

Socioeconomic Drivers of Agricultural Technology Adoption among Arable Crop Farmers in Oyo State, Nigeria

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ABSTRACT: Agricultural technology adoption is widely recognized as a key driver of agricultural productivity, rural livelihoods, and food security. However, the adoption of improved agricultural technologies among arable crop farmers in Nigeria remains below expectations due to several socioeconomic constraints. This study examined the socioeconomic determinants of agricultural technology adoption among arable crop

farmers in Oyo State, Nigeria. A multistage sampling procedure was used to select 120 arable crop farmers, and primary data were collected using a structured questionnaire. Data were analyzed using descriptive statistics and multiple regression analysis. The findings revealed that the respondents had a mean age of 48 years, indicating that most farmers were in their economically active years. Majority (65.83%) were male, 45.00% were married, and 36.67% had no formal education. The mean farm size was 8.1 hectares, while the average household size was six persons. Regression results showed that age ($\beta = 0.0256$, $p < 0.01$), household size ($\beta = 0.0012$, $p < 0.01$), educational status ($\beta = 0.0027$, $p < 0.05$), farming experience ($\beta = 0.1063$, $p < 0.05$), farm income ($\beta = 0.1165$, $p < 0.05$), farm size ($\beta = 0.0341$, $p < 0.10$), and farmers' contact with agricultural information sources ($\beta = 0.7200$, $p < 0.01$) positively and significantly influenced agricultural technology adoption. Conversely, marital status, religion, and contact with extension agents had no significant influence on adoption. The study concludes that socioeconomic factors play a critical role in shaping agricultural technology adoption among arable crop farmers in Oyo State. It recommends strengthening farmers' access to education, affordable credit, agricultural information, and effective extension services to enhance technology adoption, increase productivity, and promote sustainable agricultural development.

Keywords: *Agricultural technology adoption; Arable crop farmers; Socioeconomic determinants; Multiple regression; Oyo State; Nigeria.*

1. Introduction

Agriculture is central to economic development, employment, rural livelihoods, and food security in sub-Saharan Africa (SSA). In Nigeria, the sector provides employment and income for millions of households, contributes substantially to gross domestic product (GDP), and supplies food and raw materials to agro-based industries (Abubakar, 2023; Akpabio et al., 2025; Daud et al., 2018). However, agricultural productivity remains constrained by limited mechanization, inadequate extension services, low input use, and continued reliance on conventional production practices. These challenges are becoming more critical with population growth, urbanization, climate variability, and increasing pressure on agricultural land (Ayodele et al., 2025). Improving agricultural productivity therefore requires greater use of technologies that enhance production efficiency, profitability, and resilience. Such technologies include improved seed varieties, fertilizers,

agrochemicals, mechanization, improved agronomic practices, and climate-smart production techniques (Atkinson & Atkinson, 2023; Omotoso & Omotayo, 2026). Although these technologies can contribute to increased productivity and food security, their adoption among smallholder farmers in Nigeria remains uneven. Previous studies have primarily associated adoption decisions with factors such as education, farm size, access to credit, extension contact, market access, income, and farming experience (Onanuga et al., 2021). These factors influence farmers' access to information and resources and their capacity to invest in and manage new technologies.

Nevertheless, access to resources does not necessarily translate into adoption. Farmers with similar access to inputs, markets, or extension services may make different technology choices, suggesting that adoption is shaped by a combination of individual and farm-level characteristics. For example, education may enhance farmers' ability to evaluate information about new technologies, while farm size and income may increase their capacity to invest in them. Farming experience may facilitate informed decision-making but can also reinforce established production practices. Similarly, household size, labour availability, and farmers' group membership may influence the resources and information available for technology adoption (Amadu, 2022; Aslam et al., 2024; Kehinde et al., 2021; Rwigema, 2026; Sharma, 2020). The direction and magnitude of these relationships may also vary across production environments, making location-specific evidence important.

Oyo State provides a relevant setting for examining these relationships because of its substantial arable farming population and favourable conditions for the production of maize, cassava, yam, rice, cowpea, vegetables, sorghum, and soybean. Various agricultural interventions have promoted improved crop varieties, fertilizer use, mechanization, improved agronomic practices, and other productivity-enhancing technologies in the state (Kehinde et al., 2021). However, adoption remains heterogeneous among farmers, with some adopting several technologies while others continue to rely largely on conventional practices. Understanding the socioeconomic characteristics associated with this variation is important for designing more targeted technology-promotion interventions. Although agricultural technology adoption has been widely studied in Nigeria, much of the existing evidence focuses on particular crops, individual technologies, or specific locations. Consequently, there is a need for updated, location-specific evidence on the socioeconomic

factors associated with technology adoption among arable crop farmers in Oyo State. Such evidence can support extension agencies, policymakers, and development organizations in designing interventions that address farmers' heterogeneous resource and information constraints. This study therefore examines the socioeconomic determinants of agricultural technology adoption among arable crop farmers in Oyo State, Nigeria. Specifically, it describes farmers' socioeconomic characteristics, identifies the agricultural technologies available to them, assesses their level of adoption, and estimates the influence of socioeconomic characteristics on technology adoption.

2. Materials and Methods

2.1 Study area

The study was conducted in Oyo State, southwestern Nigeria, located between latitudes 7°03' and 9°12' N and longitudes 2°47' and 4°23' E, with a land area of approximately 28,454 km². The state shares boundaries with Kwara State to the north, Osun State to the east, Ogun State to the south, and the Republic of Benin to the west. The climate is characterized by distinct wet and dry seasons, with the wet season generally occurring from April to October and annual rainfall ranging from approximately 1,000 to 1,500 mm. The state encompasses derived savannah and rainforest ecological zones, which support the cultivation of diverse arable crops, including maize, cassava, yam, rice, cowpea, and vegetables (Asogwa et al., 2013; Omotoso & Omotayo, 2024).

2.2 Study population and sampling procedure

The study population comprised arable crop farmers in Oyo State who cultivated crops such as maize, cassava, yam, rice, cowpea, and vegetables for subsistence or commercial purposes. A multistage sampling procedure was used to select respondents. At the first stage, Oyo State was stratified into four Agricultural Development Programme (ADP) zones: Ibadan/Ibarapa, Oyo, Ogbomoso, and Saki. Two zones, Oyo and Ibadan/Ibarapa, were subsequently selected by simple random sampling to provide geographical coverage of the study area. At the second stage, five villages were randomly selected from each of the two selected zones, resulting in 10 villages. At the third stage, lists of arable crop farmers were obtained from agricultural extension offices and farmers' associations in the selected villages. Twelve farmers were randomly selected from each village, yielding a

total sample of 120 respondents. The sampling procedure was therefore designed to provide representation across selected agricultural zones and rural communities while maintaining a manageable sample for field-level data collection.

2.3 Data collection

Primary data were collected using a structured interview schedule administered to the selected farmers. The instrument was designed to obtain information on respondents' socioeconomic characteristics, farming activities, access to agricultural services, cultural beliefs, agricultural technology use, and other variables relevant to the study objectives. The interview schedule was administered directly to respondents to facilitate accurate interpretation of the questions and minimize problems associated with literacy. Responses were recorded systematically and subsequently coded for statistical analysis.

2.4 Variables and measurement

The study incorporated farmers' socioeconomic characteristics, agricultural service access, cultural beliefs, and technology adoption variables. Socioeconomic characteristics included variables such as age, sex, household size, education, farming experience, farm size, and access to agricultural services, where applicable. Technology adoption was measured according to the specific agricultural technologies considered in the study.

2.5 Data analysis

Data were analyzed using descriptive and inferential statistical techniques. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the socioeconomic characteristics and other relevant attributes of the respondents. Inferential analysis was employed to examine the determinants of agricultural technology adoption. Specifically, regression analysis was used to estimate the effects of the explanatory variables on the specified adoption outcome. The explanatory variables included relevant socioeconomic, institutional, and cultural characteristics of the farmers.

The regression model was specified generally as:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + \varepsilon_i$$

where Y_i represents the agricultural technology adoption outcome for farmer i ; $X_1, \dots, X_k$ represent the explanatory variables; β_0 is the intercept; $\beta_1, \dots, \beta_k$ are the estimated coefficients; and ε_i is the random error term. The choice of the specific regression model should correspond to the measurement scale of the dependent variable.

3. Results and Discussion

3.1 Socioeconomic characteristics of respondents

Table 1 presents the socioeconomic characteristics of the sampled arable crop farmers. The mean age of the respondents was 48.2 years, with the largest proportion (42.50%) falling within the 40–50-year age group. Only 5.83% were younger than 30 years, indicating relatively limited participation of young people in arable crop farming. The predominance of middle-aged farmers may have implications for technology adoption because age can influence both farming experience and willingness to invest in improved practices. The relatively low representation of younger farmers also reflects the broader concern regarding youth participation and succession in agricultural production (Nowak, 2021). Majority of respondents were Muslim (65.00%), while 26.67% were Christian and 8.33% practiced traditional religion. Married respondents constituted 45.00% of the sample, while 27.50% were single and 27.50% were divorced or separated. Although these characteristics describe the social composition of the farming population, their influence on technology adoption is ultimately an empirical question examined through the regression model.

Male farmers accounted for 65.83% of the respondents, compared with 34.17% females, indicating male predominance in arable crop production in the study area. This pattern highlights the importance of ensuring equitable access to agricultural information, inputs, and technologies across gender groups. Educational attainment was relatively low. About 36.67% of respondents had no formal education, 24.17% had primary education, 26.67% had secondary education, and only 12.50% had tertiary education. Limited educational attainment may constrain farmers' ability to access, interpret, and apply technical information associated with new agricultural technologies. This relationship is examined further in the regression analysis, where educational status has a significant positive association with technology adoption. Annual farm income was concentrated within the ₦100,000–₦200,000 range, which accounted for 89.17% of respondents, with a reported

mean income of ₦155,905.20 (Table 1). Household size averaged seven persons, with 68.33% of respondents having between four and eight household members. The relatively large household size may provide family labour for agricultural activities but may also increase household consumption requirements. The regression results provide a more appropriate basis for determining whether household size significantly influences technology adoption.

Table 1. Socioeconomic characteristics of arable crop farmers (n = 120)

Variable	Category	Frequency	Percentage (%)	Mean
Age (years)	<30	7	5.83	
	30–40	34	28.33	
	40–50	51	42.50	48.2
	50–60	21	17.50	
	>60	7	5.83	
Religion	Christianity	32	26.67	
	Islam	78	65.00	
	Traditional	10	8.33	
Marital status	Single	33	27.50	
	Married	54	45.00	
	Divorced/Separated	33	27.50	
Sex	Male	79	65.83	
	Female	41	34.17	
Education	No formal education	44	36.67	
	Primary	29	24.17	
	Secondary	32	26.67	
	Tertiary	15	12.50	
Farm size (ha)	<5	19	15.84	
	5–10	73	60.83	8.1

	>10	28	23.33	
Farming experience (years)	<5	32	26.67	
	5–10	72	60.00	9.4
	>10	16	13.33	
Annual farm income (₦)	<100,000	3	2.50	
	100,000–200,000	107	89.17	155,905.20
	>200,000	10	8.33	
Household size	<4	23	19.17	
	4–8	82	68.33	7
	>8	15	12.50	
Total		120	100.00	

3.2 Availability of agricultural technologies

Table 2 shows the agricultural technologies available to respondents. Herbicide and pesticide application was the most widely available technology, reported by 89.17% of farmers, followed by improved crop varieties (85.00%) and fertilizer application methods (66.67%). Mechanization services were available to 56.67% of respondents. The relatively high availability of these technologies suggests that production-oriented inputs and practices are more accessible to farmers than technologies requiring greater infrastructure, specialized information, or capital investment. In contrast, climate adaptation and resource-management technologies were less available. Agroforestry was reported by 20.00% of respondents, while weather forecasting was available to 15.83%. Irrigation facilities and drought-related technologies were reported by only 10.83% and 3.33% of respondents, respectively. This pattern indicates an important gap between the availability of conventional productivity-enhancing technologies and technologies designed to strengthen climate resilience. Limited access to irrigation and drought-management technologies may increase farmers' vulnerability to rainfall variability and dry-season production constraints (Fok, 2021; Omotoso et al., 2024).

Table 2. Availability of agricultural technologies among respondents (n = 120)

Agricultural technology	Frequency	Percentage (%)
Improved crop varieties	102	85.00
Fertilizer application methods	80	66.67
Herbicide/pesticide application	107	89.17
Mechanization services	68	56.67
Irrigation facilities	13	10.83
Drought-related technology	4	3.33
Agroforestry	24	20.00
Weather forecasting	19	15.83

3.3 Socioeconomic determinants of agricultural technology adoption

Table 3 presents the regression estimates of the socioeconomic determinants of agricultural technology adoption. Age, household size, education, farming experience, farm income, and farm size were positively associated with adoption, although the statistical strength of the relationships varied. Marital status, religion, and extension contact were not statistically significant. Age had a positive and highly significant coefficient ($\beta = 0.0256$, $p < 0.01$), indicating that older farmers were more likely to adopt agricultural technologies, holding other factors constant. This result may reflect the role of accumulated farming experience and knowledge in reducing uncertainty associated with new technologies. However, the finding should be interpreted within the context of the study rather than assuming that age universally promotes adoption. Household size was also positive and highly significant ($\beta = 0.0012$, $p < 0.01$). Larger households may provide greater family labour, thereby reducing reliance on hired labour and facilitating the implementation of technologies that require additional labour. This finding is consistent with the resource-based role of household labour in smallholder agricultural production.

Educational status had a positive and significant effect on technology adoption ($\beta = 0.0027$, $p < 0.05$). Farmers with higher educational attainment were more likely to adopt improved technologies, possibly because education enhances the ability to acquire and interpret technical information and evaluate the potential benefits and costs of innovations. This finding supports the broader evidence that human capital is an important component

of agricultural technology adoption (Hu, 2020; Kehinde et al., 2021). Farming experience was also positively associated with adoption ($\beta = 0.1063$, $p < 0.05$). Marital status was not statistically significant ($\beta = 0.0834$, $p = 0.673$), indicating that differences in marital status were not associated with systematic differences in technology adoption. Religion was similarly insignificant ($\beta = -0.0071$, $p = 0.317$), suggesting that religious affiliation did not independently explain adoption behaviour after controlling for the other variables in the model.

Extension contact also had a negative but statistically insignificant coefficient ($\beta = -0.0895$, $p = 0.188$). The lack of a significant relationship does not necessarily imply that extension services are unimportant. Rather, it may indicate that the frequency, quality, or content of extension contact was insufficient to generate measurable differences in adoption within the sample. Farmers may also obtain information through alternative channels, including other farmers, input dealers, farmer organizations, mass media, and digital platforms. Taken together, the regression results suggest that agricultural technology adoption among the sampled farmers is more strongly associated with human capital, household resources, farming experience, and economic capacity than with marital status or religious affiliation. The findings therefore support the need for technology-promotion strategies that combine access to agricultural information with measures that strengthen farmers' productive and financial capacity.

Table 3. Socioeconomic determinants of agricultural technology adoption

Variable	Coefficient	Std. Error	p-value
Age	0.0256***	0.0031	0.000
Household size	0.0012***	0.0002	0.000
Marital status	0.0834	0.3921	0.673
Educational status	0.0027**	0.0015	0.002
Years of farming experience	0.1063**	0.0662	0.021
Farm income	0.1165**	0.0562	0.017
Farm size	0.0341*	0.0126	0.054
Religion	-0.0071	0.0185	0.317
Extension contact	-0.0895	0.1085	0.188
Constant	0.7200***	0.1832	0.001

*Note: **, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Conclusion and Recommendations

This study examined the socioeconomic determinants of agricultural technology adoption among arable crop farmers in Oyo State, Nigeria. The findings show that the farming population was predominantly middle-aged and male, with relatively low levels of formal education, while most respondents operated farms of 5–10 hectares and had moderate farming experience. Agricultural technology availability and adoption varied considerably across technologies. Conventional production-oriented technologies, particularly herbicide and pesticide application, improved seed varieties, and fertilizer application techniques, were more widely available and adopted than climate-resilient and information-intensive technologies. In contrast, weather forecasting, irrigation, drought-related technologies, mechanized land preparation, and integrated pest management recorded comparatively low levels of adoption. This pattern suggests that farmers tend to adopt technologies that are relatively accessible and provide immediate and observable production benefits, whereas technologies requiring specialized knowledge, infrastructure, or higher initial investment remain less widely adopted. The regression results further demonstrate that farmers' socioeconomic conditions play an important role in technology adoption. Age, household size, educational attainment, farming experience, and farm income were positively and significantly associated with adoption, while farm size showed a positive relationship at the 10% significance level. Conversely, marital status, religion, and extension contact were not statistically significant determinants. These findings indicate that improving technology adoption requires more than increasing the physical availability of agricultural innovations. Farmers must also possess the knowledge, financial resources, labour capacity, and practical experience required to evaluate, acquire, and effectively use such technologies. Extension programmes should emphasize practical demonstrations and hands-on training, particularly for technologies with low adoption such as integrated pest management, weather forecasting, irrigation, mechanization, and drought-resilient practices. Financial institutions, government agencies, and development organizations should also expand accessible credit and input-financing schemes to reduce the financial constraints associated with technology acquisition and use. Policies aimed at accelerating agricultural technology adoption should adopt a farmer-centred approach that combines technology availability with improved human capital, financial access, technical support, and climate-resilience measures. Such an integrated approach would enhance the effective

and sustained adoption of agricultural innovations and contribute to improved productivity, food security, and sustainable rural livelihoods in Oyo State.

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