DETERMINANTS TO ADOPTION OF CLIMATE CHANGE ADAPTATION STRATEGIES BY SMALLHOLDER ARABLE CROP FARMERS IN EDO STATE

***Ehigie[1], O. A. ,Ighoro[2], A and Aigba[3], G. A**

[1]Department of Agricultural Economics and Extension Services,
Faculty of Agriculture, University of Benin, Edo state, Nigeria

[2]Department of Agricultural Extension Service and Rural Development
Faculty of Agriculture, Dennis Osadebay University, Asaba, Delta State, Nigeria

[3]Department of Agricultural Economics and Extension Services,
Faculty of Agriculture and Agricultural Technology, Benson Idahosa University , Edo state, Nigeria
For correspondence: Email: alex.ehigie@uniben.edu

ABSTRACT

The study determined the adoption of climate change adaptation strategies by smallholder arable crop farmers in Edo state, Nigeria. This study examined the socio-economic characteristics of smallholder arable crop farmers, assessed their climate change adaptation strategies, and determined the relationship between these characteristics and adaptation behavior.. a multi-stage sampling procedure was employed to select 413 valid respondents, and data were collected using structured questionnaires. descriptive statistics and Ordered Multiple Regression were used for data analysis. Results revealed that 58.6% of the farmers were male, and 64.3% were within the active age range of 31–50 years. The study also found that 71.2% had at least primary education, and 67.9% cultivated less than 3 hectares, indicating predominantly small-scale farming operations. Regarding adaptation, 56.7% of farmers adopted at least one climate change adaptation strategy, while 43.3% had not adopted any. The most common strategies were crop diversification (48.1%), use of drought-tolerant varieties (42.5%), and adjustment of planting dates (39.7%).The regression results showed that farm size, farm income, years of farming experience, and farm distance from residence had significant positive effects on adaptation, while household size had a negative effect. The study concludes that improving access to extension services, climate information, and livelihood support programs is essential for enhancing farmers' adaptive capacity in the face of climate change

Keywords: Climate Change, Adoption, Smallholder Farmers, Adaptation Strategies

1.0 INTRODUCTION

Climate change represents one of the most significant threats to agricultural sustainability in sub-Saharan Africa, where the livelihoods of millions of smallholder farmers depend heavily on climate-sensitive and predominantly rain-fed production systems. Nigeria exemplifies these dynamics. Nigeria exemplifies these dynamics. Empirical climatology and agronomic modeling show detectable warming and rainfall variability alongside crop-yield sensitivity to climate drivers across Nigerian agro-ecologies. Adejuwon (2006) projected differentiated crop responses to mid-century climate scenarios, with yield declines emerging as warming intensifies. Subsequent observational work documents temperature increases, altered onset and cessation of rains, and more frequent extremes linked to erosion and flooding stressors that magnify smallholders' production risks Morton, (2008).Subsequent investigations in the south and middle belt (e.g., Apata *et al*., 2009; Ozor & Nnaji, 2011; Ayanlade, Radeny, & Morton, 2017) documented rising recognition of shifting rains and heat and catalogued a portfolio of farm-level adaptations altered planting dates, crop/variety switching, soil and water conservation, mixed cropping, tree planting, and livelihood diversification. Critically, these studies also show that information quality (extension and peer networks), credit/liquidity, and institutional support strongly condition adoption intensity. Farm-level work in Edo has identified both the strategies farmers use and the barriers they face: determinants analyses among arable crop farmers highlight education, household size, extension contact, and farmer-to-farmer learning as positive correlates of adaptation, while information and finance emerge as persistent constraints (Ofuoku, Okoh, & Saiki, 2012). (Jerumeh et al., 2016) found that yam-based farmers report clear perceptions of changing climate alongside selective uptake of low-cost, knowledge-intensive practices. Together, these Edo-focused studies suggest substantial adaptation potential but uneven adoption precisely the gap that a perception-to-adoption investigation can illuminate.

Climate change presents a formidable threat to agricultural sustainability in Nigeria, particularly for smallholder farmers who form the majority of the agricultural labor force and depend heavily on rain-fed production systems. In Edo State, where arable crops such as cassava, yam, maize, and rice are central to livelihoods, changing rainfall patterns, rising temperatures, and recurrent flooding events have already been documented (Akingba,et al 2022.These climate-related disruptions increase the vulnerability of farmers whose adaptive capacity is constrained by inadequate access to finance, weak extension services, and limited institutional support (Ofuoku, Okoh, & Saiki, 2012).

Research across Nigeria and Africa further shows that socio-economic factors such as education, access to credit, household size, gender, and access to extension services strongly influence whether perception translates into actual adaptation (Deressa *et al*., 2009; Ayanlade, Radeny, & Morton, 2017). In Edo State, however, available evidence suggests that adoption remains selective, with farmers more likely to embrace low-cost and knowledge-based practices, while resource-intensive measures such as irrigation, agroforestry, or improved seed varieties are poorly utilized .

The persistence of these gaps has serious implications. Without widespread adoption of effective adaptation strategies, smallholder arable crop farmers in Edo State may face declining agricultural productivity, reduced household income, increased livelihood vulnerability, and heightened food insecurity. These consequences not only threaten local well-being but also undermine national climate policy goals and Nigeria's broader sustainable development commitments. Against this backdrop, understanding the determinants of adaptation is crucial. This study therefore determines the adoption of climate change adaptation strategies by smallholder arable crop farmers in Edo State, Nigeria. The aim of this research were to:

- describe the socio-economic characteristics of the smallholder arable crop farmers in the study area.
- determine the adoption of arable crop farmers' adaptation strategies to climate change.

Hypothesis:

- **Ho** There is no significant relationship between socio-economic characteristics of the farmers and adoption of climate change adaptation strategies.

2.0 METHODOLOGY

2.1 Study Area and Scope

The study was carried out in Edo State, an inland state located in the southern region of Nigeria, with Benin City as its administrative and cultural capital. Edo State was bounded in the north and east by Kogi State, in the south by Delta State, and in the west by Ondo State, placing it strategically within the forest–savanna transition zone of the country. Geographically, the state lay approximately between longitudes 06°04′E and 06°43′E, and latitudes 05°44′N and 07°34′N. It covered a total landmass of about 17,802 km² (6,873 sq. miles) and had an estimated population of 4,430,739 people according to the National Population Commission (NPC, 2018).

Edo State experienced a humid tropical climate, characterized by two distinct seasons: the rainy season, which lasted roughly from April to October, and the dry season, which extended from November to March. Average annual rainfall ranged from 1,500 mm to 2,500 mm, while temperatures generally varied between 25°C and 32°C throughout the year. These climatic conditions created a favorable environment for diverse agricultural activities, though the increasing variability in rainfall and temperature had begun to pose significant challenges to farming systems.

The vegetation of Edo State consisted mainly of lowland rainforest in the south and derived savanna in the north, providing fertile soils suitable for the cultivation of arable crops. Farming was the primary occupation of the rural population, and the major crops grown included cassava, yam, maize, rice, and cocoyam, alongside cash crops such as oil palm, rubber, and cocoa. Livestock rearing, fishing, and forestry also contributed to rural livelihoods, although crop farming remained dominant.

Administratively, the state was divided into eighteen (18) Local Government Areas (LGAs), each with distinct socio-cultural and agro-ecological features. The people of Edo State were known for their cultural heritage and strong community-based institutions, which often influenced farming decisions, access to land, and adoption of agricultural innovations. Despite its agricultural potential, the state's farmers faced constraints such as limited access to extension services, inadequate rural infrastructure, and increasing exposure to climate-related risks such as flooding, erosion, and irregular rainfall patterns.

These characteristics made Edo State a suitable location for examining farmers' perception and adoption of climate change adaptation strategies, as it combined high agricultural dependence with significant vulnerability to climate variability and change.

The people of Edo State were predominantly engaged in farming, with an estimated 838,107 households and 1,416 communities distributed across the state (NPC, 2018). Agriculture played a central role in both the economy and subsistence of rural households, providing food, employment, and income generation opportunities. The agricultural resources of the state comprised food crops, forestry products, and livestock. The major food crops cultivated included yam, cassava, maize, and rice, which formed the staple diet of the population and the basis of smallholder agricultural production. In addition, forestry products such as timber and non-timber resources contributed to rural livelihoods, while livestock rearing (goats, sheep, poultry, and cattle) was practiced on a smaller scale.

Beyond agriculture, Edo State also had a growing industrial base. Major industries included wood processing, soft drink bottling, and cement manufacturing, which provided employment and supported the state's economy. Additionally, Edo was widely recognized for its rich cultural heritage, particularly the production of locally made wooden and metal sculptures, which held both commercial and cultural significance and reflected the state's historical prominence as the seat of the ancient Benin Kingdom.

This study was limited to arable crop smallholder farmers actively engaged in the cultivation of common arable crops such as yam, cassava, maize, and rice produced in the state. By the classification of Mgbenka and Mbah (2016), farm holdings in Nigeria were categorized into three broad groups: small, medium, and large scale. Small-scale farms comprised holdings between 0.10 and 5.99 hectares, often fragmented into two or more separate parcels; medium-scale farms covered 6.0 to 9.99 hectares; and large-scale farms encompassed 10 hectares or more. This research specifically focused on small-scale farmers, defined as those cultivating between 0.10 and 5.99 hectares of land in the study area, as they represented the largest proportion of farmers in Edo State and were the most vulnerable to climate change impacts.

To facilitate sampling and ensure accurate representation, the list of smallholder farmers was obtained from the Agricultural Development Programme (ADP), Edo State, which maintained records of farming households and their production activities across the eighteen Local Government Areas (LGAs) of the state. This ensured that the study population reflected the actual distribution of arable crop farmers within the state.

The administrative capital of Edo State is Benin City, and the state is comprised of eighteen (18) Local Government Areas (LGAs). For agricultural planning and extension purposes, the Edo State Agricultural Development Programme (ADP) delineated these LGAs into three distinct agro-ecological zones: Edo Central, Edo North, and Edo South.

i. Edo Central consists of five (5) LGAs: Esan Central, Esan West, Esan North-East, Esan South-East, and Igueben.
ii. Edo North comprises six (6) LGAs: Owan West, Akoko-Edo, Etsako West, Etsako East, Owan East, and Etsako Central.
iii. Edo South consists of seven (7) LGAs: Oredo, Ovia South-West, Ovia North-East, Ikpoba-Okha, Egor, Uhunmwode, and Orhionmwon.

This classification reflects the state's administrative and ecological diversity, which shapes its agricultural practices and the distribution of farming systems across different zones.

2.2 Target Population

This includes all farmers whose farm size was between (0.10 and 5.99 hectares) and cultivates any of the arable crops such as yam, cassava, maize and rice. They constitute the population of the study.

2.3 Sampling Technique and Size

A multi stage sampling technique was adopted to select respondents for the study. The stages involved are described as follows:

The first stage involved the use of purposive selection of four (4) LGAs in each of the ADP agricultural zones in the State based on the intensity of arable crop production in the area. This condition lead to the selection Ovia south west, Ovia North East, Orhionmwon and Egor local government areas in Edo south agricultural zone while Etsako West, Etsako East, Owan West, and Akoko Edo were sampled in Edo north agricultural zone. Lastly, Esan South-East, Igueben, Esan West and Esan Central were selected from Edo central agricultural zone. At the second stage, simple random sampling technique was used to select two (2) farming communities from each of the twelve (12) LGAs selected from the three agricultural zones to have a total of 24 communities as listed in the table. Owing to lack of population of arable crop farmers in the study area, list of farmers whose farm size fall within 0.10 to 5.99 hectares were listed across the selected communities. This exercise was performed for six (6) weeks to generate listed population for this study as stated in Table3.

The third stage involved the use of simple random sampling technique to 30% of the listed population of arable crop farmers in each of the sampled communities. This gave a total of four hundred and thirty-two (432) farmers from the twenty-four (24) communities across the three (3) agricultural zones in the study area. This was done to give each community proportion of respondents. However, at the end of data collection, only 413 copies of the questionnaire used for data collection were properly filled, retrieved and analyzable. This forms a response rate of 95.60%. The communities sampled and the number of respondents in each of the agricultural zones are presented in Table 2.

Table 2.1: Agricultural zones, local government area, communities and sample size

Zone	Local Government Area	Community	Listed Population	Sample Size
Edo Central	Esan Central	Idumebo	50	15
		Irrua	65	19
	Esan South-East	Oria	53	16
		Ubiaja	72	21
	Esan West	Ekpoma	63	19
		Iruekpen	73	22
	Igueben	Eguare	67	20
		Oyomo	72	21
Edo North	Akoko Edo	Atte	52	16
		Igarra	59	18
	Etsako East	Afokpella	43	13
		Egori	61	18
	Etsako West	Ewareke	43	13
		Jattu	57	17
	Owan West	Eme-ora	73	22
		Ozalla	75	22
Edo South	Egor	Evbougide	53	16
		Oghedaivbiobaa	69	21
	Orhionmwon	Igbanke	49	15
		Urhonigbe	69	21
	Ovia North East	Iguomon	43	13
		Iguosa	54	16
	Ovia South West	Okokpon	52	16
		Ugbabosua	73	22
Total	**12 LGAs**	**24 Communities**	**1,440**	**432**
	Valid Data			**413**

Source: Self-Generated Data, 2025.

2.4 Data Collection

Primary data were collected from the field survey, using a structured questionnaire and interview schedule for illiterate respondents. The questionnaire was divided into sections..

2.5 Measurement of Variables

Two types of variables were measured for this study. They are independent and dependent variables. The independent variables were measured as follows:

- Age of the respondents was measured in years at interval level.
- Marital status: Respondents were asked to indicate their marital status, whether they were single, married, widowed or divorced.
- Farming experience was measured at interval level in years:
- Household size was measured at interval level by number of persons per household
- Source of labour was measured as either family, hired or self labour
- Respondents were asked to indicate YES or NO if they belong to any association, which are further specified to include cooperative society, Esusu.
- Respondents were asked to indicate YES or NO ill they come in contact with extension agents.
- Educational qualification: The educational status of the respondents will be measured by asking the respondents to specify their level of education. It is a categorical variable, and hence categories such as MSc/PhD (6), B.Sc. (5), NCE/OND (4), secondary (3), primary (2) and no formal education (1) was given/listed.
- Adoption of climate change adaptation strategies on arable crops: Farmers

were provided with a list of perceived effects a of climate change on arable crops and measure with a 5-point Likert type scale. Strongly Agree (5), Agree (4), Undecided (3) and Disagree (2) and Strongly Disagree (1). Decision rule for this was 3.0 grand mean score.

2.6 Data Analysis

The data were analyzed using descriptive statistics (frequency counts, means, percentages and Inferential statistics.

Hypothesis Two was analyzed with Ordered Multiple Regression model as specified below:

$Y_i = \beta_0+\beta_1x_1+ \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5 + \beta_6x_6 + \beta_7x_7 + \mu i$- - - -(2)

Where:

Y = is the dependent variable (Adoption of adaptation strategies scores)

X_1 = Age in years

X_2 = income in naira

X_3 = Farm Size in hectares

X_4 = Household size

X_5 = Experience

X6 = Farm income

X7 = Non – Farm income

μ = Error term

3.0 RESULTS AND DISCUSSION

Table 3. 1: Socio-economic of farmers

Sex	**Freq.**	**%**	**Mean**	**Std. Dev.**
Male	247	59.8		
Female	166	40.2		
Age (as at last birthday) in years				
<30.00	40	9.7		
30.00 - 39.00	81	19.6		
40.00 - 49.00	127	30.8	46.4	12.6
50.00 - 59.00	94	22.8		
60.00+	71	17.2		
Marital status				
Single	65	15.7		
Married	275	66.6		
Divorced	46	11.1		
Widowed	27	6.5		
Years in farming				
<10.00	106	25.7		
10.00 - 19.00	122	29.5	19.2	3.4
20.00 - 29.00	69	16.7		
30.00+	116	28.1		
Farm size (ha)				
<1.00	212	51.3		
1.01-2.00	57	13.8	1.63	1.40
2.01-3.00	68	16.5		
3.01-4.00	30	7.3		
4.01-5.00	46	11.1		
Highest Qualification				
Primary	145	35.1		
Secondary	183	44.3		
NCE	57	13.8		
First Degree	25	6.1		

Postgraduate	3	0.7		
Frequency of contact				
Fortnightly	15	3.6		
Monthly	23	5.6		
Once a month	20	4.8		
Once a year	355	86		
Farm income per annum (₦)				
<500000.00	83	20.1		
500000.00 - 699999.00	45	10.9		
700000.00 - 899999.00	20	4.8	1327634.9	173462.7
900000.00 - 119999.00	93	22.5		
120000.00 and Above	172	41.6		
Non-farm income per annum (₦)				
<500000.00	25	6.1		
500000.00 - 699999.00	10	2.4		
700000.00 - 899999.00	2	0.5	4725539.9	425737.8
900000.00 - 119999.00	176	42.6		
120000.00 and Above	200	48.4		
Access to credit	302	73.1		

Source: Field Survey, 2025

The results revealed that arable crop farming in the study area is male-dominated, with 59.8% of respondents being male and 40.2% female, indicating greater male participation. This supports Onyemekonwu et al. (2019) who also found male dominance in arable crop farming.In terms of age distribution, the majority of farmers were middle-aged, with 30.8% being 40–49 years and a mean age of 46 years. This implies that most respondents were still active and able to adopt new farming practices, aligning with Onyeneke et al. (2024). However, the low participation of youth (9.7%) suggests potential challenges for future agricultural continuity.The marital status distribution shows that 66.6% of the farmers were married, indicating family responsibility may encourage engagement in farming. This finding is consistent with Ahmadu and Ewansiha (2023) who reported high marriage rates among farmers.With respect to farming experience, 29.5% had 10–19 years of experience and 28.1% had over 30 years, giving an average farming experience of 19 years. This suggests high familiarity with climatic variations, supporting Belay et al. (2022) that experienced farmers possess better knowledge of climate trends.Farm size showed that 51.3% cultivated less than one hectare, while others operated within 1.01–5 hectares, classifying all respondents as small-scale farmers according to Mgbenka and Mbah (2016).Educational level results indicate a high literacy rate (88.9%), with 44.3% having secondary education and 6.1% holding first degrees. This suggests strong potential for adoption of climate-smart practices, aligning with Kangogo et al. (2021) who reported education enhances climate adaptation capacity.However, extension contact was low, with 86% of farmers receiving visits only once a year, which may limit awareness and adoption of improved technologies. This is consistent with Ayodele and Akomolafe (2024) who found similarly limited extension access among farmers.Farm income showed variation, with 20.1% earning below ₦500,000 and 64.1% earning ₦900,000 and above per year. In contrast, non-farm income was significantly higher, with 91% earning ₦900,000 and above and a mean income of ₦4,725,539.90, indicating that non-farm activities contributed substantially to livelihoods.Finally, 73.1% of respondents had access to credit, supporting Kehinde and Ogundeji (2022) that credit enhances investment capacity, while the remaining 26.9% without access remain financially constrained, consistent with Anthony-Orji et al. (2024) who link limited financial access with persistent poverty.

Adoption of adaptive strategies against climate change

The findings from Table 3.2 reveal variations in the adoption of adaptive strategies against climate change among the respondents.The most highly adopted strategy was the planting of drought-resistant varieties (70.5%), reflecting the increasing awareness among farmers of the need to address prolonged dry spells and erratic rainfall patterns that directly threaten crop yields. Similarly, flood control measures (60.8%) and cultural pest control (60.3%) were widely practiced, indicating that farmers are highly responsive to visible and immediate climatic threats such as flooding and pest infestation. The adoption of improved seeds (57.1%), crop diversification (56.9%), shifting planting dates (54.7%), and the planting of pest and disease resistant crops (53.0%) further demonstrates the willingness of farmers to embrace practices that enhance resilience and reduce vulnerability to changing environmental conditions. Other strategies such as hand weeding (53.5%), planting early maturing varieties (52.8%), and regular weeding to avoid insect pests (51.3%) also recorded high adoption, suggesting that relatively simple and cost-effective practices are attractive to smallholder farmers. Interestingly, a substantial proportion of respondents (54.7%) reported no adaptation at all, highlighting critical gaps in awareness, access to resources, or institutional support despite the availability of multiple coping mechanisms.

Table 3.2: Adoption of adaptive strategies against climate change

Adaptive Strategies	Freq.	%
Regular weeding to avoid breed of some insects pest	212	51.3
Planting of cover crops	102	24.7
Crop rotation	149	36.1
Drought Tolerant Varieties	197	47.7
Multiple cropping	159	38.5
Cultural pest control	249	60.3
Hand weeding of crops	221	53.5
Land Ownership	178	43.1
Crop Diversification	235	56.9
Use of zero tilling practices in cultivation	182	44.1
Fallow system	117	28.3

Organic farming	190	46.0
Improved seeds	236	57.1
Planting of pest and disease resistant crops	219	53.0
Effective irrigation measures	203	49.2
Biomass burning	187	45.3
Planting of drought resistant varieties	291	70.5
Flood control measures	251	60.8
Planting early maturing varieties	218	52.8
Shifting Planting dates	226	54.7
No Adaptation Method	226	54.7

Source: Field Survey, 2025.

In contrast, Several strategies exhibit low adoption rates. Planting of cover crops (24.7%) and the use of fallow systems (28.3%) recorded the lowest levels of adoption.Crop rotation (36.1%) and multiple cropping (38.5%) were similarly less practiced, reflecting constraints associated with landholding size and the preference for continuous cropping systems. Strategies that demand higher levels of technical knowledge or financial resources, such as zero tillage (44.1%), organic farming (46.0%), and effective irrigation measures (49.2%), also recorded relatively low adoption, suggesting that limited access to capital and inputs hinders widespread use. The limited adoption of these practices may be attributed to factors such as lack of knowledge, limited resources, or perceived inefficiency.

A notable finding is the high frequency of respondents reporting no adaptation method (frequency = 226, This highlights a significant gap in climate change adaptation efforts, possibly due to limited access to resources, information, or institutional support. This finding aligns with studies by Ayoola *et al.,* 2025who identified socioeconomic barriers, such as poverty and lack of extension services, as major constraints to effective climate change adaptation in Nigeria.

Ho_2: There is no significant relationship between socio-economic characteristics of the farmers and adoption of climate change adaptation strategies.

Relationship between socio-economic characteristics and adoption of adaptation strategies to climate change

This table presents the results of an ordered logistic regression analysis examining the relationship between socioeconomic characteristics and the adoption of climate change adaptation strategies. The adoption levels were measured in ordered categories (Low → Moderate → High). Variables with significant relationships are highlighted.

Farm size (B = 1.98, Exp(B) = 7.23, $p < 0.01$): Larger farm holders are over seven times more likely to adopt climate change adaptation practices extensively. This finding aligns with Nigerian studies that consistently show landholding capacity as a major determinant of adoption. Ozor, & Nnaji (2011). emphasized that larger landholdings provide greater room and resources for experimenting with climate-smart technologies.

Specifically, farm income (B = 0.94, Exp(B) = 2.56, $p < 0.01$) significance shows that farmers with greater farm income are about 2.5 times more likely to adopt higher-level adaptation strategies. Apata et al., (2009) demonstrated that resource-endowed farmers across Nigeria's agro-ecologies are better positioned to invest in climate-resilient inputs and technologies, reinforcing this finding. Also, farm distance (B = 0.46, Exp(B) = 1.59, $p < 0.01$) indicates that each additional unit increase in distance raises the odds of higher adoption by 59%. This result is consistent with Nigerian evidence showing that remoteness amplifies exposure to risks, encouraging proactive adaptation. Otitoju & Enete (2016). highlighted how infrastructure gaps and poor rural access increase risk perception and foster risk-management practices. Furthermore, experience (B = 0.15, Exp(B) = 1.16, $p < 0.05$) implies that each additional year of farming experience.

Table 3.3: Relationship between socio-economic characteristics and adoption of adaptation strategies to climate change

Regressors	Coefficient (B)	Std. Error	Odds Ratio Exp(B)	Sig.
Age	0.01	0.07	1.01	0.89
Household size	-0.64*	0.31	0.53	0.04
Experience	0.15*	0.06	1.16	0.02
Farm size	1.98***	0.45	7.23	0.00
Farm income	0.94***	0.25	2.56	0.00
Non-farm income	-0.12	0.28	0.89	0.71
Access to credit	-0.42	1.07	0.66	0.65
Farm distance (km)	0.46***	0.10	1.59	0.00

Source: Field Survey, 2025.
**Significant at 0.01 level
*Significant at 0.05 level
Pseudo R^2 (Nagelkerke) = 0.361
-2 Log Likelihood = 128.52
Chi-Square = 42.76 ($p < 0.001$)

increases the odds of higher adoption by 16%. This corroborates findings by Adeagbo *et al*. (2021), who argued that accumulated farming experience improves farmers' adaptive decision-making. For the household size (B = -0.64, Exp(B) = 0.53, $p < 0.05$), it implies that larger households are less likely to adopt extensively, reducing the odds of higher adoption by 47%. Nigerian studies, such as Otitoju & Enete (2016). noted that while large households provide labor, they also stretch resources thin, limiting the capacity to invest in new technologies.
However, age (B = 0.01, p = 0.89), non-farm income (B = -0.12, p = 0.71), and access to credit (B = -0.42, p = 0.65) were not statistically significant. Nigerian evidence on these variables is mixed. Apata et al., (2009) and noted that while credit and off-farm earnings may sometimes enable adoption, poor timing of credit delivery and weak institutional frameworks often limit their impact.

Conclusion:

This study assessed the socio-economic characteristics of smallholder arable crop farmers, the adaptive strategies employed in response to climate change, and the relationship between these characteristics and adaptation outcomes. The findings showed that arable crop farming in the study area is predominantly practiced by middle-aged, married males with substantial farming experience and relatively high literacy levels. However, access to extension services was notably limited, which may hinder timely exposure to climate information and innovative practices. Most farmers cultivated small land areas and relied primarily on mixed crop enterprises, reflecting risk-spreading strategies in response to climatic uncertainty. The adoption of climate change adaptation strategies varied widely. While a considerable proportion of farmers adopted drought-resistant varieties, flood control practices, and crop diversification, a significant number reported no adaptation measures at all, indicating persistent institutional and resource constraints. The regression analysis revealed that farm size ($p < 0.05$), farm income ($p < 0.05$), years of farming experience ($p < 0.05$), and distance of farmland from residence ($p < 0.01$) significantly influenced the likelihood of adopting climate change adaptation strategies. Conversely, household size ($p < 0.05$) had a negative influence, suggesting that larger households may divert labor and resources away from climate adaptation. Age, non-farm income, and access to credit were not statistically significant. Based on these results in the study empirically demonstrates that specific socio-economic variables play a central role in shaping adoption behavior among smallholder farmers. In conclusion, although awareness of climate change and the adoption of some adaptive strategies are evident, the effectiveness and sustainability of adaptation practices are constrained by structural limitations such as small farm size, limited extension support, and uneven access to climate-smart resources. Strengthening institutional support mechanisms and addressing socio-economic barriers remain essential to enhancing climate resilience among smallholder arable farmers.

Recommendations

Based on the findings of this study, the following recommendations are proposed to strengthen climate change adaptation among smallholder arable crop farmers:

1. Strengthen Agricultural Extension Services The extremely low rate of farmer–extension interaction (with 86% of farmers receiving only one visit per year) highlights the urgent need to improve extension delivery. Government agencies and NGOs should recruit more extension officers, provide mobility support, and incorporate ICT-based dissemination (radio advisories, SMS alerts, farmer WhatsApp groups) to ensure frequent and timely information flow on climate-smart practices.

2. Enhance Access to Climate-Smart Inputs and Technologies
Since over 51.3% of farmers cultivate less than one hectare and face limited investment capacity, subsidized access to drought-resistant seeds, early-maturing varieties, soil conditioners, and small-scale irrigation tools is essential. Input support schemes should prioritize resource-poor farmers to reduce exposure to climate risks.
3. Expand Access to Affordable and Timely Credit
Although 73.1% of farmers reported access to credit, credit timing, collateral requirements, and bureaucratic bottlenecks remain limiting. Financial institutions should design flexible, low-interest agricultural credit products, while government should coordinate credit release to align with planting seasons. Village savings groups and cooperative credit unions should also be strengthened.
4. Support Youth and Women Participation in Climate-Resilient Agriculture
The low representation of youth (9.7%) in arable farming signals a future sustainability risk. Policies should provide start-up grants, land access schemes, mechanization services, and agribusiness incubation centers to attract youth. Women should receive equal access to land, credit, membership in cooperatives, and extension activities.

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