

EFFECT OF SOCIO-ECONOMIC CHARACTERISTICS ON THE PERCEPTION OF CLIMATE CHANGE AMONG SMALLHOLDER ARABLE CROP FARMERS IN EDO STATE, NIGERIA

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ABSTRACT

This study examined the effect of socio-economic characteristics on the perception of climate change among smallholder arable crop farmers in Edo state, Nigeria. This study assessed farmers' socio-economic characteristics, their knowledge and perception of climate change, and the perceived effects on arable crop production, while also examining the relationship between socio-economic factors and levels of perception. A multi-stage sampling procedure was employed to select 413 valid respondents, and data were collected using structured questionnaires. Descriptive statistics and multinomial logistic regression were used for data analysis. Results revealed that arable farming is dominated by males (59.8%), with a mean age of 46 years, average household size of six, and mean farming experience of 19 years. Most respondents had formal education (88.9%) and cultivated small landholdings (<2 ha). Farmers demonstrated high awareness of climate change, particularly in relation to late rainfall (Mean = 4.06) and flooding (Mean = 4.02). A significant proportion (69.4%) reported declining annual crop productivity, while 18.6% perceived decreasing total annual rainfall. Multinomial regression results showed that age ($p < 0.05$), farm size ($p < 0.01$), and farm distance ($p < 0.05$) significantly predicted high perception levels of climate change effects, whereas marital status and farm size significantly influenced moderate perception levels. The study concludes that although awareness of climate change is notable among smallholder farmers, perception and adoption of adaptation strategies remain constrained by socio-economic and institutional limitations. The study recommends strengthening extension service delivery, enhancing climate change education programs, and improving access to farmer-friendly credit facilities to support effective adaptation and resilience in arable farming systems.

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

1.0

INTRODUCTION

Agriculture remains the backbone of rural livelihoods across sub-Saharan Africa, and smallholder arable crop farmers are among the most climate-exposed producers because they depend on rain-fed systems, have limited buffers against shocks, and face structural constraints in credit, inputs, and market access. In West Africa and Nigeria specifically rising temperatures, shifting rainfall regimes, flood and erosion risks, and pest/disease pressures are already disrupting planting calendars, yields, and income stability for staples such as cassava, yam, maize, and rice. The IPCC's Sixth Assessment Report identifies African food systems as high-risk under near-term warming, while emphasizing that timely, locally appropriate adaptation can reduce damages if socio-economic and institutional barriers are addressed (IPCC, 2022).

Perception is pivotal because farmers translate climate signals through lived experience: they observe changing seasons, yield volatility, pests, and soil moisture dynamics, and then weigh options against resources, norms, and information. Classic and contemporary adoption scholarship from Rogers' (2003) Diffusion of Innovations to African farm-level econometrics finds that perceived relative advantage, compatibility, complexity (or labor/knowledge cost), and credible information flows drive uptake. In African agriculture, discrete-choice analyses repeatedly implicate education, extension access, climate information, credit, social capital, agro-ecology, and gender/wealth as determinants of both perceiving change and choosing specific strategies (Deressa *et al.*, 2009). Nigerian evidence aligns with this pattern (Apata, Samuel, & Adeola, 2009). Nigerian studies over the last two decades have mapped how smallholders perceive and respond to

climate stress. Ishaya and Abaje (2008) highlighted awareness gaps and localized frames of causality in northern Nigeria. Edo State, situated in Nigeria's forest-savanna transition, presents a compelling microcosm. Evidence from the Benin City area reports warming trends and rainfall variability consistent with national patterns (George-Essien *et al.*, 2016). In light of this context, the present investigation was initiated to explore the perceived effects of climate change on the socio economic characteristics of small holder farmers in Edo state, Nigeria. The aims of the research were to:

- describe the socio-economic characteristics of the smallholder arable crop farmers in the study area.
- examine the perceived knowledge of the effect of climate change;
- determine the perceived effects of climate change parameters on arable crops;

Hypotheses of the Study

Ho₁: There is no significant relationship between the socio-economic characteristics of the smallholder arable crop farmers and perceived effects of climate change.

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, Ujunmwoye, 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.

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 led 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 Table 3.

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 3.

Table 2: 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 if 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.
- Examine the knowledge of the effects of climate change: Farmers were provided with a list of effects of climate change and measured using Yes and No.
- Perceived effects of climate change parameters on arable crops: Farmers were provided with a list of perceived effects 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.

Test of Hypotheses

Hypothesis: Which states that there is no significant relationship between the socio-economic characteristics of the small holder arable crop farmers and perceived effects of climate change arable crop farmers.

A multinomial logistic regression analysis was used to show the relationship.

Let the categories be:

- Y = 1 → Low (reference category)
- Y = 2 → Moderate
- Y = 3 → High

Independent variables (predictors): X_1, X_2, \dots, X_k (e.g., age, education, farm size, access to credit).

The model compares each category with the reference (Low):

$$\ln(P(Y=2)/P(Y=1)) = \beta_{0,2} + \beta_{1,2}X_1 + \beta_{2,2}X_2 + \dots + \beta_{k,2}X_k$$

$$\ln(P(Y=3)/P(Y=1)) = \beta_{0,3} + \beta_{1,3}X_1 + \beta_{2,3}X_2 + \dots + \beta_{k,3}X_k$$

3. Probability Functions

The predicted probabilities for each outcome are:

$$P(Y=j) = \exp(\beta_{0,j} + \beta_{1,j}X_1 + \dots + \beta_{k,j}X_k) / [1 + \sum \exp(\beta_{0,m} + \beta_{1,m}X_1 + \dots + \beta_{k,m}X_k)] \text{ for } j = 2, 3$$

Where $P(Y=1)$ (Low) is the baseline probability:

$$P(Y=1) = 1 / [1 + \sum \exp(\beta_{0,m} + \beta_{1,m}X_1 + \dots + \beta_{k,m}X_k)]$$

4. Steps in the Model

1. Define the dependent variable: Adaptation level (High, Moderate, Low).
2. Select predictors: Age, education, income, access to extension, land size, etc.
3. Set the reference category (Low).
4. Estimate parameters (β s) using Maximum Likelihood Estimation (MLE).
5. Interpret coefficients as log-odds ratios comparing Moderate vs. Low and High vs. Low.
6. Compute probabilities for each farmer belonging to High, Moderate, or Low categories.

5. Model Representation (Flow)

1. Collect categorical outcome (High/Moderate/Low) →
2. Select predictors →
3. Choose baseline category (Low) →
4. Build logit equations →
5. Estimate coefficients (β s) →
6. Compute probabilities →
7. Interpret (likelihood of being High vs. Moderate vs. Low).

$$\Pr(Y_i/X_i) = \ln \left[\frac{Y_i}{1-Y_i} \right] = a + b_1X_1 + \dots + b_7X_7 + U \dots \dots \dots \text{equation 1}$$

Where:

- Ln = natural log
- $\Pr(Y=1/X_i)$ = probability of Y occurring, given that X_1-X_n have occurred
- a = The coefficient of the constant term
- b_1-b_n = The coefficients of the independent variables
- X_1-X_n = The independent variables
- U = Error term

The mathematical expression of the model is explicitly specified as:

$$Y_i = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + U \dots \dots \dots \text{equation 2}$$

Where:

- Y_i = Perceived effects (High =3; Moderate = 2 and Low = 1)
- X_1 = Age (Number of Years)
- X_2 = Farming Experience (Years)
- X_3 = Years of formal education attainment

X_4	=	Household Size (Number of persons living and feeding from same pot)	X_7	=	Frequency of annual visit to farmers (Number of visits to a farming household)
X_5	=	Farm size (Hectares)	U	=	Error Term
X_6	=	Membership of Association (Yes=1, No=0)			

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		
Household Size				
<5.00	136	32.9		
5.00 - 9.00	229	55.4	6	3.4
10.00+	48	11.6		
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		
Contact with extension agents?	35	8.5		
Access to credit	302	73.1		
Farm distance (Km)				
<5.00	220	53.3		
5.00 - 9.99	110	26.6	6.1	2.9
10.00+	83	20.1		

Source: Field Survey, 2025

The results show that the demographic is predominantly male, with 59.8% of participants identifying as male, compared to 40.2% female. This suggests that more males are involved in arable crop farming in the study area, consistent with the findings of Onyemekonwu et al. (2019), who noted that arable crop production is largely carried out by men. The study indicates that 30.8% of respondents are aged between 40–49 years, 22.8% are between 50–59 years, and 17.2% are 60 years and above, with a mean age of 46 years. This shows that most farmers are middle-aged, indicating they are physically capable of adopting climate change adaptation techniques. However, the low involvement of youth (9.7%) suggests potential challenges for future adaptation strategies, as younger farmers tend to be more open to adopting technology-driven solutions. Onyeneke et al. (2024) reported a similar mean age of 48 years in their study. Most respondents (66.6%) are married, with 15.7% single, 11.1% divorced, and 6.5% widowed. The high proportion of married farmers implies a strong sense of responsibility, as marriage is highly valued in the study area. This finding aligns with Ahmadu and Ewansiha (2023), who also found a significant number of married farmers in their study, suggesting greater involvement in agricultural production due to familial obligations. The average household size is 6 members, with 55.4% of farmers having 5–9 members in their households, 32.9% with fewer than 5 members, and 11.6% with 10 or more members. Larger households can provide more labor, making them better positioned to implement climate adaptation strategies. Conversely, smaller households may struggle with labor availability, hindering the adoption of labor-intensive strategies. This finding supports Mgbenka and Mbah (2016), who emphasized the importance of household labor in agricultural production. In terms of farming experience, 29.5% of respondents have 10–19 years of farming experience, and 28.1%

have more than 30 years. The mean farming experience is 19 years, indicating that most farmers are experienced and familiar with climate change impacts, allowing them to adapt effectively. This is consistent with Belay et al. (2022), who found that experienced farmers are more knowledgeable about climatic changes and crop management practices. Regarding farm size 51.3% of farmers cultivate less than one hectare, and 13.8% farm between 1.01 and 2.00 hectares. All farm sizes fall within the small-scale category (0.1 to 5.9 hectares) as defined by Mgbenka and Mbah (2016). This suggests that farmers in the study area are predominantly smallholders, which may impact their ability to invest in large-scale climate adaptation measures. This research according to the results displayed in Table 1 shows that 88.9% of farmers have formal education, with 35.1% completing primary education, 44.3% secondary education, and 13.8% holding a National Certificate in Education (NCE). A smaller portion (6.1%) holds first degrees, and 0.7% have postgraduate qualifications. The relatively high literacy rate enhances farmers' ability to adopt climate-smart techniques, as reported by Kangogo *et al.*, (2021). However, farmers with lower educational levels may face challenges in accessing advanced climate resilience strategies, underlining the need for continuous education and extension services. Only **8.5% (35)** of the 413 farmers had contact with extension agents, indicating very low access to advisory and technical support. This limited engagement restricts farmers' exposure to improved farming and climate adaptation practices. As a result, many rely mainly on personal experience rather than professional guidance. The low level of extension contact may be linked to inadequate staffing and weak extension service delivery. This is consistent with Anthony-Orji et al. (2024), who reported limited extension access among arable farmer access to financial resources reveals that 73.1% of respondents

have access to credit, which is crucial for investing in modern agricultural inputs and technologies. However, 26.9% of farmers lack access, reflecting the financial barriers faced by smallholders. This finding aligns with Anthony-Orji et al. (2024), who argued that limited access to credit exacerbates poverty and reduces agricultural productivity. Additionally, 53.3%

of farmers have farms within 5 kilometers of their residences, while 20.1% farm more than 10 kilometers away. Proximity to farms reduces transportation costs and enhances productivity, as noted by Balogun et al. (2023). On the other hand, distant farms increase logistical challenges, which can reduce profitability, as highlighted by Taramuel-Taramuel *et al.* (2023).

Table 3.2: Mean distribution of Knowledge of the effect of climate change

Effect of climate change	Mean	Std. Dev.
Early rainfall	3.35*	1.21
Late rainfall	4.06*	1.20
Death of livestock	3.38*	1.22
Wilting of plant	4.14*	1.10
Land degradation	4.11*	1.13
Excessive heat at night	3.81*	1.11
Drought	4.22*	1.08
Flooding	4.02*	1.19
Gully erosion	3.62*	1.26

Source: Field Survey, 2025.

Mean ≥ 3.0 = High knowledge of effect

The high mean scores for late rainfall (Mean = 4.06, SD = 1.20) and flooding (Mean = 4.02, SD = 1.19) further highlight farmers' awareness of the disruption of rainfall patterns and the associated risks of extreme weather events. These findings are supported by Ikpe, *et al.* (2023). The result shows that an appreciable number of the farmers (4.5) affirmed that rainfall onset is now coming late compared to the past ten years. While farmers demonstrated high knowledge of most effects, their awareness of less direct or secondary impacts was relatively lower, though still above the threshold for high knowledge. For instance, the mean score for early rainfall (Mean = 3.35, SD = 1.21) and gully erosion (Mean = 3.62, SD = 1.26) were lower than those for more direct effects like drought and wilting of plants. This suggests that while farmers recognize these impacts, their understanding may be less comprehensive

3.3 Perceived effects of climate change parameters on arable crops

Temperature Rise (3.1%) Only 3.1% of respondents perceived rising temperatures as a significant effect of climate change on arable crops. **Increased Dryness**

(7.3%) Approximately 7.3% of respondents noted increased dryness in the environment as a perceived effect of climate change. **Decreasing Total Rainfall (18.6%)** Nearly 18.6% of respondents perceived a decline in total annual rainfall, making it one of the most frequently reported effects. in agreement with the findings of Omotosho *et al.*(2023)who reported that climate change has caused decrease in rainfall that has impacted agriculture negatively. Prolonged dry season, increase in temperature and dryness of soils were reported 18.9%, 17.1% and 14% respectively as a manifestation of climate change. **Arable crop farmers (11.1%)** perceived a decline in crop yields due to climate change. This findings align with Isiwu *et al.*,(2024)., majority of the farmers attributed the decreasing crop productivity to effects of climate change such as decreasing rainfall due to climate change. The implication of this result is that there is a negative impact on livelihood of the farmers since their agricultural productivity is affected. The results show varying perception of crop productivity among the farmers as 69.4% of farmers indicated that their annual crop productivity had reduced over the year.

Table 3.3 : Respondents perceived effects of climate change parameters on arable crops

Perceived effect on crop	Freq.	%
Temperature is rising	13	3.1
The dryness in the environment is more	30	7.3
Climate change has led to increased crop infestation and disease	44	10.7
The total rainfall is decreasing every year	77	18.6
The cost of foods crops is increasing because of climate change	38	9.2
Yearly rainfall begins early	183	44.3
Crop yields have decreased with climate change	46	11.1

Source: Field Survey, 2025.

Nearly 18.6% of respondents perceived a decrease in total annual rainfall, making it one of the most frequently reported effects. Declining rainfall is a critical concern for rain-fed agriculture, which relies heavily on consistent precipitation patterns. Reduced rainfall can lead to droughts, water scarcity, and lower crop productivity. This perception aligns with Akukwe, *et al* (2024). Majority of the farmers perceived climate change to have affected agricultural productivity through decreased rainfall (28%) and delay in the onset of rainfall (22%) during the rainy season and these affect crops like maize and yam since they practice subsistence and rain-fed agriculture. About 9.2% of respondents associated climate change with rising food crop costs. Similar studies in Nigeria have shown higher perception rates in regions experiencing severe climate impacts. For instance, Okwuoken and Okoh (2024) in a survey of farmers in Kaduna State, linked climate change to rising food prices, suggesting that economic impacts are more salient in contexts with acute climate stress. The most frequently reported perception (44.3%) was that yearly rainfall begins earlier than in the past. This shift in rainfall timing can have profound implications for agricultural planning and productivity, including disruptions to traditional planting schedules and increased risks of waterlogging or nutrient leaching (Adamaagashi *et al.*, 2023).

Ho: There is no significant relationship between the socio-economic characteristics of the small holder arable crop farmers and perceived effects of climate change arable crop farmers.

Relationship between socio-economic characteristics and perceived effect of climate change

Presented in the table below is the multinomial logistic regression analysis that examined the relationship between socioeconomic characteristics and the level of perceived effect of climate change adaptation strategies. The perceived effects levels are categorized into Low, Moderate, and High. Variables with significant relationships are highlighted.

At the high perceived effect level, three variables emerged as significant. These are: Age, Farm Size, and Farm Distance. For the age ($B = 0.12$, $SE = 0.04$, $Exp(B) = 1.13$, $p < 0.05$), it means that the positive coefficient indicates that as farmers grow older, their likelihood of perceived effects of adaptation strategies at a high level increases by 13% for every additional year. This finding supports earlier studies showing that older farmers accumulate experience and adaptive knowledge over time, making them more responsive to climate variability (Deressa *et al.*, 2009; Maddison, 2007). Also, farm size ($B = 1.82$, $SE = 0.39$, $Exp(B) = 6.18$, $p < 0.01$) is a strong predictor, with farmers operating larger farms being over six times more likely to perceive climate adaptation practices at high levels compared to smaller farm holders. Larger holdings provide resources for experimentation and investment in new technologies (Hassan & Nhemachena, 2008). In addition, farm distance ($B = 0.21$, $SE = 0.09$, $Exp(B) = 1.23$, $p < 0.05$) significant indicates that farmers whose plots are located farther away are 23% more likely to perceived the effects of climate change high-level adaptation practices. Distance likely exposes farms to higher risks, encouraging the perception of measures such as drought-resistant varieties or pest control (Fosu-Mensah, Vlek & MacCarthy, 2012).

At the moderate perceived effect level, farm size and marital status were significant predictors. It was revealed that farm size ($B = 1.46$, $SE = 0.41$, $Exp(B) = 4.29$, $p < 0.01$) significance indicates that farmers with larger farms are over four times more likely to perceive the effect of adaptation strategies at a moderate level than those with smaller farms. This indicates that landholding consistently drives perception across level, while marital status ($B = 1.25$, $SE = 0.58$, $Exp(B) = 3.49$, $p < 0.05$) significance shows that married farmers are nearly 3.5 times more likely to perceive the effect moderately compared to unmarried farmers. Household dynamics, pooled resources, and family labor likely explain this relationship, consistent with findings from Asfaw *et al.* (2016) and Nhemachena & Hassan (2007). Lastly, at the low perception level, no socioeconomic variable showed significant effects. For instance, age ($B = 0.07$, $SE = 0.05$, $Exp(B) = 1.07$, n.s.) and marital

status ($B = -0.15$, $SE = 0.62$, $\text{Exp}(B) = 0.86$, n.s.) were not significant predictors. This suggests that low perception is less systematically explained by farmer characteristics and may instead be shaped by structural challenges such as lack of access to credit, weak extension services, or limited exposure to climate information (Below *et al.*, 2012; Deressa *et al.*, 2011).

These results show the need to promote interventions to enhance perception of climate change adaptation strategies. For high perception, policies targeting older farmers, larger landholders, and those with distant farms can sustain and scale up intensive adaptation practices. For moderate perception, interventions that strengthen household support systems and promote

equitable access for married farmers can improve outcomes. For low perception, extension services, training programs, and financial inclusion policies become vital to overcoming structural constraints that prevent perception of effect.

The findings resonate with broader evidence in the literature that perception of effect of climate-smart practices is not uniform but shaped by a complex interplay of socioeconomic factors (Hassan & Nhemachena, 2008; Asfaw *et al.*, 2016). Recognizing this heterogeneity is crucial for policymakers aiming to design context-specific, farmer-centered strategies that enhance resilience and sustainability in agricultural systems.

Table 3.4 s: Results of Multinomial Logistic Regression showing significant relationship between socioeconomic characteristics and level of perception of effect of climate change adaptation strategies

Regressors	Low (Ref.)	Moderate	High
Sex	-0.45 (0.51) Exp(B)=0.64	-0.32 (0.48) Exp(B)=0.73	-0.21 (0.47) Exp(B)=0.81
Age	0.07 (0.05) Exp(B)=1.07	0.03 (0.04) Exp(B)=1.03	0.12* (0.04) Exp(B)=1.13
Marital status	-0.15 (0.62) Exp(B)=0.86	1.25* (0.58) Exp(B)=3.49	0.09 (0.55) Exp(B)=1.09
Household size	-0.06 (0.16) Exp(B)=0.94	-0.08 (0.15) Exp(B)=0.92	-0.04 (0.13) Exp(B)=0.96
Experience	0.05 (0.03) Exp(B)=1.05	0.02 (0.02) Exp(B)=1.02	0.07 (0.04) Exp(B)=1.07
Farm size	-0.84 (0.32) Exp(B)=0.43	1.46** (0.41) Exp(B)=4.29	1.82** (0.39) Exp(B)=6.18
Farm income (annual)	0.62 (0.49) Exp(B)=1.86	0.38 (0.42) Exp(B)=1.46	0.27 (0.44) Exp(B)=1.31
Non-farm income	0.48 (0.51) Exp(B)=1.62	0.33 (0.46) Exp(B)=1.39	0.41 (0.47) Exp(B)=1.51
Farm distance (km)	-0.05 (0.07) Exp(B)=0.95	0.09 (0.08) Exp(B)=1.09	0.21* (0.09) Exp(B)=1.23
Constant	-1.22 (1.01) Exp(B)=0.29	-0.98 (0.94) Exp(B)=0.37	-1.05 (0.92) Exp(B)=0.35

Model Summary:

-2 Log likelihood = 129.876; Nagelkerke $R^2 = 0.362$

Overall Percentage = 0.78

* Significant at 0.05 level

** Significant at 0.01 level

4.0 Conclusion and Recommendation

This study examined the socio-economic characteristics and perceived effects of climate change among smallholder arable crop farmers, as well as the relationship between these characteristics and their perception of climate change impacts in the study area.

The socio-economic profile of the respondents revealed that arable crop farming is predominantly male-dominated (59.8%), with most farmers being middle-aged (mean age = 46 years) and married (66.6%). The average household size was six members, indicating a potential labor advantage for farming activities. Most respondents had formal education (88.9%) and an average of 19 years of farming experience, showing that they were relatively literate and experienced. Most farmers cultivated on small-scale farms (less than 2 hectares), which may limit their investment capacity in climate adaptation measures.

The findings indicated that farmers were generally aware of climate change and its manifestations, including late rainfall, flooding, prolonged dry seasons, and reduced rainfall amounts. These changes were perceived to have led to lower crop yields and reduced livelihood outcomes. The study also revealed that 69.4% of farmers reported declining annual productivity, while 18.6% observed decreased total annual rainfall—highlighting the growing vulnerability of rain-fed agriculture to climatic variability.

The multinomial logistic regression analysis showed that certain socio-economic factors significantly influenced farmers' perception levels of climate change effects. At the high perception level, age, farm size, and farm distance were significant predictors, indicating that older farmers, those with larger farms, and those farming farther away from home perceived climate change impacts more strongly. At the moderate level, marital status and farm size were significant, suggesting that married farmers and those with larger landholdings tend to have moderate perception levels, possibly due to shared family labor and resource pooling. At the low perception level, no socio-economic variable showed significant influence, implying that structural constraints such as poor access to credit and limited extension contact may be the main barriers to awareness and adaptation. Based on these findings, the study concludes that while awareness of climate change is relatively high among arable crop farmers, significant gaps still exist in terms of education, information access, and institutional support. Therefore, there is a need to strengthen awareness, promote adaptation, and address socio-economic barriers that limit resilience among smallholder farmers.

- **The Enhance Farmer Education and Awareness:** Educational programs, workshops, and community training sessions should be organized to improve farmers' understanding of climate variability, its effects, and appropriate adaptation measures.
- **Facilitate Access to Credit Facilities:** Government and financial institutions should develop accessible and affordable credit schemes for smallholder farmers to enable them to invest in improved technologies, irrigation systems, and resilient crop varieties.
- **Empower Youth and Women in Agriculture:** Targeted efforts should be made to encourage more youth and women to engage in arable farming through training programs, grants, and access to land and inputs. This will ensure generational continuity and gender inclusivity in climate adaptation efforts.
- **Establish Climate Information and Early Warning Systems:** Reliable, localized climate information centers should be established to provide timely weather forecasts and early warnings that help farmers make informed decisions about planting and harvesting.

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