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Factors Influencing Farmers' Perception of Climate Variability and Change in Kano State, Nigeria

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HIGHLIGHTS

- Socio-economic factors such as age, education, farming experience and household income were significantly affecting farmers' perception of climate change and variability.
- Inconsistent information sources negatively affect perception quality.
- Improved access to education and reliable extension contacts is essential for better perception of climate change.

ARTICLE INFO

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ABSTRACT

The study examined the socio-economic determinant of farmers' perception of climate change in Kano State, Nigeria in 2025. A quantitative research design was employed using structured questionnaires received from 369 farmers with minimum of 10 years' experience. Descriptive statistics, composite perception index and multiple linear analysis were used for analysis of data. The level of perception index indicate a high level of climate change awareness among farmers (Mean =3.11), while rainfall unpredictability, temperature changes and declining agricultural productivity being the most perceived indicators. Multiple regression analysis showed that annual household income, farming experience, age, and education positively and significantly influenced farmers' perception of climate change (R^2 = .636, $p < 0.05$). Contrarily, source of information had significant and negative effect, highlighting that increase access to information does not necessarily means better understanding because of issues around quality and reliability. The study concludes that while farmers perceived climate change, their understanding level is driven by socio-economic variables and reliable sources of information. The study recommends focus on improving access to education, enhancing extension services and ensuring dissemination of reliable climate information to strengthen farmers' ability to respond to climate change.

INTRODUCTION

Agriculture is an important sector ensuring food supplies, raw materials for agro-based industries, greater employment opportunities and sustainable livelihoods. However, the sector is increasingly confronted with climate change, which refers to long time shifts in weather patterns and temperature caused mostly by human activities (United Nations, n.d.). Climate change continues to threaten agricultural and food production worldwide. Global food security and livelihood sources are being disrupted by unpredictable weathers, rising temperature and extreme weather events. The reliance of agriculture on weather and natural resources exposes it more to climate shocks (Sthitaprajna & Shasani, 2026). Recent studies indicate that climate change is becoming more pronounced globally, placing agricultural productivity and livelihoods at high risk (Intergovernmental Panel on Climate change [IPCC], 2021). Due to its heavy reliance on rainfall, low technology and investments,

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agriculture is in developing countries is expected to experience severe impacts (IPCC, 2022).

Agriculture in many African countries is highly vulnerable to climate change because farming systems are predominantly rainfed and constrained by limited access to inputs, insurance, and capital. Over 60% of rural households in sub-Saharan Africa depend on agriculture for food and livelihoods (Shuaibu & Nchak, 2021). Climate variability, including rising temperatures, irregular rainfall, droughts, floods, and increased pest and disease outbreaks, has adversely affected agricultural productivity and sustainability, threatening the livelihoods of smallholder farmers (Ezeh et al., 2026). If current trends persist, crop yields in sub-Saharan Africa are projected to decline by 10–40% by 2050 (IPCC, 2018).

Nigeria, the populous African country has an estimated population of about 241 million people (Worldmeters, 2026). It relies heavily on agriculture for employment (about 70%) and rural livelihoods making it highly vulnerable to climatic shocks (Central Bank of Nigeria [CBN], 2024). Climate change is expected to deteriorate food security, while increasing pressure on resources; water, arable lands, and livestock feed (Braun et al., 2023). Despite these challenges, agriculture must continue to meet the growing food and nutritional demands of population.

There are many empirical studies on farmers' perception of climate change. However, these studies are diverse and shaped by socio-economic characteristics. Socio-economic factors considered key variables influencing perceptions to climate change (Kumar & Saxena, 2024). More educated farmers or household with reliable information are more likely to perceived climate change and make creative decisions (Ghanghas et al., 2015; Ahmed & Givens, 2025). Despite growing research in Nigeria, there is limited empirical data focusing specifically on socio-economic determinants of farmers' perception of climate change especially at rural levels where most agricultural production take place.

In line of this, the research aims to bridge the void by assessing the determinants of farmers' perceptions of climate change in Kano state Nigeria. Notably, it investigates how selected socio-economic characteristics influence perceptions of climate change. The results are expected to contribute to the existing literature and provide empirical evidence for improved agricultural production and sustainable livelihoods.

METHODOLOGY

The study was conducted in 2025 in Bichi Local Government Area (LGA), Kano State, Nigeria. Situated within the Sudan Savannah agro-ecological zone, the area is predominantly agrarian, with a rainy season extending from May to October. Major crops include rice, maize, groundnut, millet, guinea corn, vegetables, and Bambara nut. Bichi was selected due to its vulnerability to climate change and reliance on rain-fed agriculture.

A descriptive correlational research design was used. The target population comprised 75,000 registered farmers. Based on the Krejcie and Morgan (1970) table, 382 respondents were selected, with 369 valid responses analyzed. A multi-stage sampling procedure was employed: Bichi LGA was purposively selected for its agricultural importance, and respondents were randomly chosen from 11 wards with proportional village representation. Only farmers with a minimum of 10 years' farming experience were included in the study.

Variables were coded as follows: age (≤20 years (1), to >50 years (5), education (no education (0) to vocational training (5), farming experience (10 years (1) to ≥41 years (5), source of information (media (1), extension officer (2), fellow farmers (3), local leaders (4) NGOs (5), others (6), and annual household income (low (1), medium (2), high (3). Binary variables were measured on a two-point scale Yes (2), No (1); using the midpoint of 1.50, mean scores ≥1.50 indicated accepted sources, while scores <1.50 indicated non-accepted sources.

Data were collected using a validated questionnaire. Farmers' perceptions of climate change were measured on a 4-point Likert scale (1 = Strongly Disagree to 4 = Strongly Agree). The instrument yielded a Cronbach's alpha of 0.71. A composite perception index (1.00–4.00) was computed by averaging item scores and categorized using the equal interval method (Omorogiuwa, 2018) as low (1.00–1.99), moderate (2.00–2.99), or high (3.00–4.00).

Descriptive statistics and multiple linear regression were used to analyze the data at the 5% significance level using SPSS:

$$Y_i = \beta_0 + \beta_1 (\text{Age}) + \beta_2 (\text{Education}) + \beta_3 (\text{Farming experience}) + \beta_4 (\text{Source of information}) + \beta_5 (\text{Annual household income}) + \varepsilon i$$

Where, Y_i is the perception score, β_0 is the intercept, β_1–β_5 are regression coefficients, and εi is the error term.

RESULTS

Farmers' perception of climate change indicators

The level of perception index presented in Table 1 shows that farmers in the study area had a high perception of climate change indicators, with the overall mean of 3.11. Rainfall unpredictability had the highest mean score (Mean = 3.409), followed by temperature change (Mean = 3.358). Agricultural productivity decline (Mean = 3.218), pest and disease incidence (Mean = 3.163), flood and erosion related events (Mean = 3.163), and drought and water scarcity (Mean = 3.098) were highly perceived by the farmers. However, perceived change in rainfall amount (Mean = 2.832) and storm and wind intensity (Mean = 2.832) recorded moderate perception levels.

Farmers access to climate change information

Data descriptive statistics data disclosed that farmers relied on multiple sources of information pertaining climate change. Extension workers emerge as the most important source of information with 82.66 %, fellow farmers is next with 63.14% and media with (56.64 %). The cumulative mean score (1.549) is above the decision threshold (1.50), indicating acceptable level of information access. Meanwhile, reliance on information from informal source such as fellow farmers and leaders may sometimes be misleading or lack reliability and accuracy as my may affect quality of the information (Table 2).

Socio-economic determinant of farmers' perception

The data summary of multiple regression show that farmers' perceptions of climate change are strongly associated with their

Table 1. Level of perception of climate change indicators among farmers

Climate indicator	Mean score	Standard Deviation	Interpretation
Temperature change	3.358	0.672	High perception
Perceived change in rainfall amount	2.832	0.713	Moderate perception
Pest and disease incidence	3.163	0.671	High perception
Storm and wind intensity	2.832	0.713	Moderate perception
Flood and erosion	3.163	0.800	High perception
Drought and water scarcity	3.098	0.543	High perception
Agricultural Productivity decline	3.218	0.412	High perception
Rainfall unpredictability	3.409	0.880	High perception
Overall Perception Index	3.11		High perception

Note: Perception levels were classified using the equal interval method: 1.00 – 1.99 = Low; 2.00 - 2.99 = Moderate, 3.00 – 4.00 = High. (*Source:* Omorogiuwa, 2018).

Table 2. Source of climate change information among the farmers

S.No.	Source of Information	Yes (Freq.)	Yes (%)	No (Freq.)	No (%)	Mean	Std. Dev.
1	Media	209	56.64	160	43.36	1.566	0.701
2	Extension Officers	305	82.66	64	17.34	1.827	0.511
3	Fellow Farmers	233	63.14	136	36.86	1.631	0.379
4	Local Leaders	148	40.10	221	59.89	1.401	0.577
5	NGOs	198	53.66	171	46.34	1.537	0.811
6	Others	123	33.33	246	66.67	1.333	0.489
	Cumulative Mean					1.549	

Note: Division Rule ≥1.50 = Accepted source

socio-economic characteristics. The coefficient determination (R^2 = .636) suggest that approximately 63.60% of the variation in the perceptions is explain by the model. This indicates a good model fit and highlights the variables relevance. Durbin- Watson value (2.018) show lack of autocorrelation and confirm model reliability estimates (Table 3).

Regression coefficient analysis was employed to obtain the contribution of individual variable; age was positive and significantly affect perception ($\beta = 0.170$, $p < 0.05$), indicating aged farmers may likely perceived changes in climate better. This may be due to their prolonged involvement in farming and years of experience in tracking environmental changes.

Education also indicate a positive and statistically significant relationship ($\beta = 0.096$, $p < 0.05$), showing that more educated farmers are likely to have a better understanding of climate change because of the expected improve information processing ability.

Farming experience was found to be positive ($\beta = 0.266$, $p < 0.05$), highlighting the role of experience in improving perception. Farmers with more years' experience tend to identify climate trends and impacts.

Annual household income happens to had the significant positive influence ($\beta = 0.387$, $p < 0.05$), demonstrating that wealthy households are positioned to had better access to information, resources and technologies which enhance their perception of climate change. Contrary to this, source of information showed a negative influence but significant relationship ($\beta = -0.203$, $p < 0.05$). This finding suggests possible limitations in the relevance, quality or reliability of the information sources available. The result indicates increased access to information does not always mean better understanding or perception especially when it is from unreliable and inconsistent sources (Table 4).

Regression equation

The estimated regression equation for predicting farmers' perception of climate change is:

$$Y = 10.033 + 0.722X_1 + 0.369X_2 + 0.958X_3 - 0.596X_4 + 2.499X_5$$

Where, Y = Perception of climate change, X_1 = Age, X_2 = Education, X_3 = Farming experience, X_4 = Source of Information, X_5 = Annual household income.

DISCUSSION

The level of perception of climate change indicators reveals high perception of climate change among farmers. This suggests that farmers in the study have substantial awareness of climate-related changes, which may be attributed to prolonged farming activities and exposure to environmental changes. Highly favourable

Table 3. Summary of multiple regression of socio-economic determinants of farmers' perception of climate change

Model	R	R^2	Adjusted R^2	Std. Error	F Change	df1	df2	Sig.	Durbin- Watson
1	0.798	.636	0.631	3.027	127.054	5	363	0.000	2.018

Note: Predictors: Age, Education, Farming Experience, Source of Information, Annual Income
Dependent Variable: Perception of Climate Change

Table 4. Estimated regression coefficients

Variable	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
Constant	10.033	0.700		14.322	0.000		
Age	0.722	0.155	0.170	4.649	0.000	0.751	1.331
Education	0.369	0.130	0.096	2.825	0.000	0.870	1.149
Farming Experience	0.958	0.147	0.266	6.533	0.000	0.604	1.656
Information Sources	-0.596	0.100	-0.203	-5.984	0.000	0.870	1.149
Annual Income	2.499	0.253	0.387	9.879	0.000	0.652	1.533

Note: Dependent Variable: Perception of Climate change.

perception of rainfall unpredictability and changes in temperature indicates that farmers are concerned about climatic factors that directly influence planting decisions, agricultural yields and productivity. These findings are consistent with those of Yeleliere et al. (2023). However, farmers in the present study perceived rainfall unpredictability more strongly, likely due to their prolonged exposure to local climate trends. This suggests regional differences in how farmers perceive and rank climate indicators.

The strong perception of pests and diseases incidence and declining agricultural productivity reflects the practical experience of the respondents, as these factors have direct economic implications. This supports the argument that farmers' perception is mainly centred on observable climate impacts. Similarly the moderate perception of storm intensity and rainfall variability suggest that they occur less frequently in the study area.

The regression results indicate that socio-economic characteristics play a crucial role in influencing farmers' perception of climate change. The selected variables explained 63.6% of the variation in climate perception ($R^2 = .636$). The significant influence of age on perception of climate change suggests that older farmers are more likely to recognize changes in climatic conditions than younger farmers. This may be attributed to their longer period of interaction with the farming environment, which provides an extensive experience and basis for comparing past and present climatic patterns. This finding contrasts with Okafor et al. (2024), who reported that older farmers are generally less likely to adopt technology-based climate adaptation strategies. However, this may be due to the distinction between perception and adaptation. While adaptation often requires innovation, investment and willingness to accept new practices, perception depends on the ability to observe and interpret environmental changes. Similarly, Olugbenga et al. (2025) reported that younger farmers were more innovative, productive and more likely to engage with climate information. However, the present study highlights that greater innovation does not necessarily equate to stronger climate perception, rather, accrued environmental experience seems to play a more important role in shaping farmers' recognition of climate changes.

The positive influence of income indicates that economic resources may enhance farmers' capacity to access climate information, training opportunities and adaptive technologies. This finding is consistent with Olugbenga et al. (2025), who reported that farmers with higher incomes were better positioned to invest in agricultural inputs and respond to climate-related risks. Although, their study focused on investment decisions under climate variability, both studies indicate that financial capacity influences how farmers engage with climate-related challenges. Farmers with greater economic resources may have more opportunities to obtain information and assess environmental changes, which strengthens their perception of climate change. Omokpariola et al. (2025) reported similar findings that poor households are less likely to mitigate climate impacts due to poor access to resources (money, credits) and their subsistence nature increases their vulnerability and limit their resilience.

The significant influence of farming experience and age highlights the value of accumulated environmental knowledge in shaping climate perception. This suggests that perception is not always driven by formal knowledge, but also by accumulated practical experience and observations. Although, Sthitaprajna and Shasani (2026), reported young farmers tend to be more adaptable to climate change related challenges, their finding focused on adaptation practices rather than perception of climate change. Moreover, both findings suggest that farming experience improves farmers' ability to understand and respond to climatic challenges. The consistency the two studies positioned practical experience as an important asset in building climate awareness and resilience. Mishra et al. (2025) also observed that older farmers are more likely to adopt climate mitigation measures more effectively than younger farmers in Odisha, India. This complements finding by suggesting that age and experience not only enhances perception but also strengthens adaptation.

The positive influence of education aligns with the existing literature, stressing that literacy improves access to available information and strengthen decision-making ability. Moreover, the low level of tertiary education suggests the need for improved training, inclusion of climate change in to school curricula and enhance extension services. This agrees with the study by Babu et al. (2025) who reported that education improves mitigation capacity of farmers through increasing access to information, improving perceptions, and knowledge and guide farmers in making productive decisions. While their study focused on mitigation capacity, the present study shows that education also strengthens perception particularly where tertiary education is limited.

The negative relationship between information sources and climate perception suggest that the quality and credibility of information may be more important than the quantity of information received by the farmers. This finding contradicts Sthitaprajna and Shasani (2026), who reported that information-source utilization contributes positively to farmers' adaptive capacity. However, their study also observed a negative regression coefficient for information source utilization, where the authors attributed this to possible deficiencies in the quality of available information. The similarity in direction between the two studies

suggests that access to information alone may not guarantee improved climate understanding. When information is informal, inconsistent and poorly communicated, increased exposure may lead to confusion rather than improve perception. This reiterates the need for an improved extension system that will ensure timely dissemination of reliable and consistent climate information. This interpretation is further supported by Arunachalan et al. (2025) and Madaki et al. (2023), who reported that regular extension contact improves farmers' access to information, adoption of better agricultural practices, productivity, income and climate change awareness.

The regression results are reinforced by the composite perception result, which shows a higher level of climate change awareness among the respondents. The significant influence of selected socio-economic variables such as income, farming experience and education helps explain the observed variation in perception levels of various climate indicators. This entails that while farmers recognise climate change, the magnitude and accuracy of their perception are shaped by their socio-economic characteristics (Shitu & Nain, 2025), which links the perception with the determinants identified in regression model.

Generally, the findings underscore the importance of direct interaction with the environment in influencing climate change perception and reiterate the need for improved and sustainable extension services in the region aimed at improving the dissemination of reliable knowledge of climate change and variability for enhanced perception and resilient agricultural production.

CONCLUSION

The study reveals that farmers in the study area possess high level of awareness of climate change. However, the extent of this perception is significantly shaped by socio-economic factors. Income, age, farming experience and education positively influence perception, with income being the strongest determinant. The negative effects of sources of information indicate that access alone is insufficient unless the information is consistent, and reliable. Therefore, extension agencies should fortify the dissemination of validated climate information to the farmers through regular farmer training and advisory services. Efforts should focus on improving farmers' access to financial support and educational opportunities to strengthen their capacity to access climate information and employ appropriate adaptation measures. Similarly, integrating climate change education into extension programmes and adult learning can enhance farmers' understanding and decision making abilities. These measures would help strengthen the resilience of agricultural livelihoods and improve informed adaptation response in the study area.

DECLARATIONS

Ethics approval and informed consent: Throughout the study, the respondents were asked for their informed consent.

Conflict of interest: The research was carried out without any financial or commercial ties that might be seen as a potential conflict of interest, according to the authors. The authors affirm that they carefully examined, amended and edited the content as necessary when preparing this work. The final content of this publication is entirely the authors' responsibility.

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