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ASSESSMENT OF ADOPTION OF IMPROVED AGRICULTURAL TECHNOLOGIES AND HOUSEHOLD FOOD SECURITY AMONG FARMERS IN AKWA IBOM STATE, NIGERIA

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Abstract

The study assessed adoption of improved agricultural technologies and household food security among farmers in Akwa Ibom State, Nigeria. The Population of this study consisted of all rural farmers in Akwa Ibom State, Nigeria. Using a multistage sampling technique, 335 farmers were selected across six Local Government Areas and data were collected using a structured questionnaire. Analysis was conducted using descriptive statistics, Technology Adoption Index (TAI), food security measurement tools (HFIAS, HDDS, FCS) and multiple regression analysis. The findings revealed that the average age of farmers was 44.2 years old, with a mean farm size of 2.3 hectares, a monthly income of ₦82,700 and a household size of 5.6 persons, respectively. Based on Technology Adoption Index (TAI), 26.3% of the farmers had low adoption, 48.4% had medium adoption and 25.3% had high adoption levels. Food security assessment showed varied household outcomes regression results identified income, education, farm size and adoption level as significant predictors of food security ($P < 0.05$). The study concluded that moderate adoption of improved technologies was associated with improved food security outcomes among farming households. Based on the findings, it was recommended that agricultural extension services be strengthened to promote awareness and practical application of underutilized but impactful technologies such as irrigation and climate-smart practices which should be adopted.

Keywords: Assessment, Adoption, Improved Agricultural Technologies, Household, Food Security

1.0 Introduction

The global demand for sustainable food systems and enhanced agricultural productivity has increasingly underscored the critical role of improved agricultural technologies in addressing food security challenges, particularly in developing regions. Innovations such as improved seed varieties, mechanization, fertilizer application, pest control measures, irrigation systems and digital farming tools have demonstrated potential to boost crop yields, enhance resource use efficiency and reduce vulnerability of farming households to climatic and economic shocks (Rizzo *et al*., 2024; Adeyemo *et al*., 2024). However, diffusion and adoption of these technologies, vary widely due to multiple socio-economic, institutional and environmental factors (Bogado *et al*., 2024; Ruzzante *et al*., 2021).

Adoption is more than mere access to technology, it involves sustained use of innovations in daily agricultural practices (Fadeyi *et al*., 2022). Evidence suggests that adoption levels are influenced by demographic attributes (e.g., education, age), farming experience, market access, extension services and awareness about food security (Aboagye-Darko and Mkhize, 2025; Smidt and Jokonya, 2021). Consequently, understanding these drivers is essential for tailoring interventions that support agricultural transformation and ensure sustainable food systems.

Food security is defined by the FAO as a situation where all people have physical, social and economic access to sufficient, safe and nutritious food, remains a pressing concern in Sub-Saharan Africa (Onyeaka *et al*., 2024; Gassner *et al*., 2019). Despite the expansion of agricultural technologies, rural farming households continue to experience varying degrees of food insecurity due to low adoption rates, limited farm productivity and systemic inequalities (Ehiwario *et al*., 2024; Kimani, 2024). The linkage between technology adoption and food security outcomes has been acknowledged, but remains underexplored in context-specific settings, especially when considering the depth of multidimensional food security measures such as dietary diversity and access (Pawlak and Kołodziejczak, 2020; Eze and Abe, 2024).

Previous studies have affirmed that enhanced adoption of agricultural innovations can lead to improvements in food availability and access, thereby enhancing household welfare (Muzari, 2016; Chen and Li, 2022). However, the adoption process is often constrained by institutional limitations and socio-economic disparities, making it crucial to assess both the extent of technology use and its tangible effects on food security (Bello *et al*., 2024). An

understanding of these dynamics will inform policies aimed at transforming agriculture into a more inclusive and resilient sector.

In Akwa Ibom State, where agriculture remains a primary livelihood source, existing research suggests notable efforts in technology dissemination; yet, empirical data on actual adoption levels and food security outcomes remain sparse and fragmented. For example, Effiong and Iheme (2024) highlighted the role of media technologies in agricultural production, but do not delve into how these innovations translate into household food security. Asa (2023) provided valuable insights with determinants of food security, but did not explicitly account for the role of technology adoption. Furthermore, Kenneth and Abia (2018) focused on sustainable rural development but did not empirically evaluate specific technology adoption patterns or their direct food security implications. These gaps underscore the need for a comprehensive study that evaluates the types and levels of improved agricultural technologies adopted by farmers and investigates how these influence household food securities in the State.

2.0 The Objective of the Study

The broad objective of this study was to assess adoption of improved agricultural technologies and household food security among farmers in Akwa Ibom State, Nigeria. The specific objectives of the study were to:

i. describe the socio-economic characteristics of farmers.

ii. identify types of improved agricultural technologies, adoptedamong farmers.

iii. determine food security status of farming households in the study area.

iv. identify factors influencing household food security among farmers.

3.0 Methodology

3.1 The Study Area

The study was carried out in Akwa Ibom State, Nigeria. The State is located in the South-South geopolitical zone of the country. The State is bounded by Cross River State to the East, Abia State to the North, Rivers State to the West and the Atlantic Ocean to the South. Covering an area of approximately 7,081 square kilometers, Akwa Ibom is predominantly agrarian, with a large proportion of its population engaged in smallholder and subsistence farming. The target population comprised farmers registered with the All Farmers Association of Nigeria (AFAN),

Akwa Ibom State Chapter, who are actively involved in agricultural production across rural and urban communities in the State.

A multistage sampling technique was employed to select respondents for the study. First, six Local Government Areas (LGAs) were purposively selected. These include: Abak, Etinan, Eket, Ikot Ekpene, Oron and Uyo. These LGAs were chosen based on their high agricultural activity and the concentration of AFAN-registered farmers. In the second stage, 30% of the registered farmers were proportionately selected from each LGA, resulting in a total sample size of 335 respondents. The decision to use 30% was guided by Krejcie and Morgan's (1970) recommendation for determining adequate sample size from a known population, ensuring representativeness, while maintaining manageability for fieldwork.

Primary data were collected using a structured questionnaire data analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics such as frequency counts, percentages, means and standard deviations were used to summarize socio-economic characteristics. For the assessment of the level of adoption of improved technologies, a Technology Adoption Index (TAI) was computed by assigning weighted scores to the frequency of adoption of various technologies using a Likert-type scale ranging from "Not Adopted" (1) to "Fully Adopted" (4). Farmers were then categorized into low, medium and high adopters based on their cumulative adoption scores using percentile cut-offs. To determine household food security status, three validated tools were employed: the Household Food Insecurity Access Scale (HFIAS), the Household Dietary Diversity Score (HDDS) and the Food Consumption Score (FCS). HFIAS scores were categorized into food secure, mildly insecure, moderately insecure and severely insecure based on FAO guidelines. HDDS classified respondents based on the number of different food groups consumed in the past 24 hours, while FCS was computed from the frequency and nutritional weight of food groups consumed over the past seven days. Cross-tabulations were used to explore the distribution of food security status across different adoption categories.

Multiple regression analysis was employed to identify the socio-economic and technological factors influencing household food security. The model was specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \epsilon$$

Where:

- Y = Household Food Security Score (dependent variable),
- X_1 to Xn = explanatory variables (age, gender, education level, household size, farm size, farming experience, monthly income and adoption level of improved technologies),
- β_0 = constant,
- β_1 to βn = coefficients of the explanatory variables,
- ϵ = error term.

This model enabled the estimation of the relative contribution of each variable to household food security outcomes.

4.0 Results and Discussion

4.1 Socio-economic Characteristics of Farmers

Table 1 shows that 32.8% of the farmers were aged 41–50 years, with a mean age of 44.2 years. Males made up 59.1% of the respondents. Education levels were relatively high—35.8% had secondary and 35.5% tertiary education, while only 8.7% had non formal education. Most farmers (42.7%) cultivated 1–2 hectares, with a mean farm size of 2.3 hectares. Monthly income averaged ₦82,700, with 42.7% earning ₦50,000–₦100,000. Households typically had 4–6 members (51.3%), with an average size of 5.6 persons. Farming experience averaged 11.4 years, with 32.8% having 6–10 years of experience.

The socio-economic profile of farmers in Akwa Ibom State, as reflects a population that is both relatively youthful and experienced in agricultural practice. With the majority aged between 31–50 years and an average age of 44.2 years, the farming population is largely within economically productive age brackets. This age structure presents a demographic advantage for the adoption of improved agricultural technologies, as younger and middle-aged farmers tend to be more open to innovation, consistent with Rogers' Diffusion of Innovation theory, which emphasizes the role of adopter categories in technology uptake.

The dominance (59.1%) of male respondents suggests a gender imbalance in farming participation, though the participation of females (40.9%) remains substantial. This observation supports findings by Lahai *et al*. (2000) and Awuor *et al*. (2021), who emphasized persistent gender disparities in agricultural participation and access to resources. While men are often more visible in farming, women's significant involvement highlights the importance of gender-

sensitive agricultural extension strategies to ensure inclusive technology dissemination and training.

The high level of formal education among the respondents, where over 70% had at least secondary education, indicates a relatively literate farming population. This has positive implications for technology adoption since educational attainment enhances farmers' capacity to access, interpret and apply agricultural innovations effectively, as supported by Sennuga *et al*. (2020) and Adeyemo *et al*. (2024). Educated farmers are more likely to benefit from extension services and adopt improved practices, which can boost productivity and resilience.

Table 1 also shows that most (42.7%) farmers were smallholders, with cultivating 1–2 hectares and a mean farm size of 2.3 hectares. This aligns with the structure of Nigerian agriculture, which is largely characterized by small-scale, subsistence-oriented production systems. The limited landholding capacity may constrain large-scale adoption of some capital-intensive technologies, yet the prevalence of smallholders also provides a strategic entry point for scalable, low-cost innovations suitable for small-scale production.

Table 1 further reveals that a substantial proportion (42.7%) earn between ₦50,000 and ₦100,000 monthly, while only 10.4% earn above ₦150,000. This moderate income profile underscores the importance of cost-effective technologies that are financially accessible. As Isiorhovoja *et al*. (2020) pointed out, farmers' economic behavior, particularly savings and investment capacity, influences their ability to invest in improved practices. Moreover, income levels affect household food security, reinforcing the need for technology packages that enhance productivity and profitability.

Table 1 also indicates that majority (51.3%) of the farming households had 4–6 members, with an average size of 5.6 persons. This moderate household size may provide adequate labor for farming activities, while also posing food security challenges if productivity is low. Larger households, although having more labor, require greater food and income resources, making adoption of yield-enhancing technologies critical for meeting family needs. The majority (61.8%) of the respondents had over six years of farming experience, with a mean of 11.4 years. Farming plays a significant role in farmers' decision-making and openness to innovation. As observed by Echebiri and Onu (2019), experienced farmers are better positioned to assess the risks and benefits associated with new technologies. However, prolonged reliance on traditional practices may also lead to resistance if innovations are perceived as complex or incompatible with existing systems.

Table 1: Socio-economic Characteristics of Farmers in Akwa Ibom State (n = 335

Variable	Category	No.	%	Mean
Age (years)	21–30	45	13.4	44.2
	31–40	82	24.5	
	41–50	110	32.8	
	51–60	72	21.5	
	>60	26	7.8	
Sex	Male	198	59.1	
	Female	137	40.9	
Educational Level	Non formal education	29	8.7	
	Primary	67	20.0	
	Secondary	120	35.8	
	Tertiary	119	35.5	
Farm Size (ha)	<1	81	24.2	2.3
	1–2	143	42.7	
	3–5	89	26.6	
	>5	22	6.5	
Monthly Income (₦)	<50,000	92	27.5	82,700
	50,000-100,000	143	42.7	
	100,001-150,000	65	19.4	
	>150,000	35	10.4	
Household Size	1–3	48	14.3	5.6
	4–6	172	51.3	
	7–9	89	26.6	
	>9	26	7.8	
Farming Experience	1–5 years	52	15.5	11.4
	6–10 years	110	32.8	
	11–15 years	97	29.0	
	>15 years	76	22.7	

4.2 Types of Improved Agricultural Technologies adopted Among Farmers

Table 2 shows that the most adopted technologies among 335 farmers were improved seeds (π = 3.43), chemical fertilizers (π = 3.31), and pest/disease control (π = 3.10), indicating high adoption. The least adopted were irrigation (π =1.66), agroforestry (π =1.79), and climate-smart technologies (π = 1.90), showing low adoption.

The findings revealed that improved seeds and chemical fertilizers were the most commonly adopted technologies among farmers in Akwa Ibom State. This pattern is consistent with the findings of Obayelu (2016), who noted high adoption rates of improved crop varieties and fertilizers among Nigerian smallholder farmers due to their direct and visible impact on yield and income. Similarly, Wainaina *et al*. (2016) highlighted that improved seeds and fertilizers often complement each other in enhancing farm productivity, which likely explains their widespread adopted among the farmers studied. The high adoption of pest and disease control methods aligns

with the findings of Akinwalere (2025), who emphasized the importance of integrated pest management practices in improving crop resilience and productivity among cocoa farmers in Ondo State, Nigeria.

On the other hand, the low adoption of irrigation technologies, agroforestry practices and climate-smart technologies points to a gap in technological diffusion in areas that address long-term sustainability and resilience to climate variability. This result corroborates the findings of Oladeji *et al*. (2023), who observed low adoption of climate-smart maize varieties in the Southern Guinea Savannah of Nigeria, attributing the trend to limited awareness, financial constraints and lack of institutional support. Likewise, Omotayo *et al*. (2023) found that adoption of agroforestry practices among smallholder farmers was hindered by low technical knowledge and inadequate access to extension services.

The moderate level of overall adoption among the majority of respondents reflects a similar pattern observed by Lawi *et al*. (2021) in Kilombero District, Tanzania, where most rice farmers exhibited a medium level of adoption due to gradual exposure to new technologies and limited access to credit and machinery. This suggests that while awareness and partial utilization of improved technologies are present, full integration across multiple technology types remains constrained.

Moreover, the relatively low mean scores for mechanized tools and soil conservation techniques suggest infrastructural and capital barriers. Madhukar *et al*. (2021) similarly identified capital investment, inadequate technical know-how and high maintenance costs as major barriers to the adoption of mechanized technologies. This implies that without targeted support mechanisms, the adoption of capital-intensive technologies may continue to lag in Akwa Ibom State.

Taken together, the adoption patterns observed support the premise of the Diffusion of Innovation Theory that adoption is not uniform but varies depending on individual farmer characteristics, the nature of the innovation and the enabling environment. This reinforces the findings of Masere and Worth (2022), who argued that innovation uptake among resource-constrained farmers is heavily influenced by socio-economic context, access to resources and perception of innovation benefits. The predominance of medium adopters in this study thus reflects the transitional state of technology diffusion in the area, where some innovations are well integrated, while others remain on the periphery due to systemic barriers.

Table 2: Distribution of Farmers According to Types of Improved Agricultural Technologies adopted (n = 335)

Technology Type	Not Adopted No. (%)	Rarely Adopted No. (%)	Often Adopted No. (%)	Fully Adopted No. (%)	Mean Score
Improved seeds	10 (3.0%)	22 (6.6%)	115 (34.3%)	188 (56.1%)	3.43
Chemical fertilizers	15 (4.5%)	30 (9.0%)	126 (37.6%)	164 (48.9%)	3.31
Organic fertilizers	140 (41.8%)	97 (29.0%)	66 (19.7%)	32 (9.6%)	1.96
Mechanized tools	125 (37.3%)	78 (23.3%)	78 (23.3%)	54 (16.1%)	2.18
Irrigation technologies	202 (60.3%)	67 (20.0%)	43 (12.8%)	23 (6.9%)	1.66
Pest and disease control methods	35 (10.4%)	39 (11.6%)	121 (36.1%)	140 (41.8%)	3.10
Post-harvest storage techniques	78 (23.3%)	82 (24.5%)	94 (28.1%)	81 (24.2%)	2.53
Agroforestry practices	180 (53.7%)	74 (22.1%)	51 (15.2%)	30 (9.0%)	1.79
Soil conservation techniques	113 (33.7%)	77 (23.0%)	78 (23.3%)	67 (20.0%)	2.30
Climate-smart technologies	160 (47.8%)	82 (24.5%)	58 (17.3%)	35 (10.4%)	1.90

4.3 Food Security Status of Farming Households in the Study Area

Table 3 shows that only 28.1% of households were food secure, while 71.9% experienced varying levels of food insecurity: mild (30.1%), moderate (25.4%), and severe (16.4%). Table 3 indicates a strong link between technology adoption and food security, 41.2% of high adopters were food secure, compared to 13.6% of low adopters. Severe food insecurity was highest among low adopters (30.7%).

Table 3 also sowed that 39.4% had high diversity, 42.4% medium, and 18.2% low. Table 3 further reveals that 47.1% of high adopters had high dietary diversity, compared to just 12.9% of low adopters. Conversely, 33.0% of low adopters had low dietary diversity, versus 12.9% of high adopters.

Based on WFP thresholds Table 3 shows that majority (56.7%) of households had acceptable food consumption, 29.3% were borderline, and 14.0% had poor consumption. Table 3 shows that 70.6% of high adopters had acceptable food consumption, compared to 34.1% of low adopters. Poor consumption was more common among low adopters (27.3%) than high adopters (7.1%).

The findings from this study demonstrate a clear pattern where higher adoption of improved

agricultural technologies is associated with better household food security outcomes. The HFIAS results showed that a substantial proportion of farming households experienced food insecurity, with 71.9% falling into mild, moderate, or severe food insecurity categories. This aligns with the findings of Kabalo *et al*. (2019), who reported seasonal fluctuations and high levels of food insecurity in rural Ethiopia, indicating that food insecurity remains a significant challenge in agrarian settings. The correlation between low technology adoption and increased food insecurity observed in this study is similarly reflected in their findings, as food insecurity was exacerbated by limited agricultural capacity and seasonal constraints.

The observed distribution across food insecurity categories supports earlier findings by Chinnakali *et al*. (2014), who reported high levels of food insecurity in urban resettlement areas in India and identified economic vulnerability and limited access to resources as key drivers. The pattern in this study, where low adopters were more likely to experience severe food insecurity, reinforces the assertion that access to and adoption of productivity-enhancing innovations can mitigate food insecurity among vulnerable households.

The HDDS analysis further supports the positive influence of improved technology adoption on dietary quality. High adopters exhibited higher dietary diversity, implying improved nutritional access and variety. This observation is consistent with the findings of Otekunrin *et al*. (2021), who emphasized the role of agricultural innovation in enhancing food and nutrition security. Their study concluded that improved technology adoption contributed significantly to access to diverse food groups, particularly protein-rich sources such as legumes, meat and fish. The relatively low consumption of milk products and eggs in the current study, despite moderate to high adoption rates, also resonates with their findings that economic factors, cultural practices and availability may still limit access to certain food groups even among households with acceptable dietary diversity.

Furthermore, the Food Consumption Score (FCS) results affirm that improved agricultural technology adoption positively influences overall food availability and dietary adequacy. The finding that 70.6% of high adopters had acceptable food consumption aligns with the evidence presented by Otekunrin *et al*. (2021), who observed similar improvements in food consumption patterns among adopters of improved technologies. The reduced proportion of poor consumption among high adopters in this study also mirrors their conclusion that agricultural interventions targeted at promoting adoption can serve as an effective tool to combat chronic food insecurity

and malnutrition.

Taken together, the results across all three food security indicators, HFIAS, HDDS and FCS, demonstrate consistency with the body of literature, particularly the studies by Kabalo *et al*. (2019), Chinnakali *et al*. (2014) and Otekunrin *et al*. (2021). These studies provide corroborative evidence that the adoption of improved agricultural technologies leads to enhanced food security outcomes by increasing food availability, accessibility and dietary quality. The findings from this study further underscore the importance of promoting technology dissemination and adoption among farming households to address persistent food insecurity and improve livelihoods in rural Nigeria.z

Table 3: Household Food Insecurity Access Scale (HFIAS) Classification of Respondents (n = 335)

Food Security Status	Score Range	No.	%
Food Secure	0 – 1	94	28.1%
Mildly Food Insecure	2 – 7	101	30.1%
Moderately Food Insecure	8 – 14	85	25.4%
Severely Food Insecure	15 – 27	55	16.4%
Total		**335**	**100.0**

Cross-tabulation of Food Security Status by Adoption of Improved Agricultural Technologies (n = 335)

Food Security Status	Low Adopters No. (%)	Medium Adopters No. (%)	High Adopters No. (%)
Food Secure (0–1)	12 (13.6%)	47 (29.0%)	35 (41.2%)
Mildly Food Insecure (2–7)	19 (21.6%)	61 (37.7%)	21 (24.7%)
Moderately Food Insecure (8–14)	30 (34.1%)	38 (23.5%)	17 (20.0%)
Severely Food Insecure (15–27)	27 (30.7%)	16 (9.9%)	12 (14.1%)
Total	88 (100.0%)	162 (100.0%)	85 (100.0%)

Household Dietary Diversity Score (HDDS) Categories of Respondents (n = 335)

Dietary Diversity Category	Food Groups Consumed	No.	%
Low Dietary Diversity	≤ 3	61	18.2%
Medium Dietary Diversity	4 – 5	142	42.4%
High Dietary Diversity	≥ 6	132	39.4%
Total		**335**	**100.0**

Cross-tabulation of Dietary Diversity by Adoption of Improved Agricultural Technologies (n = 335)

Dietary Diversity Category	Low Adopters No. (%)	Medium Adopters No. (%)	High Adopters No. (%)
Low Diversity (≤ 3)	29 (33.0%)	21 (13.0%)	11 (12.9%)
Medium Diversity (4 –5)	34 (38.6%)	74 (45.7%)	34 (40.0%)
High Diversity (≥ 6)	25 (28.4%)	67 (41.4%)	40 (47.1%)
Total	88 (100.0%)	162 (100.0%)	85 (100.0%)

Food Consumption Score (FCS) Classification of Respondents (n = 335)

Food Security Category	Score Range	No.	%
Poor Consumption	0 – 21	47	14.0%
Borderline Consumption	21.5 – 35	98	29.3%
Acceptable Consumption	> 35	190	56.7%
Total		**335**	**100.0**

Cross-tabulation of Food Consumption Score by Adoption of Improved Agricultural Technologies (n = 335)

Food Security Category	Low Adopters No. (%)	Medium Adopters No. (%)	High Adopters No. (%)
Poor Consumption (≤ 21)	24 (27.3%)	17 (10.5%)	6 (7.1%)
Borderline (21.5 –35)	34 (38.6%)	45 (27.8%)	19 (22.4%)
Acceptable (> 35)	30 (34.1%)	100 (61.7%)	60 (70.6%)
Total	88 (100.0%)	162 (100.0%)	85 (100.0%)

4.4 Factors Influencing Household Food Security Among Farmers

Table 4 shows that education, farm size, income, and adoption of improved technologies positively and significantly influenced household food security, while household size had a negative effect. Key predictors included education ($\beta = 0.146$, $p = 0.003$), farm size ($\beta = 0.278$, $p = 0.003$), income ($\beta = 0.00001$, $p = 0.001$), and adoption level ($\beta = 0.243$, $p = 0.000$). Household size negatively affected food security ($\beta = -0.109$, $p = 0.002$). The model explained 39.2% of the variation in food security (adjusted $R^2 = 0.392$, $p < 0.001$).

This finding agrees with Asa (2023), who identified educational attainment, income and adoption of improved agricultural practices as critical determinants of food security among rural households in Akwa Ibom State. Similarly, Ehiwario *et al*. (2024) affirmed that socio-economic and technological factors, particularly education and technology adoption, positively influenced food security status in Delta and Edo States. The significant positive relationship between education and food security corroborates the view of Oke and Ogundokun (2023), who found that education improves knowledge, decision-making and adoption of food security-enhancing practices among farming households in Oyo State.

The positive effect of farm size on food security aligns with of Kuwornu *et al*. (2013), who noted that larger farm sizes often translate into higher food production, leading to improved household food availability and access. Furthermore, Sarmin *et al*. (2024) in their comparative study in Bangladesh observed that households with larger landholdings and higher income levels reported better food security outcomes, thereby reinforcing the present study's result on the significance of farm size and income.

The finding that household size negatively affects food security is in line with Ukonu *et al*. (2024), who reported that larger households tend to experience more pressure on food resources, increasing the risk of food insecurity. This is also supported by Ingutia and Sumelius (2022), who identified household size as a critical constraint to food access and dietary adequacy in rural Kenya, especially when income and productivity are limited.

The strong positive association between the adoption level of improved agricultural technologies and food security resonates with the meta-analysis by Ruzzante *et al*. (2021), which concluded that adoption of improved technologies significantly contributes to increased agricultural productivity and household food security across developing countries. Bukchin and Kerret (2020) similarly emphasized that technology adoption enhances sustainability and food resilience among smallholder farmers, supporting the observed impact in this study.

The insignificance of sex, age and farming experience in this study contrasts with some previous findings. For instance, Chinnakali *et al*. (2014) found sex disparities in food security outcomes, suggesting that female-headed households were more vulnerable to food insecurity. However, the current study's insignificance of sex may indicate a narrowing of gender-based food security gaps in the study area. Additionally, the non-significant effect of farming experience diverges from Sariyev *et al*. (2025), who highlighted experience as an enabler of better resource management and adaptive strategies that promote food security...

Table 4: Multiple Regression Analysis Showing Factors Influencing Household Food Security among Farmers in Akwa Ibom State (n = 335)

Explanatory Variable	Unstandardized Coefficient (β)	Standard Error (SE)	Standardized Coefficient (β)	t-value	p-value
Age (years)	-0.021	0.019	-0.051	-1.105	0.270
Sex	0.384	0.272	0.059	1.412	0.159
Educational Level	0.146**	0.048	0.152	3.042	0.003
Household Size	-0.109**	0.035	-0.167	-3.114	0.002
Farm Size	0.278**	0.092	0.132	3.022	0.003
Farming Experience	0.035	0.028	0.058	1.250	0.212
Monthly Income	0.00001***	0.000003	0.198	3.333	0.001
Adoption Level of Improved Technologies	0.243***	0.055	0.215	4.418	0.000

Model Summary: $R = 0.637$; $R^2 = 0.406$; Adjusted $R^2 = 0.392$; $F(8, 326) = 27.80$; $p < 0.001$.

Note: *$p < 0.01$, $p < 0.05$, significant at 1% and 5% levels respectively.

5.0 Conclusion and Recommendations

5.1 Conclusion

The study assessed adoption of improved agricultural technologies and household food security among farmers in Akwa Ibom State, Nigeria. Findings revealed that while a majority of farmers had adopted key technologies such as improved seeds, chemical fertilizers and pest and disease control methods, the adoption of irrigation, agroforestry and climate-smart technologies remained significantly low.

Food security analysis indicated that only 28.1% of the farming households were food secure, with the majority experiencing mild to severe levels of food insecurity. A significant relationship was observed between technology adoption and food security status, as farmers with high adoption levels were more likely to be food secure. The study concludes that increased adoption of improved agricultural technologies plays a critical role in enhancing household food security among farming households.

5.2 Recommendations

Based on the findings of this study, the following recommendations are made:

i. Enhance Access and Incentives for Low-Adopted Technologies: Government and development agencies should promote adoption of low-utilized, but impactful technologies such as irrigation systems, climate-smart practices and agroforestry through subsidized inputs, awareness campaigns and demonstration farms. These interventions are crucial for year-round production and long-term food security resilience.

ii. Strengthen Agricultural Extension Services: Agricultural extension agents should be adequately trained and deployed to provide tailored support and capacity-building programs for farmers, especially in underutilized technologies. Continuous education will help farmers understand the benefits and practical application of these technologies to improve adoption rates. and

iii. Promote Farmer-Led Technology Clusters: Encouraging formation of farmer groups or cooperatives that focus on specific improved technologies can foster peer learning and collective investment. These clusters can serve as innovation hubs that accelerate adoption and, consequently, improve food availability, diversity and household nutrition outcomes.

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