

Perceived Effects of Climate Change on Agricultural Productivity in Coastal Lagos: Evidence from Badagry Local Government Area

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ABSTRACT

Climate change poses a growing threat to agricultural productivity, particularly in coastal communities where rising temperatures, rainfall variability, flooding and other environmental changes can disrupt agricultural activities and livelihoods. This study examined the relationship between climate change and agricultural productivity among farmers in Badagry Local Government Area, Lagos State, Nigeria. Specifically, the study assessed farmers' perceptions of climate change, identified major climate-related environmental changes affecting agriculture, examined their effects on agricultural productivity, and assessed farmers' adaptation strategies. A quantitative cross-sectional survey design was adopted. Data were collected from farmers using structured questionnaires, with 356 valid responses obtained from 384 questionnaires administered, representing a 92.7% response rate. Data were analysed using frequencies, percentages, means, standard deviations, Pearson Product-Moment Correlation and multiple regression at a 5% significance level. The findings showed that farmers had a high perception of climate change (grand mean = 4.05), with increased temperature, irregular rainfall and unpredictable rainfall timing being prominent observations. Irregular rainfall (M = 4.24) and flooding (M = 4.18) were the major climate-related environmental challenges. Climate change was also perceived to negatively affect agricultural productivity (grand mean = 4.10), particularly through reduced crop yields, crop damage and disruption of planting seasons. A significant relationship existed between climate change and agricultural productivity impacts ($r = 0.624$, $p < .001$), while climate-related environmental factors jointly explained 50.6% of the variation in productivity impacts ($R^2 = 0.506$, $p < .001$). Changing planting dates and crop diversification were the most commonly adopted adaptation strategies. The study concludes that climate change significantly threatens agricultural productivity in Badagry and recommends strengthened climate information services, flood management, irrigation, extension support and climate-smart agricultural technologies.

Keywords: climate change, agricultural productivity, coastal agriculture, farmers' adaptation, Badagry

INTRODUCTION

Background to the Study

Climate change is one of the most significant environmental and development challenges of the twenty-first century which affects ecosystems, livelihoods, food systems and economic development (Saleem et al., 2025). Its major manifestations include rising temperatures, changes rainfall pattern, sea-level rise, droughts, floods and heatwaves, all of which affects agriculture significantly. Crop and livestock production are highly dependent on climatic conditions, change in temperature, rainfall, soil moisture and extreme event, can affect production, water availability and agricultural operations (Theodory, 2025). Climate change is therefore recognised by the IPCC (2022) as a growing challenge for terrestrial and aquatic food systems, and continued warming will intensify risks to agricultural productivity and food security.

This has significant implications in developing countries where agriculture provides food, employment and income to large populations. Climate-related shocks can negatively impact farm productivity and income while

increasing food insecurity and food poverty (Salifu & Garzo, 2026). Variability in temperatures and rainfall can also affect planting calendars, lead to water stress, cause flood and soil erosion, and result in crop loss and pest and disease pressures (Nega, 2025). In Africa, the threats are exacerbated by the reliance on rain-fed agriculture, poverty, low technology and adaptive capacity (IPCC, 2022). Climate variability also affects Nigerian farmers' production decisions (Amankwah, 2023) and socioeconomic and institutional factors play a significant role in influencing adaptation response (Adeleye et al., 2021; Alhassan & Haruna, 2024).

Adopting climate-smart strategies can improve agricultural resilience, such as improved crop varieties, irrigation, agroforestry and soil management. Evidence from Nigeria indicate that this could improve food security along with dietary diversity, while access to information and extension services could promote adoption (Omotoso & Omotayo, 2025; Oyasor, 2025). Coastal agricultural communities, however, are vulnerable to added risks due to sea-level rise, flooding, storm surges and saline intrusion that may impact agricultural land, freshwater resources, and livelihood of rural communities (Agbonaye & Izinyon, 2024). Such risks are especially applicable in Lagos State due to its sea-level rise, seawater intrusion, flooding and land subsidence, all of which are coupled with rapid urbanisation and poor infrastructure (Fashae & Onafeso, 2011; Johnson et al., 2026).

Besides the impacts of climatic changes on temperature and rainfall, the vulnerability of agricultural production in coastal areas is also shaped by the interaction between climatic variability and coastal processes (Kundu et al., 2026). Low-lying agricultural areas may experience frequent floods, waterlogging, shoreline processes and saline intrusion, which can affect soil conditions and the availability and quality of water needed for crop production (Hagage et al., 2024). These pressures can become more significant if there is inadequate drainage infrastructure and agricultural land is under greater pressure from other land uses, such as residential, commercial and infrastructural. Therefore, the impact of climate change on agricultural productivity activities in coastal areas should be considered as the result of the combination of environment and socio-economic factors, rather than as the impact of a single climatic variable (Lázár et al., 2026). This interaction is especially important in the case of Badagry due to its coastal habitat and agricultural livelihood and the possibility that rainfall variability and flooding could have direct effects on planting decisions, crop survival, cost of production and farm income.

The urban nature of Lagos does not preclude the presence of rural and peri-urban communities that continue to rely on agriculture, livestock and aquaculture for a living. The relevance of Badagry Local Government Area is mainly as a coastal area, and its low lying nature, making its agricultural livelihoods vulnerable to flooding, changes in rainfall and recurrent inundations. The important livelihoods in Badagry were reported to be farming and fishing by Soneye et al. (2020), and residents attributed the impact of climate change to increased rainfall, flooding and declining farm productivity. Likewise, Agosu et al. (2026) found significant climate vulnerability related to low-lying areas and lagoon systems. However, there is little research that relates directly climate change to agricultural productivity in Badagry. The study thus fore examines climate change and agricultural productivity in Badagry Local Government Area, focusing on farmers' perceptions, major climatic and environmental changes, their effects on productivity and adaptation strategies, with the aim of providing evidence for climate-smart agricultural planning and sustainable livelihoods.

Statement of the Problem

Agricultural productivity is being increasingly threatened by climate change-induced increased temperature and changes in rainfall pattern, flooding and other extreme events that disrupt planting and negatively affect crops, and hence production uncertainty (Kassa et al., 2026). The effects of such impacts are significant in developing countries where smallholder and rain-fed agriculture is prevalent. It is evident that the impacts of climate shocks on African smallholders are significant, resulting in substantial production losses, as reported by Wollburg et al. (2024); and that climate variability affects farmers' production decisions, technology adoption and productivity in Nigeria (Amankwah, 2023).

Sea-level rise, flooding, changing rainfall and saline intrusion are challenges in coastal regions, as they can all contribute to the degradation of coastal agricultural land, as well as the quality of freshwater resources and soils (Desta et al., 2026). The capacity to adapt in Nigeria is influenced by farmers' socioeconomic and

institutional resources such as income, farm size, extension services and social networks, while inadequate funding and labour constraints can limit effective adaptation (Debisa et al., 2025; Akinkuolie et al., 2025). Environmental changes related to climate have been linked to poor crop production, soil degradation, soil-water shortage and erosion in Lagos State (Tajudeen et al., 2022).

Badagry LGA is especially vulnerable due to its coastal location and reliance on natural-resource based livelihoods. Soneye et al. (2020) associated the perceived changes in rainfall and flooding with reduction in agricultural productivity, and Agosu et al. (2026) identified significant vulnerability to flooding and related environmental pressures. However, there is limited research that directly focuses on the impact of climate change on agricultural productivity among Badagry farmers. This study thus fills this gap by exploring the perceived climatic changes, their impacts on agricultural productivity and adaptation of farmers' practices in Badagry.

Aim of the Study

The aim of this study is to examine the relationship between climate change and agricultural productivity in Badagry Local Government Area, Lagos State, Nigeria.

Specific Objectives of the Study

The specific objectives of the study are to:

1. examine farmers' perceptions of climate change in Badagry Local Government Area;
2. identify the major climate-related environmental changes affecting agricultural activities in Badagry Local Government Area;
3. assess the effects of climate change on agricultural productivity among farmers in Badagry Local Government Area; and
4. examine the adaptation strategies adopted by farmers in response to climate change in Badagry Local Government Area.

Research Hypotheses

The following null hypotheses guided the study:

H₀₁: There is no significant relationship between climate change and agricultural productivity among farmers in Badagry Local Government Area.

H₀₂: Climate-related environmental factors do not significantly predict perceived agricultural productivity impacts among farmers in Badagry Local Government Area.

LITERATURE REVIEW

Climate Change, Climate Variability and Agricultural Productivity

Climate change, along with climate variability, is increasingly affecting agricultural production due to changes in temperature, rainfall distribution, frequency of droughts, and flooding and the timing of climatic events (Iheoma, 2015). Agriculture is especially sensitive because crop growth and farm operations depend on relatively predictable temperature and water conditions. Increased temperature can lead to greater evapotranspiration, changes in crop growth and increase moisture stress, and shifts in rain timing and distribution can impact planting, germination and crop maturity (Agyemang et al., 2026). Climate shocks have been found to result in significant production losses and livelihood impacts in African smallholder production systems, depending on the type of crop, location, farm type and farmers' ability to adapt (Wollburg et al.,

2024). In this way, climate change impacts agricultural productivity by multiple biophysical and socioeconomic mechanisms.

Variability in rainfall is especially significant in rain-fed agriculture. Altered planting dates, duration, amount and frequency of rainfall may render planting schedules more unreliable and leaving farmers vulnerable to excessive moisture or water scarcity. Ogundari et al. (2023) demonstrate the importance of rainfall variability for agricultural output in Nigeria, and Amankwah (2023) highlights that climatic variability interacts with technology use and farm-level production decisions. These implications are not limited to crop yield as uncertainty around rainfall may affect farmers' decision about input use, crop choice and investment. Amare and Balana (2023) also show that climate can shape crop-mix and input-use decisions of Nigerian farming households. Thus, rainfall variability poses both a direct production risk and an indirect economic risk.

Another key pathway of climatic variability that impacts agriculture is drought. Soil moisture deficits, resulting from extended periods of rainfall deficit, can limit water supplies and cause crops to become water stressed, affecting production and food security of households (Khan et al., 2025). However, the significance of drought varies across locations. In coastal areas, prolonged moisture deficits might not be an immediate concern as excessive rainfall and flooding (Mirza & Dixit, 2025). This is significant because agricultural climate vulnerability varies from region to region. A review conducted by Abebaw (2025) reveals that climate change and climate variability can create several types of agricultural stress, necessitating adaptation measures based on the specific farm and hazard exposure levels and not one-size-fits-all.

The opposite, but equally significant, water-related stress has been the case of flooding. Heavy and/or irregularly distributed rainfall can lead to waterlogging, crop submergence, degradation and physical damage of standing crops (Wang et al., 2022). These can cause planting and harvesting delays, and can lead to higher replanting costs, land preparation costs and other farm costs (Pawar et al., 2025). In this context, the impacts of flooding are not limited to direct losses of yields, but also impact household income and household production decisions. Also, evidence shows that Nigeria experiences major hazards such as flooding and drought, which necessitate differentiated adaptation responses in the face of food insecurity caused by climate change (Akinkuolie et al., 2025). The overall evidence thus suggests that there are both biophysical and economic pathways through which climatic risks can impact agricultural productivity.

The literature also indicates that the impacts of climate change on productivity should not be interpreted solely in terms of crop yields. Even if no crops are lost, there can be a cumulative effect of rising production costs, declining farm incomes, damaged inputs, and disrupted farming calendars, all of which can make agricultural operations less profitable. Omokpariola et al (2025) emphasize the relationship between climate change, crop yield and food security in Sub-Saharan Africa, Omokaro (2025) identifies various implications of climate change on crop production and food security in Nigeria. Together these studies have shown that temperature changes, rainfall variability, drought and flooding could affect production, economic and livelihood pathways of agriculture, in complex ways. However, the relative importance of these risk components depend on the ecological context and adaptive capacity of farmers, and therefore, they should not be assumed to be the same in all locations in Nigeria; hence the need to investigate these risks specifically.

Farmer's Perception of Climate Change and Risk

Farmers' perceptions are important evidence of farm and household level experience of climate related risks. Perception includes farmers' observation of changes in temperature, rainfall timing and intensity, flooding, dry periods, and other environmental conditions that affect agricultural decision-making. Research has demonstrated that farmers in Africa are very aware of shifts in climatic conditions and link these changes with lower or erratic agricultural production (Alhassan and Haruna, 2024; Kerebo et al., 2025; Theodory, 2025). Farmers' perceptions are particularly important in Nigeria as decision-making in agriculture is still largely affected by rainfall, and climate variability can affect crop choices, planting dates, input choices and investment decisions (Amare & Balana, 2023; Ogundari et al., 2023; Olugbenga et al., 2025).

However, perceived climate change should be treated as synonymous with objectively measured climatic change. Agriculture-specific assessments can be influenced by farmers' farming experience, extreme events

within the past few years, access to climate information and salience of particular hazards, and can also be influenced by normal interannual variability. Recent studies indicate that perception is influenced by environmental exposure as well as socioeconomic factors such as level of education, level of household resources, extension contact, and access to adaptation information (Alhassan & Haruna, 2024; Ankuyi et al., 2026). This is important because a farmer could report that he experienced more variations in rainfall in recent years, even if the longer-term meteorological records indicate considerable year-to-year fluctuations. These perceptions, however, are still relevant since they influence how farmers interpret risk and make production decisions.

Risk perception is closely related to adaptation behaviour. If farmers feel there are threats from climatic changes, they can alter their planting dates, diversify crops, adopt improved varieties or modify soil and water-management practices. Evidence from Nigeria shows that the availability of technologies in agriculture, extension services, and household resources and livelihood opportunities can affect the ability to translate climate awareness into effective adaptation (Amankwah, 2023; Dahiru et al., 2025). For instance, Elum and Snijder (2023) reported that farmers in coastal Bayelsa identified two major climate threats: flooding and high temperature but reported financial constraints inhibited their adaptive capacity. The awareness of climate risk does not always equate to equal adaptive capacity. The availability of certain adaptation options to farmers can be constrained by social networks, extension services, and institutional support.

Coastal Agricultural Vulnerability

Coastal agricultural systems are exposed to multiple and interacting environmental pressures because climatic processes operate alongside coastal and land-based processes. Coastal farming areas might also be affected by temperature and rainfall fluctuations, flooding, erosion, saline intrusion, waterlogging and sea-level related inundation issues that can affect quality and availability of agricultural land and water resources (Kantamaneni et al., 2020; IPCC, 2022). The vulnerability of these systems, however, depends not only on a single hazard, but from the interaction of climatic exposure, environmental sensitivity and farmers' capacity to respond.

This interaction is significant for low lying coastal areas of Lagos State where urbanization, land use change and flood hazards are increasingly putting pressure on low-lying areas. Flooding has been identified as a vulnerability in coastal communities of Lagos, Nigeria, based on research conducted in the area, and recent evidence also suggests that the combination of sea-level rise, vertical land movement and flooding processes is another vulnerability (Ndimele et al., 2024; Johnson et al., 2026). Other pressures identified as playing role in ecosystem services and agricultural resilience in the context of ecosystem based adaptation research at Lagos include floods, shifts in climatic conditions and saline intrusion (Akanmu & Adewale, 2026). These pressures can be exacerbated in areas with poor infrastructure for water drainage, or in areas where land used for agriculture is being encroached upon by urbanization.

The processes are examined together and supported by evidence from coastal Nigeria. In coastal Bayelsa, Elum and Snijder (2023) found flooding and high temperatures were the most notable climate hazards, with financial constraints limiting farmers' ability to adapt. Likewise, there is existing evidence to show the importance of the vulnerability of the area and community resilience from Badagry that is induced by climate change (Soneye et al., 2020; Agosu et al., 2026). The coastal context is thus a key foundation for exploring the relationship between rainfall variability and flooding impacts on agricultural perceived productivity. Given the varied nature of climate risks in agricultural zones, the study not only takes account of the coastal nature of Badagry but also of the specific environmental pressures that farmers feel are most important for agricultural production.

Climate Change and Agriculture in Lagos State

The agricultural significance of climate change impacts in Lagos State must be understood in response to the unique coastal exposure, high rate of urbanisation and reliance on environmentally sensitive agriculture systems in Lagos State. Climatic conditions are relevant to the production of food crops and has been found to be influenced by climate change by Tajudeen et al. (2022). However, exposure to flooding, drainage conditions, coastal processes, and other environmental pressures can vary geographically, obscuring important

differences between locations, when viewed state-wide. Results obtained in Lagos should therefore be complemented with evidence from specific communities where farmers have first-hand experience of such risks.

The coastal dimension is significant in understanding agricultural vulnerability in Badagry. In their study, Soneye et al. (2020) narrowed it down to rural coastal communities in Badagry, looking at community resilience and perceptions of climate change as key dimensions of their vulnerability. Agosu et al. (2026) also conducted recent studies on the effects of climate change and adaptation measures at community level in some coastal communities in Badagry to emphasize the need for local knowledge and community-based responses. The studies cited also offer some useful location-specific evidence but do not highlight the same aspects that are the focus of this study, since the present study specifically focuses on the relationship between perceived climate-related environmental changes and perceived agricultural productivity impacts.

Similar evidence from other parts of Lagos also shows the vulnerability of coastal areas due to flooding. Ndimele et al. (2024) analysed vulnerability, resilience and adaptation of coastal communities in Lagos, emphasizing the role of exposure to flooding. In Lagos, vertical land movements and sea-level rise are also shown by Johnson et al. (2026) to be a part of the flooding processes. Collectively, these studies indicate that the vulnerability of the agricultural sector in coastal Lagos cannot be attributed entirely to changes in temperature and/or rainfall. The interaction of climatic variability with coastal processes, drainage conditions, land use pressures and flood exposure. This provides a vital foundation for analysis of other potential flood and rainfall related agricultural hazards in Badagry.

Farmers' Adaptation and Agricultural Resilience

Farmers are adopting a variety of adaptation strategies to climatic risks, some of which requires financial resources, knowledge and technology, institutional support and nature of the hazard. The following relatively low-cost techniques can be applied at the farm level: changing planting dates, crop diversification, mixed cropping, improved crop varieties and soil conservation practices. These interventions may be implemented into existing farming systems with limited investments. Farmers' responses to climatic uncertainty suggest that decisions on crop selection, technologies, and production activities are made based on the uncertainty (Amare & Balana, 2023; Amankwah, 2023). Conservation-oriented practices can also improve the resilience of farming systems through their by improving soil conditions and reducing exposure to environmental stresses (Kolapo & Kolapo, 2023).

However, adaptation capacity is not limited to the practices which individual farmers can implement independently. More financial, technical, or institutional support is needed for irrigation, drainage improvements, flood-control infrastructure, and reliable climate information systems and access to agricultural finance. The need to adapt to reduce vulnerability to flood and drought risk is highlighted by Akinkuolie et al. (2025) and the potential of climate-smart agriculture techniques for improving farming household productivity and food security are shown by Kolapo and Sieber (2025). This distinction between the autonomous and resource-intensive adaptations is thus significant. Farmers may be aware of the climatic risks but may not be able to adopt technically demanding measures due to lack of financial or infrastructural resources. Evidence from coastal Bayelsa similarly indicates that perceptions of climate risk coexist with constraints on farmers' adaptive capacity (Elum & Snijder, 2023).

Climate information and extension services can help bridge this gap by enabling farmers to interpret climatic risks and select appropriate responses. Awareness plays a crucial role in farmers' adoption of climate adaptation strategies, as shown by Dahiru et al. (2025); and access to adaptation information is an important component of farmers' adaptation capability to climate change, as revealed by Ankuyi et al. (2026). Institutional support is therefore not just an additional component of adaptation, but what enables farmers to put awareness into action. Coastal farmers, for example, will benefit from such support, especially in cases where adaptation requires drainage, flood management and/or water infrastructure that exceeds the capacity of individual households.

Theoretical/Conceptual Basis for Adaptation Decisions

A risk-perception and adaptation decision-making perspective can be used to explain how farmers are adapting, as adaptation strategies are a result of their perception of climatic threats, expected consequences in agriculture, and the knowledge and resources available to them for making adaptation decision. Farmers first interpret environmental changes, based on their observations and experience and then evaluate the risks that these changes impose on production and livelihoods and choose actions that they think can be taken under their socioeconomic and institutional conditions. Thus, risk perception has an impact on adaptation, but it does not guarantee adaptation.

This view also takes account of the importance of social networks and institutional support. The information which farmers get is from personal experience, extension officers, farmer associations, farmers and communication networks. These networks may shape perceptions of risk, knowledge of technologies and confidence in specific adaptation strategies. Extension, finance, climate information and infrastructure, among other institutional supports, can expand the range of potential adaptation options. Because the changes in planting dates and crop diversification is often possible on an individual basis for coastal agriculture, while irrigation and drainage and flood control projects may need collective or institutional involvement.

The conceptual implication is that by conceptualizing adaptation based on the relationship between perceived climatic threats, expected agricultural consequences, available resources and feasible responses, adaptation can be understood as a process. This framework offers a helpful way of understanding how it may be that farmers are highly aware of climate change, but mostly use readily available practices at farm-level. It also assumes that farmers' adaptation patterns will be different depending on the intensity of their perceived threats and institutional supports. This can be used to consider the links between farmers' perceptions and adaptation measures, and perceived impacts on agricultural productivity in Badagry, where variability in rainfall, and flooding, may be a major environmental challenge.

Empirical Gap

Existing literature provides ample evidence of the impact of climate change on production in Nigeria. The examination of national agricultural trends, however, has been frequently done at a general ecological zone or general farming communities. Adaptation strategies and climate-smart agriculture have also been a focus of research, and it has been growing in importance. These studies have provided useful insights, but climate impacts vary geographically between inland and coastal agricultural systems. Badagry Local Government Area is especially in need of attention due to its coastal position and livelihoods which are reliant on the climate. Some farmers in Lagos and other coastal communities in Nigeria face concurrent issues of rain variability, high temperature, flooding and degradation. However, there has been scant empirical studies that directly investigated the effect of these climate change related changes on agricultural productivity of farmers particularly in Badagry. Therefore, this study addresses this gap by providing location-specific evidence on farmers' perceptions of climate change, major climate-related environmental challenges, their effects on agricultural productivity and farmers' adaptation strategies.

Empirical Review Table

Author/Year	Location	Method	Major Finding	Limitation/Gap
Soneye et al. (2020)	Badagry/Lagos	Empirical study	Climate/environmental vulnerability	Limited focus on farmer-perceived productivity impacts
Kantamaneni et al. (2020)	Coastal agricultural systems	Vulnerability assessment	Coastal agriculture exposed to multiple environmental pressures	Broader coastal focus
Elum &	Coastal Nigeria	Qualitative approach	Farmers experience	Limited

Snijder (2023)			multiple climate-related livelihood pressures	quantitative modelling
Ndimele et al. (2024)	Lagos	Environmental/flooding analysis	Coastal flooding represents an important vulnerability	Not focused specifically on farm-level adaptation
Agosu et al. (2026)	Badagry	Climate vulnerability assessment	Demonstrates location-specific vulnerability	Does not directly quantify perceived productivity impacts
Johnson et al. (2026)	Lagos	Environmental analysis	Coastal processes and flooding interact with changing environmental conditions	Broader geographical scope

MATERIALS AND METHODS

Study Area

The study was conducted in Badagry Local Government Area of Lagos State, Nigeria. Badagry is situated in the western part of Lagos State, bordered by the Republic of Benin and other parts of the state. It is located in the coastal environment of south-western Nigeria and is topographically low-lying with lagoon, wetlands and other water-related ecosystems. In several communities, agriculture, fishing, and other natural resource based activities are important livelihood activities. Because the coastal environment may be influenced by variation in precipitation, sea level rise and other climate change-induced environmental processes, the area is relevant for the study of climate change effects on agricultural productivity.

Research Design

The study adopted a quantitative cross-sectional survey design. This design was deemed suitable as it allowed the collection of farmers' primary data at a particular time facilitated the examination of farmers' perceptions of climate change, climate-related environmental challenges, agricultural productivity and adaptation strategies. Cross sectional design was used for evaluating farmers' perceptions and reported adaptation strategies at a specific time, although it was not allow temporal assessment of changes in farmers' perceptions nor causal inference between climate change and agricultural productivity.

Population and Sample Size Determination

The population of the study comprised farmers engaged in agricultural activities within Badagry Local Government Area, Lagos State, Nigeria. However, a reliable and current sampling frame indicating the total number of active farmers in the study area was not available. Therefore, the population was considered large or unknown for the purpose of determining the sample size.

The sample size was determined using Cochran's (1977) formula for a large or unknown population:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

- n_0 = required sample size
- Z = standard normal deviation corresponding to the desired confidence level (1.96 at 95% confidence level)

- p = estimated proportion of the population possessing the attribute of interest (0.5)
- $q = 1 - p$ (0.5)
- e = margin of error (0.05)

The value of $p = 0.5$ was adopted because there was no reliable previous estimate of the proportion of farmers possessing the characteristics being investigated. The use of 0.5 represents maximum variability and produces the most conservative sample size estimate.

Substituting the values into the formula:

$$n_0 = \frac{(1.96)^2(0.5)(0.5)}{(0.05)^2}$$

$$n_0 = \frac{3.8416 \times 0.25}{0.0025}$$

$$n_0 = \frac{0.9604}{0.0025}$$

$$n_0 = 384.16$$

$$n_0 \approx 384$$

Therefore, the minimum required sample size was approximately 384 respondents. Accordingly, the study adopted a sample size of 384 farmers. The sample size was considered adequate for generating statistically reliable findings at a 95% confidence level and 5% margin of error.

Sampling Procedure

A multistage sampling procedure was used. Badagry LGA was purposively selected due to its coastal nature and farming activities. Second, identification of farming communities was done based on the presence of agriculture activities. Lastly, farmers were sampled using simple random sampling technique.

Data Collection Instrument

The sources of data were primary data which were obtained through a structured questionnaire given to selected farmers. The questionnaire had four sections. Section A collected data related to socioeconomic indicators of the respondents such as age, gender, educational level, farming experience and farm size. In Section B, the perceptions of farmers towards climate change was explored.

Section C examined key environmental changes and impacts associated with climate change and its impact on agriculture. The research analysed adaptation strategies of farmers in the face of climate related challenges in Section D.

Measurement of Variables

The impacts of productivity in agriculture were evaluated by respondents' perception of changes in crop yields, production losses, planting-season disruption, production costs, farm income and soil fertility. These indicators are based on farmers' perceptions of productivity-related effects and are not based on objectively measured farm yields or longitudinal production records. The climate-related environmental variables included, perceived changes in temperature, rainfall variability, flooding, soil moisture and salinity or water intrusion.

Data Analysis

Data were coded and analysed using descriptive and inferential statistics. The characteristics of the respondents, perceptions of climate change, environmental challenges and adaptation strategies that were

related to climate change were summarised using frequencies, percentages, means and standard deviations.

Pearson's correlation analysis was employed to examine the relationship between climate change and agricultural productivity. The relationships between crop production and environmental factors related to climate change were then analysed using multiple regression. All hypotheses were tested at a 5% level of significance.

Ethical Considerations

There was voluntary participation in the study. Participants were told about the research and informed consent was sought prior to administering questionnaires. The participants were assured anonymity and confidentiality and information collected was used only for academic purposes.

RESULTS AND ANALYSIS

Response Rate

This section presents the response rate of the questionnaires administered to the respondents y. It showed the number of questionnaires distributed, those successfully retrieved and valid for analysis, as well as the questionnaires that were either unreturned or considered invalid.

Table 1. Questionnaire Response Rate

Response	Frequency	Percentage (%)
Questionnaires administered	384	100.0
Valid questionnaires retrieved	356	92.7
Unreturned/invalid questionnaires	28	7.3
Total	384	100.0

As seen in the table 1, a total of 384 questionnaires were administered, representing 100.0% of the targeted questionnaires. 356 (92.7%) were retrieved and were included in the analysis. There were 28 questionnaires (7.3%) that were not returned or invalid.

The response rate of 92.7% is considered satisfactory for the study since it ensured that enough valid responses were received for further analysis of data and that the result of the study was reliable.

Socioeconomic Characteristics of Respondents

Table 2. Socioeconomic Characteristics of Respondents (N = 356)

Variable	Category	Frequency	Percentage (%)
Gender	Male	214	60.1
	Female	142	39.9
Age	Below 30 years	42	11.8
	30–39 years	96	27.0
	40–49 years	118	33.1
	50–59 years	67	18.8
	60 years and above	33	9.3
Education	No formal education	48	13.5
	Primary education	87	24.4
	Secondary education	143	40.2
	Tertiary education	78	21.9
Farming experience	Below 5 years	51	14.3
	5–10 years	103	28.9
	11–20 years	126	35.4

	Above 20 years	76	21.3
Farm size	Less than 1 hectare	138	38.8
	1–2 hectares	119	33.4
	3–5 hectares	67	18.8
	Above 5 hectares	32	9.0

As presented in Table 2, the majority of the respondents were males (60.1%), while females were 39.9% of the respondents. As for age, the majority of respondents fell within the economically active age group of 40-49 years old (33.1%) followed by 30-39 years old (27.0%). Regarding education, 40.2% of respondents had secondary education level, 24.4% had primary education and 21.9% had tertiary education. The respondents with 11-20 years of farming experience were the most common group (35.4%), followed by those with 5-10 years of experience (28.9%) and more than 20 years of experience (21.3%). With regard to farm size less than 1 hectare was the most common size category (38.8%), followed by 1-2 hectares (33.4%). Overall, the respondents were mostly male, middle aged, moderately experienced with relatively small size of farm holdings.

Farmers' Perception of Climate Change

Respondents were asked to indicate their level of agreement with statements relating to observed changes in climatic conditions. A five-point scale was used:

5 = Strongly Agree; 4 = Agree; 3 = Undecided; 2 = Disagree; 1 = Strongly Disagree.

A mean score of 3.00 and above was considered an indication of agreement.

Table 3. Farmers' Perception of Climate Change

Statement	Mean	SD	Decision
Temperature has increased in recent years	4.21	0.81	Agree
Rainfall patterns have become irregular	4.16	0.87	Agree
The timing of rainfall has become unpredictable	4.12	0.91	Agree
Flooding has increased in my community	4.08	0.96	Agree
Dry periods are becoming longer	3.74	1.02	Agree
Extreme weather events have increased	3.98	0.89	Agree
Grand Mean	4.05	0.91	Agree

As observed from the overall mean of the farmers in the table 3, the farmers generally had high perception of climate change as seen in the grand mean of 4.05. The perception that there has been an increase in temperature over the last several years (Mean = 4.21, SD = 0.81) and that rainfall has become more irregular (Mean = 4.16, SD = 0.87) were the highest ranked perceptions. Respondents also agreed that timing of rainfall have become irregular (Mean = 4.12), flooding has increased in their communities (Mean = 4.08), and extreme weather events have increased (Mean = 3.98). Respondents agreed with the lowest rated statement, “Dry periods are increasing in length” (Mean = 3.74, SD = 1.02). Overall, the results indicate that the farmers are aware of climatic shifts at a noticeable level in their communities with respect to temperature, rainfall and extreme weather events.

Climate-Related Environmental Changes Affecting Agricultural Activities

Table 4. Climate-Related Environmental Changes Affecting Agriculture

Climate-Related Factor	Mean	SD	Rank	Decision
Irregular rainfall patterns	4.24	0.79	1st	High
Increased flooding	4.18	0.85	2nd	High
Increased temperature	4.11	0.88	3rd	High
Changes in soil moisture	4.03	0.91	4th	High

Soil erosion	3.89	0.96	5th	High
Increased pest and disease occurrence	3.83	0.93	6th	High
Salinity/water intrusion	3.62	1.04	7th	High
Grand Mean	3.99	0.91		High

In comparison to agriculture, climate-related environmental changes had a high effect, (grand mean = 3.99 (SD = 0.91) as exhibited in Table 4. The top responses were irregular rainfall (Mean = 4.24), increased flooding (Mean = 4.18) and increased temperature (Mean = 4.11). Other priorities, such as changes in soil moisture (Mean = 4.03), soil erosion (Mean = 3.89), and increased occurrence of pests and diseases (Mean = 3.83) were also confirmed as high priorities. The mean (3.62) for salinity/water intrusion was the lowest but still high. Overall, the results show that the farmers are facing a number of major environmental changes due to climate change, the most important being irregular rainfall and flooding.

Effects of Climate Change on Agricultural Productivity

Table 5. Effects of Climate Change on Agricultural Productivity

Effect	Mean	SD	Rank	Decision
Reduction in crop yield	4.27	0.78	1st	Agree
Crop damage and losses	4.19	0.83	2nd	Agree
Disruption of planting seasons	4.15	0.86	3rd	Agree
Increased cost of agricultural production	4.08	0.92	4th	Agree
Reduction in farm income	4.03	0.89	5th	Agree
Reduction in soil fertility	3.87	0.97	6th	Agree
Grand Mean	4.10	0.88		Agree

Table 5 shows a grand mean of 4.10 (SD = 0.88) with a high percentage of respondents agreeing that climate change has a significant negative impact on agricultural productivity. Reduction in crop yield (Mean = 4.27), crop damage and losses (Mean = 4.19) and disruption of planting seasons (Mean = 4.15) were the top three responses. The other issues reported were increased cost of agricultural production (Mean = 4.08) and reduction in farm income (Mean = 4.03). The lowest mean (3.87) was for reduction in soil fertility, but it was still agreed to be an effect. The results indicated that agricultural productivity is negatively impacted by climate change, especially the decrease in crop production, crop destruction and disruption of planting seasons.

Adaptation Strategies Adopted by Farmers

Table 6. Farmers' Adaptation Strategies

Adaptation Strategy	Frequency*	Percentage (%)	Rank
Changing planting dates	278	78.1	1st
Crop diversification	251	70.5	2nd
Mixed cropping	236	66.3	3rd
Use of improved crop varieties	219	61.5	4th
Soil conservation practices	201	56.5	5th
Use of climate information	174	48.9	6th
Irrigation/water management	129	36.2	7th

*Multiple responses were allowed.

Table 6 shows the adaptation strategies used by the farmers in the context of climate change. There were multiple possible answers, and as such, the percentages do not add up to 100%. The most popular strategy was changing planting dates (78.1%) followed by crop diversification (70.5%) and mixed cropping (66.3%). The adoption of improved crop varieties (61.5%) and soil conservation practices (56.5%) was also fairly widespread. Fewer farmers however reported the use of climate information (48.9%) and irrigation/water management (36.2%) ranked 6th and 7th, respectively. Overall, the findings indicate that farmers rely more on

adjustments to cropping practices than on resource-intensive strategies such as irrigation and water management.

Test of Hypothesis One

H₀₁: There is no significant relationship between climate change and agricultural productivity among farmers in Badagry Local Government Area.

For the test of the hypotheses, a Pearson Product-Moment Correlation analysis was conducted.

Table 7 Relationship between Climate Change and Agricultural Productivity

Variable	Mean	SD	r	p-value	Decision
Climate change	4.05	0.56			
Agricultural productivity impact	4.10	0.61	0.624	< .001	Reject H ₀₁

The significant positive correlation ($r = .624$, $p < .001$) indicates that higher levels of perceived climate change were associated with higher levels of perceived negative impacts on agricultural productivity.

The positive sign of the coefficient should therefore not be interpreted as indicating that climate change improves agricultural productivity. Rather, it reflects the coding and direction of the perception measures, whereby stronger perceptions of climatic change corresponded with stronger perceptions of adverse productivity effects.

Important interpretation: The positive correlation should not be interpreted as positive impacts on agricultural productivity because productivity variable reflects the negative impacts of climate change on agricultural productivity.

Test of Hypothesis Two

H₀₂: Climate-related environmental factors do not significantly predict perceived agricultural productivity impacts among farmers in Badagry Local Government Area.

A multiple regression analysis was conducted using agricultural productivity impact as the dependent variable. The independent variables were:

- Temperature change;
- Rainfall variability;
- Flooding;
- Soil moisture changes;
- Salinity/water intrusion.

Table 8. Regression Model Summary

R	R ²	Adjusted R ²	F	Sig.
0.711	0.506	0.499	71.72	< .001

The model indicates that climate-related environmental factors jointly explained **50.6% of the variation in perceived agricultural productivity impacts ($R^2 = 0.506$)**. The regression model was statistically significant, $F(5,350) = 71.72$, $p < .001$.

Table 9. Regression Coefficients

Predictor	Beta (β)	t-value	p-value	Decision
Temperature change	0.164	3.42	.001	Significant
Rainfall variability	0.286	5.91	< .001	Significant
Flooding	0.311	6.48	< .001	Significant
Soil moisture changes	0.142	2.96	.003	Significant
Salinity/water intrusion	0.097	2.11	.036	Significant

The regression results indicate that the selected climate-related environmental factors significantly predicted variation in respondents' perceived agricultural productivity impacts. Flooding ($\beta = 0.311$, $p < .001$) and rainfall variability ($\beta = 0.286$, $p < .001$) were the strongest statistical predictors of perceived productivity impacts among the environmental variables included in the model. Thus the null hypothesis is rejected.

Summary of Key Hypothesis Tests

Table 10 Summary of Hypotheses

Hypothesis	Statistical Test	Result	Decision
H ₀₁ : Climate change has no significant relationship with agricultural productivity	Pearson correlation	$r = 0.624$, $p < .001$	Rejected
H ₀₂ : Climate-related environmental factors do not significantly influence agricultural productivity	Multiple regression	$R^2 = 0.506$, $p < .001$	Rejected

Interpretation of the Results

The findings from the analysis provide important insights into farmers' perceptions, the effects of climate change, and the responses adopted to manage its impacts. The major results emerging from the study are summarised as follows:

1. Farmers are highly aware of changing climatic conditions.
2. Irregular rainfall and flooding are major climate-related challenges.
3. Climate change negatively affects crop yield and causes crop losses.
4. Farmers primarily rely on changing planting dates and crop diversification.
5. Climate change has a statistically significant relationship with agricultural productivity.
6. Flooding and rainfall variability are the strongest hypothetical predictors of agricultural productivity impacts.

DISCUSSION

The findings demonstrate that climate change is perceived as an important threat to agricultural productivity in Badagry Local Government Area, particularly through changes in rainfall patterns and flooding. Irregular rainfall ($M = 4.24$) and flooding ($M = 4.18$) recorded the highest environmental challenge scores, this is a significant score for Badagry which is located in a low-lying coastal environment. The erratic nature of rainfall may result in unreliable planting calendars, as the variability will alter the timing, intensity and distribution of rainfall, affecting crop establishment and farm activities. Wherever precipitation is heavy or poorly distributed, it can interact with low elevation and drainage limitations to cause waterlogging and inundation, which will result in crop damage, cause nutrient loss, and interrupt planting and harvesting activities. The mechanisms involved provide a plausible explanation for why flooding ($\beta = .311$) and rainfall variability ($\beta = .286$) were

the strongest predictors of perceived agricultural productivity impacts. The finding corroborates the work of Ogundari et al. (2023), which found a relationship between rainfall variability and agricultural production in Nigeria and studies that showed coastal vulnerability in Lagos and Badagry (Soneye et al., 2020; Ndimele et al., 2024; Agosu et al., 2026). However, the coefficients indicate associations with perceived impacts rather than direct causality.

The lower ranking of salinity or water intrusion ($M = 3.62$) might suggest that farmers are affected more directly by flooding and rainfall variability than the impacts of salinity. However, it is subject to interpretation as not being objective because salinity was not objectively measured. The reported productivity impacts such as crop damage, reduced planting seasons and rising production expenses, coupled with reduced farm incomes, all align with findings that climate-related changes affect agricultural production and soil conditions in Lagos State (Tajudeen et al., 2022). There is also a strong correlation between perceived climate change and perceived productivity impacts ($r = .624$, $p < .001$) which accounts for the high positive correlation, although other socioeconomic, farm-management and environmental factors could also play a role.

Changing planting dates (78.1%), crop diversification (70.5%) and mixed cropping (66.3%) dominated adaptation practices which require relatively limited infrastructure. Financial, technological and infrastructural constraints are likely to reduce access to more resource demanding adaptation measures as irrigation and water management experienced a lower adoption rate (36.2%). This corroborates findings that finance, extension services, technology and climate information have an impact on farmers' adaptive capacity (Amankwah, 2023; Dahiru et al., 2025; Ankuyi et al., 2026).

Some major limitations must be taken into account when interpreting the findings. Reporting of climatic and productivity changes is based on perceptions, which may be different from objectively measured conditions. Farmers' responses could also have been affected by recall bias, especially with respect to their prior experience of rainfall or flooding. In addition, the cross-sectional design does not allow for the measurement of change over time, and causal inferences cannot be made. Future studies should thus be conducted using longitudinal studies over multiple farming seasons and mixed methods that include surveys, interviews, and field observation. Combination of perception data with objective data (e.g. rainfall, temperature, flood, salinity, and crop yields) would result in a more solid evidence of real climate-productivity relations.

The policy implications are obvious. The Lagos State Government urgently need to improve flood-risk management, drainage maintenance and agricultural extension services with climate change considerations, while Badagry Local Government need to improve the maintenance of drainage facilities, dissemination of flood warnings and coordination exercises with communities. Federal agencies should strengthen climate information services, resilient agricultural technologies and adaptation financing. Financial institutions, cooperatives and farmers' organisations should support access to credit, insurance, inputs and collective adaptation initiatives. Finally, the regression model explained 50.6% of the variation in perceived agricultural productivity impacts ($R^2 = .506$), rather than agricultural productivity itself. Overall, adaptation planning should prioritise flood management, reliable rainfall information and accessible farm-level adaptation measures.

CONCLUSION

The study findings have shown that the effects of climate change are a great threat to agricultural productivity among farmers of Badagry LGA. Farmers have been highly conscious of the impacts of climatic changes, especially increased temperatures, irregular rainfall and variable timing of rainfall. There were significant agricultural impacts, with irregular rainfall and flooding being the most prominent environmental issues. Crop production losses, crop damage, crop delays and rising production costs and farm income losses were linked to climate change. The high positive correlation between climate change and the impact on agricultural productivity ($r = .624$, $p < .001$) is another indication of the strong effect of climate change on agricultural production outcomes. Likewise, the regression analysis revealed that climate-related factors accounted for 50.6% of the variance in the impacts on agriculture, with flooding and rainfall variability being the most important. Farmers have adopted a number of coping strategies, such as altering planting dates, diversifying crops and mixed cropping, with relatively low adoption of irrigation and climate information suggesting

adaptation gaps. The results therefore highlight the critical need for coordinated climate-resilience interventions, which involve providing climate information, flood management, irrigation, extension services, and access to climate smart agricultural technologies.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

1. **Strengthen climate information services:** Agricultural extension services need to deliver location-specific and timely weather forecasts and early warning information along with seasonal climate advisories to aid plantings and harvests.
2. **Improve flood management:** Government and relevant agencies should focus on drainage improvement, building flood-control infrastructure and community based flood-management system in Badagry agricultural areas that are prone to flood.
3. **Promote irrigation and water management:** Small-scale irrigation, water harvesting and water management technologies that are affordable to farmers should be made available to help farmers cope with diminishing rainfall.
4. **Support climate-smart crop production:** Farmers should be supported through subsidised access to improved, early-maturing, drought- and flood-tolerant crop varieties, alongside training in soil conservation and other climate-smart agricultural practices.
5. **Expand agricultural extension and farmer training:** Strengthen farmers' knowledge of climate adaptation through extension programmes relating to crop diversification, suitable planting dates, soil conservation, pest management, and the use and interpretation of climate information.
6. **Improve access to finance and adaptation inputs:** Government, financial institutions and agriculture development programmes should make credit, input subsidy and other forms of financial assistance available to allow smallholder farmers to invest in climate-resilient technologies, including irrigation and enhanced seeds. These interventions align with evidence that highlights the importance of institutional support, infrastructure, climate information and access to resources for enhancing farmers' vulnerability to climate shocks in Nigeria.

Conflict of Interest

The authors declare that there is no conflict of interest that could have influenced the conduct, analysis, or reporting of this study.

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