig farmers in the study area. Multi-stage sampling procedure was used to select one hundred and twenty (120) pig farmers. Data were collected using a structured questionnaire and analyzed with descriptive statistics and simple regression analysis. Pig farmers had a mean farm income of N1,04,3000.00. Result showed that 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 climate -smart technologies. Simple regression showed that adoption of climate Smart 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 climate-smart technologies, as adoption and income had effect on farmers' household food security. The study therefore recommended that extension agencies should provide regular training programs on the use of climate-smart technologies to pig farmers. 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: Climate-smart technologies, constraints to technology adoption, farm income, food security, pig farmers

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 Ritchie *et al*.,[28] 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.[3] 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

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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%. According to Chenais *et al*.,[10] Pig production provides an important source of livelihood for Smallscale farmers. Thus, increasing pig production capacity through technology adoption is crucial in enhancing the food security and income of rural pig farmers in Nigeria.

Technology could be described as the application of scientific knowledge to solve problems, enhance efficiency, and improve outcomes.[18] Climate-smart 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.[19] These technologies are used to improve growth rates, reproduction, disease resistance, and overall sustainability of pig production. Among these technologies are: 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.[22]

Climate-smart 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 climate-smart 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.[11]

Food security refers to the availability, accessibility, and utilization of food that meets dietary needs for an active and healthy life.[26] 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.[24]

Nevertheless, socio-cultural beliefs and other factors significantly influence pig production in Nigeria.[12] 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.[8] On the health front, pig farmers face challenges, such as the prevalence of zoonotic diseases, such as African pig fever and pig flu, which threaten herd health and productivity, necessitating improved veterinary services and biosecurity measures.[21] 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.[12]

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.[17] 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 smallholder 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. Kalu *et al*.,[17] 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. Without empirical evidence on this relationship, policymakers, agricultural extension personnel and development agencies may find it difficult to design appropriate interventions aimed at improving pig production and reducing household food insecurity.

This study therefore seeks to assess the farm income, food security, and constraints to adoption of improved pig production technologies on the household food security of farmers in Abia State.

The broad objective of the study is to assess the income, food security, and Constraints to adoption of climate-smart technologies of farmers in Abia State, Nigeria.

The specific objectives were to:

i. Estimate the income realized from pig farming among farmers;
ii. Determine the food security status of farmers; and
iii. Examine constraints to adoption of climate-smart technologies among pig farmers in the study area.

The hypothesis was tested:

i. H_{0i}: There is no significant relationship between income from pig farm income and their food security in the study area.

METHODOLOGY

The study was conducted 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.

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

Multi stage sampling technique was employed in selecting the sample size of 120 respondents.

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

Objective 1: 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 percentages, and its mean scores were derived.

Objective 2: 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 falls 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-thirds 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;

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

Where M = number of food secure/insecure households
N = the number of households in the sample

Objective 3: Examine Constraints to Adoption of Pig Production technologies among Farmers in the Study Area

This was measured by providing a list of nine (9) constraint items to the respondents. They were asked to state the severity of each constraint item 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

Model Specification

Model specification technologies does effect farmers adoption of climate-smart not have significant on food security status of the in the study area.
This hypothesis was tested using a simple linear regression model
The model is stated thus:

$$Y = b_0+bX+ei\ldots$$

Where:
Y = Adoption of climate Smart technologies (Mean score)
X = Food security status
e = error term.

Hypothsis 2

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:

$$Y = b_0+bX+ei\ldots$$

Where:
Y = income from pig farming (in Naira)
X = Food security status
e = error term

RESULTS AND DISCUSSION

The results in Table 1 showed that the mean farm 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.[14] The substantial income realized by some of the farmers may be attributed to their adoption of

Table 1: Distribution of respondents according to estimation of income status of the pig farmers in the study area (*n*=120)

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

improved management practices and technologies, which enhance productivity and reduce mortality.

This finding aligns with Onah *et al.*,[27] 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 2 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 results in Table 2 showed that the 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,[14] livestock production plays a vital 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.*,[2] 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.

Table 2: Determination of food security status of rural pig farming households in the study area (*n*=120)

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

Source: Field survey, 2025

Results in Table 3 show constraints to the use of improved pig production technologies among pig farmers in the study area (*n*=120).

The results in Table 3 revealed that major constraints affecting the adoption of improved pig production technologies were the high cost 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[7] 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 the required quality and quantity. According to Ezeh and Michael,[13] 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[23] 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.[1]

Table 3: Distribution of respondents according to perceived constraints to the use of improved pig production technologies in Abia State

S. No.	Constraints	Very serious	Serious	Not serious	Mean ($\bar{x}$)	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 labour 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
12.	Poor infrastructure (roads, electricity, etc.)	10 (30)	41 (82)	69 (69)	1.51	0.648
13.	Climate change issues	9 (27)	29 (58)	82 (82)	1.39	0.626
	Grand mean				2.06	

Source: Field Survey, 2025. Figures in parentheses are frequencies multiplied by Likert nominal values

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 labour cost ($\bar{x}$ = 2.08).

From Table 4, 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 the 1% probability level indicates that the model adequately explained the relationship between technology adoption and household food security.

The coefficient of adoption of climate-smart 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*.,[5] who reported that adoption of improved livestock production technologies significantly enhanced food security among rural households by increasing productivity and farm income. Similarly, FAO[15] emphasized that improved livestock technologies contribute substantially to sustainable food systems, improved nutrition, and rural household welfare.

Table 4: 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 the 5% level of probability, +=Lead Equation, and the values in bracket are the t-values. Decision: H_0 rejected

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

Result in Table 5 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 Table 5, the coefficient of income (1.202E-007) was positive and significant at the 5% probability level, indicating that household food

Table 5: 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 the 5% level of probability, +=Lead Equation, and the values in bracket are the *t*-values. Decision: H_0 rejected

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*.,[25] who reported that increased livestock income significantly improved food accessibility and reduced vulnerability to food insecurity among rural households. Similarly, Akinbile *et al*.[6] 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 the 5% alpha level.

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 climate-smart 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 climate smart technologies had effecton 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 a need to provide mechanisms for accessing credit by rural pig farmers through the 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 programs for the pig farmers to create awareness and deepen the capacity of the farmers on technologies, such as 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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