



**CLIMATE CHANGE AND AGRICULTURE: ADAPTATION
STRATEGIES FOR SUSTAINABLE DEVELOPMENT IN UZO-
UWANI LOCAL GOVERNMENT AREA OF ENUGU STATE,
NIGERIA**



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Abstract

Climate change is regarded as one of the most significant threats to national security, exerting profound impacts on biodiversity, ecosystems, public health, energy systems, agriculture and natural resources. These effects are especially noticeable in developing nations where the majority of people rely on agriculture for food, economy and source of livelihood. Hence the need to examine the effects of climate change on agricultural production and suggest adaptation strategies for the study area. The research employed a mixed-methods design with 150 respondents as a sample. Using basic random (balloting) sampling techniques, five of the sixteen communities in the study area were chosen. Five farmers with at least five years of agricultural experience from five chosen villages in the study area were purposively selected and interviewed along with few key informants. The data were analyzed using IBM's Statistical Package for

Social Sciences (SPSS), version 20 while in-depth interviews were transcribed and analyzed thematically using Nvivo 26. Results revealed that majority of the respondents are young adults, particularly in the 25-34 age range. The results also revealed climate change as the major factor affecting agricultural productivity in the study area. The findings show that farmers in the study area were highly vulnerable to the adverse effects of climate change with about 83.7% of the farmers being directly affected because they depend on rain-fed agriculture. The findings further indicate a rising level of poverty in the area, with about 54% of the farmers attributing this trend to the impacts of climate change on agricultural productivity. The study found that agricultural productivity has declined as a result of climate change impacts, evident is seen in reduced rainfall, delayed onset of rains, rising temperatures, reduction in soil fertility and prolonged dry season. Consequently, this decline in agricultural productivity in the study area has compelled many farmers to diversify their livelihoods and income by engaging in secondary occupations such as trading. The study concludes that climate change has reduced agricultural productivity in Uzo-Uwani LGA thereby worsening poverty and forcing farmers into supplementary occupations. Traditional adaptation measures such as adjusting planting dates, crop diversification and mixed cropping etc and relying in indigenous knowledge provide some coping capacity but remain insufficient. It is therefore recommended that modern adaptation strategies like climate-smart agriculture, small-scale irrigation, drought-tolerant crops and supportive policy frameworks be implemented to strengthen resilience and ensure sustainable rural livelihoods.

Keywords: Climate Change, Agriculture, Adaptation Strategies and Sustainable Development

Introduction

Agriculture is seemingly a fundamental source of sustenance and also an effective mechanism for eradicating extreme poverty and stimulating economic growth in developing countries. World Bank (2025) report that agricultural growth is more effective in alleviating poverty when compared with growth in other industrial or development sector. In the area of food production, agriculture apparently generate millions of employment opportunities on farms and holds significant potential to create additional jobs throughout the broader supply chain. Michael, (2024) highlighted that adequate nutrition contributes to improved health and productivity, fosters entrepreneurial capacity and constitutes a vital long-term investment in economic development. For instance, agriculture contributes over 40% of Nigeria's GDP, employs about 70% of the population, and produces about 80% of the food needs. Although, agriculture still accounts for about 88% of non-oil export earnings, its contribution has seriously declined over the decade falling from about 75% of total export earnings in the 1960s to less than 3% currently (Mahmud, 2023). Despite its significant economic contributions, Nigeria's agricultural sector is confronted with numerous challenges that adversely affect its productivity. These challenges include inadequate land tenure system, limited adoption of irrigation farming, the impacts of climate change such as drought, flood, sea level rise etc and ongoing land degradation. Additional constraints include low levels of technological advancement, elevated production costs, inefficient distribution of agricultural inputs, restricted access to financing, substantial post-harvest losses, and poor market accessibility (FAO, 2022).

Climate change in Intergovernmental Panel on Climate Change usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean

and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change therefore refers to any changes in climate over time, whether due to natural variability or as a result of human activity. (IPCC) (2023). Climate change a major global environmental threat that directly reduces agricultural productivity, particularly in Africa. Driven by both natural cycles and human activities, it poses significant risks to food production and economic stability on the continent, highlighting the urgent need for adaptive strategies for sustainable development. The effects of climate change can be felt through anthropogenic activities, particularly greenhouse gas emissions from burning fossil fuel, deforestation and industrial processes affecting both natural and human systems all over the world (IPCC, 2021). The National Aeronautics and Space Administration (NASA, 2023), reported that the last decade stands as the warmest on record globally; average temperatures have increased by roughly 1.1°C relative to pre-industrial benchmarks. This trend has intensified heatwaves, droughts and wildfires leading to severe impacts on ecosystems, agriculture and human health particularly in vulnerable regions like Uzo-Uwani LGA. Research indicates that global mean sea levels have risen by approximately 8-9 inches since 1880, with a significant portion of this increase occurring in the last two and a half decades (Sarrau et al., 2024). This trend has led to intensified coastal erosion, increased flooding and saltwater intrusion into freshwater systems, posing a substantial threat to agricultural sustainability. Furthermore, the World Health Organization (WHO, 2021) reports that climate change has exacerbated global health risks by increasing the prevalence of heat-related illnesses, the spread of vector-borne diseases, and the severity of food insecurity.

In Enugu State, Nwangwu et al (2024) highlighted that the most significant impacts of climate change experienced by farmers are: reduced yields leading to a significant decrease in farm income. Also, Akukwe, Mba and Isiwu (2024) specifically highlighted rainfall decline, delayed onset of rain and a prolonged dry weather as part of the impact of climate change faced by farmers. In addition to rising temperatures and soil degradation, farmers face depleted water sources and increased physical drudgery resulting from heat stress. Furthermore, many farmers inadvertently exacerbate climate change through land-clearing practices such as deforestation; this, in turn, reduces environmental resilience. Consequently, these same populations become increasingly vulnerable as they lack the socio-economic capacity to effectively cope with or adapt to the resulting climatic shift. Climate change poses a significant threat to agricultural production globally, with rural regions like Uzo Uwani Local Government Area (LGA) in Enugu State, Nigeria being particularly vulnerable. The area's dependency on rain-fed agriculture makes it highly sensitive to changes in temperature, rainfall patterns, and extreme weather events. While the general impacts of climate change on agriculture are well-documented, there is a need for localized studies that address the unique challenges and adaptation needs of specific communities. Therefore, this paper seeks to examine the Impact of Climate Change on Agricultural Production in Uzo-Uwani Local Government Area of Enugu State, Nigeria: Adaptation Strategies and Development Perspectives.

Statement of the Problem

Agriculture serves as the economic cornerstone of Uzo-Uwani LGA providing the primary source of livelihood for most residents while sustaining local food security, employment and rural development. The area faces critical challenges from climate change, including irregular rainfall, rising temperatures, and unexpected flooding, which have led to declining crop yields,

increased pest outbreaks, and heightened food insecurity. Despite awareness of these threats, there is limited knowledge about the specific impacts of climate change on agriculture in this locality. Many farmers also lack awareness and resources to adapt effectively, with cultural, institutional, and economic barriers hindering adaptation strategies. This study addresses the gap in empirical evidence on climate change's impact on agricultural production in Uzo-Uwani LGA, the adaptation measures farmers employ, and possibilities for integrating these strategies into sustainable rural development. The aim is to provide insights to inform policymakers, local authorities, and development practitioners on building resilient agricultural systems and promoting sustainable rural development amid climate change in Uzo-Uwani LGA, Enugu State, Nigeria.

The general objective of this study is to ascertain the impact of climate change on agricultural production and indigenous adaptation strategies used by farmers with particular reference to the agricultural zone of Uzo-Uwani Local Government Area of Enugu State. To achieve this aim, the following objectives were achieved, to examine the farmers' level of knowledge about the causes of climate change in Uzo-Uwani L.G.A. of Enugu State; secondly the research seeks to find out how climate change affect the agricultural production in Uzo-Uwani L.G.A. of Enugu State; the third objective is to investigate the traditional and modern adaptation practices available to farmers for the alleviation of climate change impacts on agricultural production in Uzo-Uwani L.G.A. of Enugu State; and finally to suggest strategies on how climate change impact on agriculture be remedied in Uzo-Uwani L.G.A. of Enugu State.

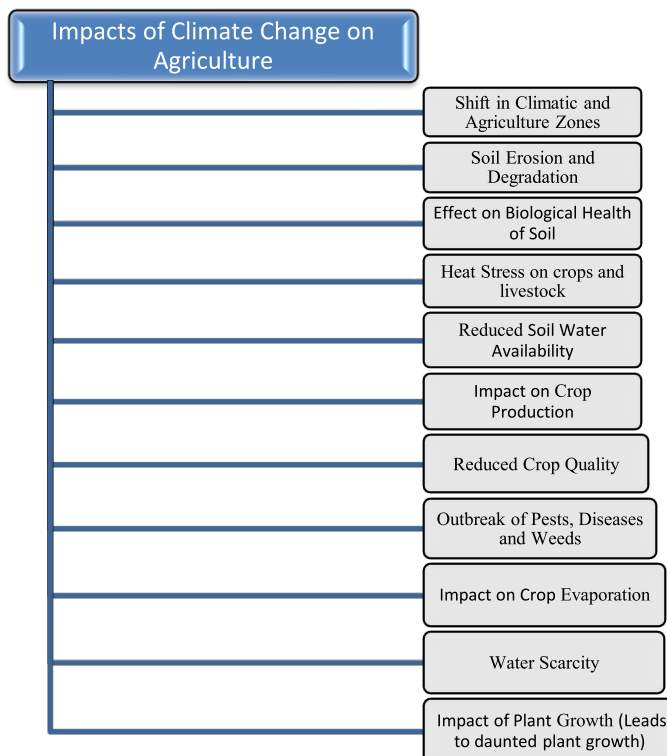


Fig 1: Climate Change Impacts on Agriculture

Source: Author, 2025

Materials and Methods

The Study Area

The cross-sectional survey research design was adopted for the study. The study area is Uzo-Uwani Local Government Area (L.G.A.) in Enugu State created in 1976. It has its administrative headquarters in Umulokpa town. Uzo-Uwani L.G.A. is located between latitude 6°55N and 7°15N and longitude 6°30E and 7°00E. The study area covers an area of 855 km² and bounded to the west and north-west by Kogi State, to the south by Anambra State, to the south-east by Ezeagu and Udi Local Government Areas, to the east by Igbo Etiti Local Government Area, and to the north-east by Nsukka Local Government Area. It lies within the northern section of the Anambra plain of Nigerian lowlands. The study area has a tropical wet-and-dry climate. It usually experiences an average eight months of rainfall between March and October and four months of dry season between November and February. The choice of Uzo-Uwani LGA, for this study, was due to perceived reduction of agricultural products from the area. Uzo-Uwani L.G.A is made up of 16 autonomous communities. They include Nrobo, Abbi, Ugbene, Nimbo, Nkpologu, Uvuru, Akpugo Ezedike, Adani, Ogurugu, Asaba, Igga, Ojor, Umulokpa, Adaba, Nkume and Ukpata. While three (3) communities, Igga, Ojor, and Ogurugu speak Igala Language and other thirteen (13) communities speak Igbo Language. The major economic activity in the area is agriculture. Predominantly the farmers cultivate cassava, maize, yam, rice including other vegetables. They also plant fruits and rear livestock and ruminants such as goat, local cow, sheep, pig etc.

Sampling Size

The targeted population is made up of farmers in Uzo-Uwani LGA and copies of questionnaires were administered to farmers in their various homes and farms. A purposive sampling technique was employed in selecting five (5) communities in the study area. The areas selected were the areas with high agricultural activities. Uzo-Uwani L.G.A has a population of 102,174 persons consisting of 63,759 males and 63,391 females (National Population Commission, 2006). The targeted population for this study were farmers (male and female) aged 18 years and above. A multi-stage cluster sampling technique was adopted in this study. This technique entails making use of the combination of the simple random sampling, systematic sampling technique and the purposive sampling techniques for the selection of the respondents from the farming communities, villages and housing units. The sample size for the study is 150 respondents selected randomly from 5 Communities in the study area (see table 1 below). The total number of the respondents interviewed was derived from the population of each of the selected communities. The Yamane (1967) formula for finite population was used to statistically determine the sample size. The five communities selected as sample were:

Table 1: Showing selected communities

S/N	Community	Village 1	Village II
1	Igga	Akwulu	Asado
2	Ojor	Umuasaba	Uमितodo
3	Adani	Ajuona	Uwenakpa
4	Nimbo	Umuoma	Ukpabi
5	Nkpologu	Ama-Ezike	Nkpunator

Source: Author, 2025

Data Collection and Analysis

Data were collected through oral interview and questionnaire. The quantitative data from the questionnaire were analyzed using the IBM Statistical Package for the Social Sciences (SPSS) software version 20. Descriptive statistics such as frequencies, percentages, and graphic illustrations, which includes bar charts and pie-charts, were used to present the data collected. The qualitative data were analyzed thematically using NVivo version 26.

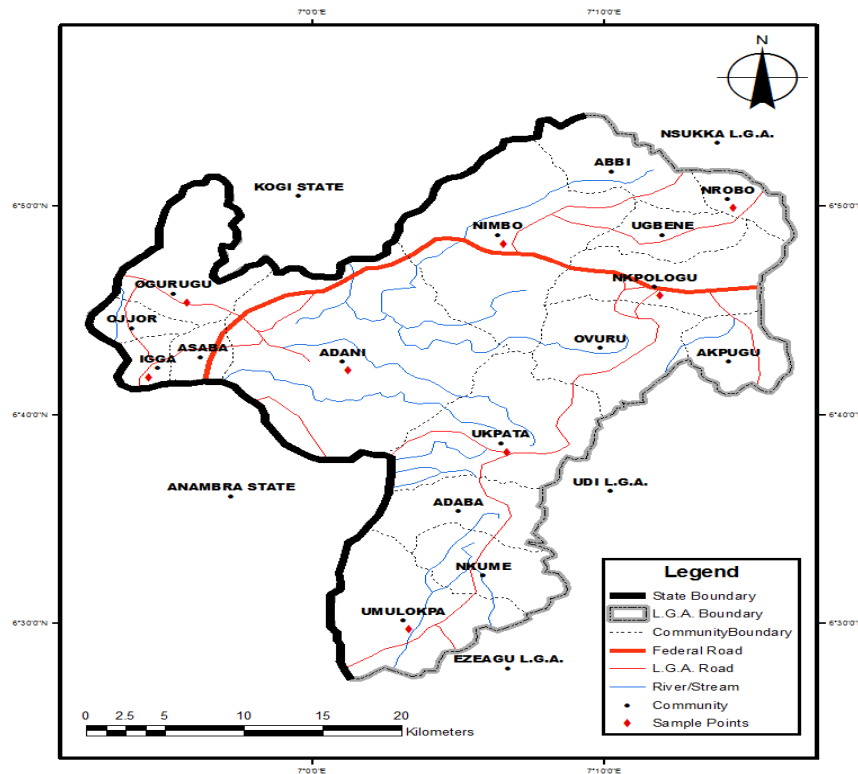


Fig 2: Map of Uzo-Uwani L.G.A. Source: Uzo-Uwani L.G.A. Town Planning Authority (2020)

Data Analysis and Results

Socio-Demographic Information of the respondents

Table 2: Socio-demographic information of respondents by sex, age, marital status, educational attainment and income level

Category	Frequency(N)	Percentage(%)
Sex		
Male	75	50
Female	75	50
Age (Years)		
18-24	30	20
25-34	35	23.33

35-44	25	16.67
45-54	20	13.33
55-64	20	13.33
65+	20	13.33
Marital Status		
Single	50	33.33
Married	75	50
Divorced	15	10
Widowed	10	6.67
Educational attainment		
No formal education	10	6.67
Primary education	30	20
Secondary education	50	33.33
Tertiary education	15	10
Postgraduate education	10	6.6
Level of income (Annual)		
Low (100,000 or less)	40	26.67
Middle (200,000 -500,000)	70	46.67
High (above 500,000)	40	26.67

Source: Author's field survey, 2025

Table 2 above revealed that the gender distribution is balanced with 50% male and 50% female participants, indicating equal representation. The majority of respondents are young adults, particularly in the 25-34 age range (23.33%) and 18-24 (20%). This suggests a youthful demographic with older age groups of (35-44, 45-54, 55-64 and 65+) comprising smaller percentages. Half of the respondents are married (50%) while a significant portion is single (33.33%). The lower percentages of divorced (10%) and widowed (6.67%) individuals reflect a predominantly stable marital environment. Most respondents have completed secondary education (33.33%), followed by primary education (20%). Tertiary education is relatively low at 10%, with postgraduate education even lower at 6.67%. This indicates a need for further educational development in the population. The income distribution showed that nearly half of the respondents (46.67%) fall into the middle-income category (200,000-500,000) and high income (above 500,000) groups represented 26.67% each highlighting a diverse economic landscape.

Knowledge of Climate Change

It is pertinent to know whether the people have knowledge of what climate change is all about. In this section, data were presented on people's general knowledge of what climate change is, people believe on whether the climate is actually changing and where they have heard about it.

Table 3: Respondents' View on whether they have Heard of Climate Change before now

Heard of climate change	Frequency	Percentages
Yes	110	73.33
No	40	26.67
Total	150	100.0

Source: Authors' field survey, 2025

Table 3 above showed that 73.33% of the proportion have heard about climate change while 26.67% of the proportion have no idea about climate change. This implies that majority of the respondents are indeed aware of the change in the climate or have heard about climate change before the research was carried out.

Table 4: Respondents view on what they know about Climate Change

Types of climate change	Frequency	Percentages
Change in nature	40	40.9
Change in weather	35	17.9
Change in temperature	30	19.3
Change in the earth	25	16.0
Changes in length of day	20	5.9
Total	150	100.0

Source: Authors' field survey, 2025

Table 4 revealed the distribution of subjects that know about climate change. The table reveals that 40.9% of the proportion agrees that they know about changes in nature ie that climate change is a natural phenomenon. It may also be inferred from the table that as low as 5.9% of the proportion know about change in the length of the day. Only 16.0% of the proportion knows about changes in the earth while 17.9% and 19.3% of the proportion know about changes in weather and changes in temperature respectively. The implication of the findings is that majority of the respondents believes that climate change is a natural phenomenon, this is a clear indication that majority of the farmers do not have clear understanding of the causes of climate change maybe due to poor information sources or lack of proper awareness.

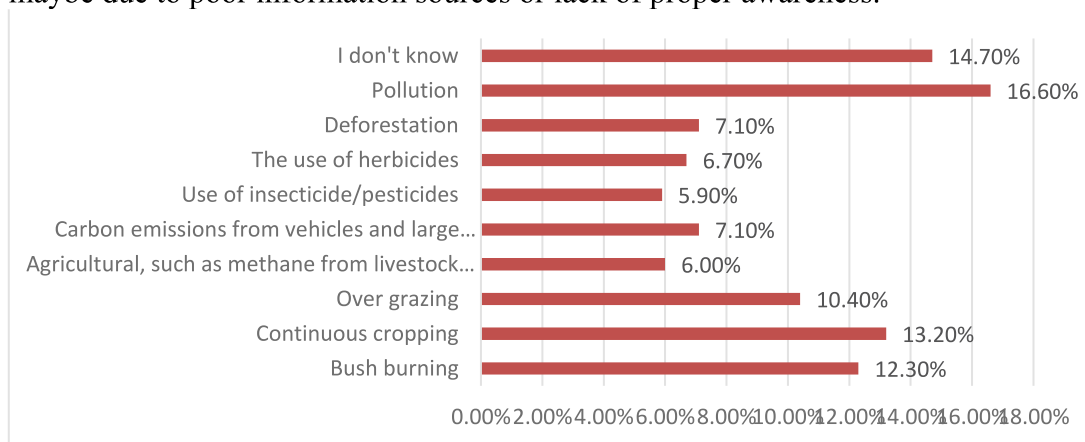


Figure 3: Respondents' knowledge on causes of climate change

Figure 3 depicts the causes of climate change by the respondents. The figure reveals that pollution which constitutes 16.6% proportion is responsible for climate change. In addition, 13.2% and 12.3% proportion of the respondents believe that continuous cropping and bush burning respectively are responsible for climate change. However, 14.7% proportions of the respondent don't know the actual cause of climate change. The implication of the findings here is that majority of the respondents do not know the actual cause of climate change and this calls for urgent sensitization of farmers on the actual cause of climate change because when the cause of a thing is not known solution may be difficult to find.

Table 5: Effects of Climate Change

Have you been affected	Frequency	Percentages
Yes	120	83.7
No	30	16.3
Total	150	100.0

Source: Authors' field survey, 2025

Table 5 above shows the distribution of respondent who have been affected by climate change. Higher proportion reveals that they have been affected in one way or the other. This proportion constitutes 83.7%, while 16.3% of the proportion reveals that climate change has no effect at all. This implies that majority of the respondents have lost their farm produce to the climate change impact maybe because they have poor knowledge of adaptation strategies to use. Therefore, it is pertinent for government agencies, NGOs, Extension Workers etc to come into play by creating awareness on the proper way of adaptation.

Table 6: Distribution of Respondents by the Extent they have been affected by Climate Change

S/n	Item	High extent %	Moderate extent %	Low extent %	No extent %	Total
1	Water availability for irrigation	40(26.67)	50(33.3)	40(26.67)	20(13.33)	150(100.0)
2	Drying up ponds and streams	55(36.67)	45(30.00)	35(23.33)	15(10.00)	150(100.0)
3	Risk of sickness	30(20)	60(40.00)	40(26.67)	20(13.33)	150(100.0)
4	Spread of disease	50(33.33)	40(26.67)	40(26.67)	20(13.33)	150(100.0)
5	Damage of building	45(30.00)	35(23.33)	50(33.33)	30(20.00)	150(100.0)
6	Damage to roads and bridges	35(23.33)	50(33.3)	45(30.00)	20(13.33)	150(100.0)
7	Roof damage by acid rain	20(13.33)	40(26.67)	60(40.00)	30(20.00)	150(100.0)
8	Poverty level	60(40.00)	40(26.67)	30(20.00)	20(13.33)	150(100.0)
9	Loss of live	25(16.67)	35(23.33)	50(33.33)	40(26.67)	150(100.0)
10	Flood occasion	50(33.33)	45(30.00)	35(23.33)	20(13.33)	150(100.0)
11	Type/difficulty of work done on the farm, cost of production (input and labour cost net project from farming)	40(26.67)	55(36.67)	35(23.33)	20(13.33)	150(100.0)

Source: Authors' field survey, 2025

Table 6 shows the extent to which climate change has affected the respondents. As can be seen from the table, 26.67% proportion of the respondent believed that climate change has greatly affected item 11 to a higher extent while 32.2% and 9.1% agreed that climate change affected item 11 moderately and to low extent respectively. In addition, 10.0% of the proportion believe that climate change has no effect on item 11. Climate change is believed to affect item 6 in higher extent by 24.1% of the proportion, 31.6% and 22.8% proportion moderately and at low extent respectively while 21.6% of the proportion don't believe that climate change affect item 6. The above table also reveals that 49.2% proportion believed that climate change moderately affect item 4 while 11.3% of the proportion does not agree. In addition, 54.2% proportion believes that climate change affect poverty level (item 8) to a high extent while 9.0% indicated a low extent. 43.0% and 45% believes that climate change affect item 9 and item 10 respectively in higher extend. Item 5 is believed to be greatly affected by climate change according to 27.4% of the proportion while 33.6% and 15.6% of proportion believe that climate change affects it moderately and to no extent respectively. Climate change is believed to affect item 7 in higher extent by 32.4% of the proportion, 29.9% and 24.4% proportion moderately and low extent respectively while 13.3% of the proportion don't believe that climate change affect item 7.

Table 7: The Extent Climate Change has affected the Cultivation of Crops

s/n Item	High %	extent %	Moderate %	Low %	extent %	No %	extent %	Total
1 Clearing of farmland	20(13.33)	40(26.67)	60(40.00)	30(20.00)	150(100)			
2 Planting month	55(36.67)	45(30.00)	35(23.33)	15(10.00)	150(100)			
3 Spacing during planting	25(16.67)	35(23.33)	50(33.33)	40(26.67)	150(100)			
4 Germination of crop seeds	55(36.67)	45(30.00)	35(23.33)	15(10.00)	150(100)			
5 Quantity of fertilizer application	25(16.67)	35(23.33)	50(33.33)	40(26.67)	150(100)			
6 Pest and disease infestation of crops	60(40.00)	40(26.67)	30(20.00)	20(13.33)	150(100)			
7 Pest and disease control	35(23.33)	50(33.3)	45(30.00)	20(13.33)	150(100)			
8 Rainfall pattern	60(40.00)	40(26.67)	30(20.00)	20(13.33)	150(100)			
9 Flooding of farmland	40(26.67)	55(36.67)	35(23.33)	20(13.33)	150(100)			

Source: Authors' field survey, 2025

Table 7 depicts the distribution of the effect of climate change on cultivation of crops. The following interpretations can be made from the table: Item 1; 22.8% of the proportion believe that climate change affect crop production in high extent. In addition, 40.5% and 27.9% of the proportion believe that climate change affect crop production to a moderate and low extent respectively while 8.8% of the proportion believes it has no effect. In item 4; 54.3% of the proportion believe that climate change affects the germination of crop production in high extent. In addition, 26.6% and 10.6% of the proportion believe that climate change affect crop production to a moderate and low extent respectively while 8.5% of the proportion believes it has no effect. In item 9; 43.9% of the proportion believe that climate change affect crop production in (flooding of farmland) in high extent. In addition, 31.7% and 11.0% of the proportion believe that climate change affect crop production to a moderate and low extent respectively while 13.5% of the proportion believes it has no effect. About 31% of the proportion believes that

climate change affect crop production in relation to item 6, 7 and 8 respectively. Item 2; 49.5% of the proportion believe that climate change affect crop production in high extent. In addition, 33.6% and 10.0% of the proportion believe that climate change affect crop production to a moderate and low extent respectively while 7.0% of the proportion believes it has no effect. Item 5; 37.5% of the proportion believe that climate change affect crop production in high extent. In addition, 32.2% and 18.1% of the proportion believe that climate change affect crop production to a moderate and low extent respectively while 12.1% of the proportion believes it has no effect. This implies that the respondents have poor knowledge of climate change adaptation strategies or coping strategies and also lack the proper facilities for proper adaptation.

Table 8: Altering Planting and Harvesting date to cope with the Impact of Climate Change

Alteration of planting and harvesting dates	Frequency	Percentages
Yes	125	83.33
No	25	16.67
Total	150	100.0

Source: Authors' field survey, 2025

Table 8 shows that majority of the respondents altered their planting and harvesting date with the impact of climate change. This amount to 83.33% proportion of the respondent while 16.67% of the proportion did not do any of such to cope with the impact of climate change

Table 9: Growing of Varieties of Crops in an area to cope with the adverse effect of Climate Change

Response	Frequency	Percentages
Yes	100	66.67
No	50	33.33
Total	150	100.0

Source: Authors' field survey, 2025

From table 9 above, we see that higher number/proportion (66.67%) indicated that they grow varieties of crops to cope with the adverse effect of climate change while 33.33% of the proportion do not grow varieties of crops to cope with climate change.

Figure 5: Showing how the respondents coped with climate change impact

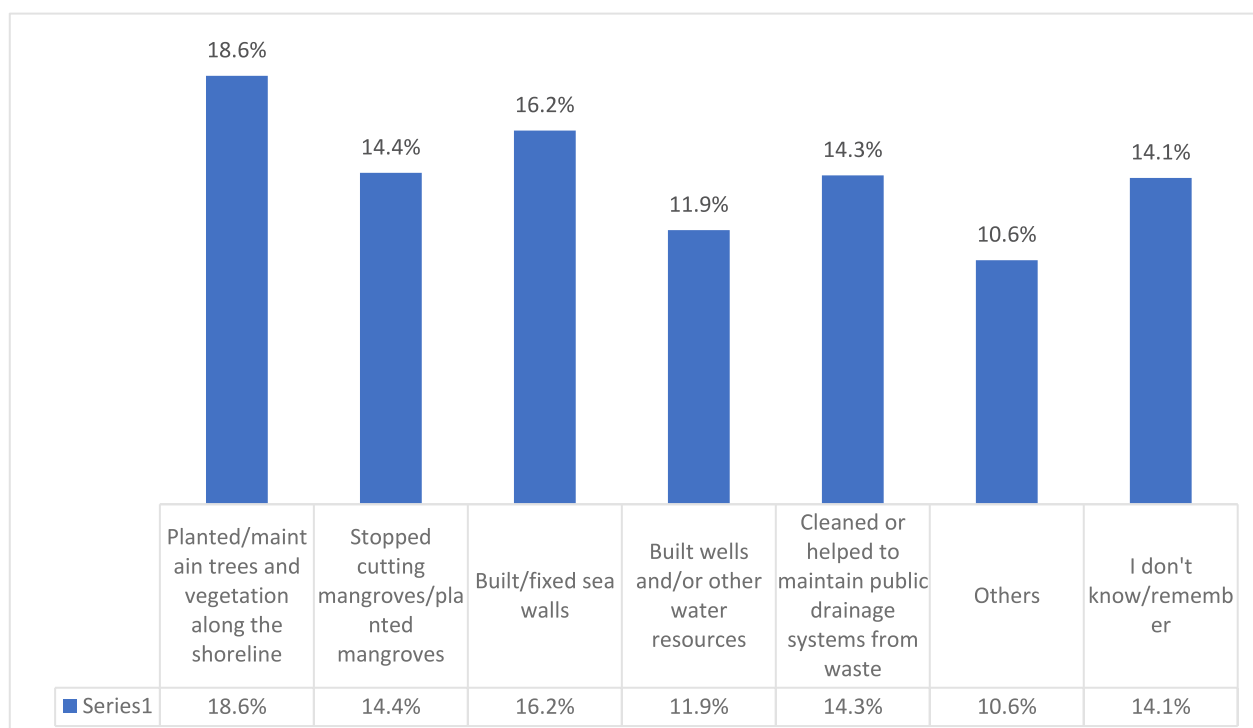


Figure 5 depicts how they respondents adapt to climate change. About 18.6% of the proportion planted trees while 16.2% built/fixed sea walls. Those who stopped cutting mangrove/planted mangrove and those who cleaned or helped to maintain drainage constitutes 14.4% and 14.3%, respectively, while those who built wells and other water resources constitutes 11.9%. About 14% of the proportion don't know or remember what they did to cope with climate change.

Table 10: Adaptation Practices they make use of before and after planting

Adaptation practices	Frequency	Percentages
Traditional	130	86.67
Modern	20	19.33
Total	150	100.0

Source: Authors' field survey, 2025

Table 10 shows the distribution of adaptation practices the respondents used before and after planting. The table reveals that 86.67% of the proportion indicated that they use traditional method while 19.33% of the proportion used modern practices.

Table 11: Traditional Adaptation Strategies they make use of before and after planting

Traditional adaptation Strategies	Frequency	Percentages
Mulching	30	20
Using of bag of sand/wood as ridging	25	16.67
Molding of farm ridges at the farm boundaries	40	26.67

Using ashes as disease control	40	13.33
Making larger heaps to avoid flood	35	24.7
Others, include afforestation, and agro forestry	10	6.67
Total	150	100.0

Source: Author's filed survey, 2025

Table 11 reveals the type of traditional adaptation strategies the respondents have used. Making larger heaps to avoid flood and molding farm ridges at the farm boundaries are the highest type of traditional adaptation strategies used with 23.33% and 26.67% respectively. Followed by using bag of sand/wood as ridging with 16.67%, use of ashes as disease control with 13.33% and mulching with 20%. While afforestation and agro forestry were mentioned by only 6.67% respondents.

Table 12: Modern Adaptation Strategies they make use of before and after planting,

Modern adaptation strategies	Frequency	Percentages
Changes in planting species	35	23.33
Crop diversification	30	20
Use of chemicals, fertilizer and pesticide	25	16.67
Irrigation system	40	26.67
Others, includes cultivation of short term crops and mixed cropping etc	20	13.33
Total	150	100.0

Source: Author's field survey, 2025

Table 12 shows the type of modern adaptation strategies the respondents have used. Use of chemicals, fertilizer and pesticide and changes in planting species are the most modern adaptation strategies used by the respondents with 16.67% and 23.33% respectively. Followed by crop diversification (20%) and irrigation system 26.26%. However, only 13.33% respondents mentioned cultivation of short term crops, mixed cropping etc

Table 13: Type of Adaptation Practices they are Aware of or have used

Types of adaptation practices	Frequency	Percentages
Changes in planting month	30	20
Use of chemicals and fertilizers	25	16.67
Changes in planting species	40	26.67
Plant along a river and streams	20	13.33
Change in planting methods	35	23.33
Total	150	100.0

Source: Authors' field survey, 2025

Table 13 reveals the type of adaptation practices the respondents are aware of or have used. Changes in planting months and use of chemicals and fertilizers are mostly used by the respondents and this amount to 20% and 16.67% of the proportion respectively. Changes in planting methods amounts to 23.33% of the proportion. However, 26.67% and 13.33% of the proportion change their planting species and plant along a river or stream respectively.

Figure 6: Constraints to climate change adaptation in Uzo-uwani LGA

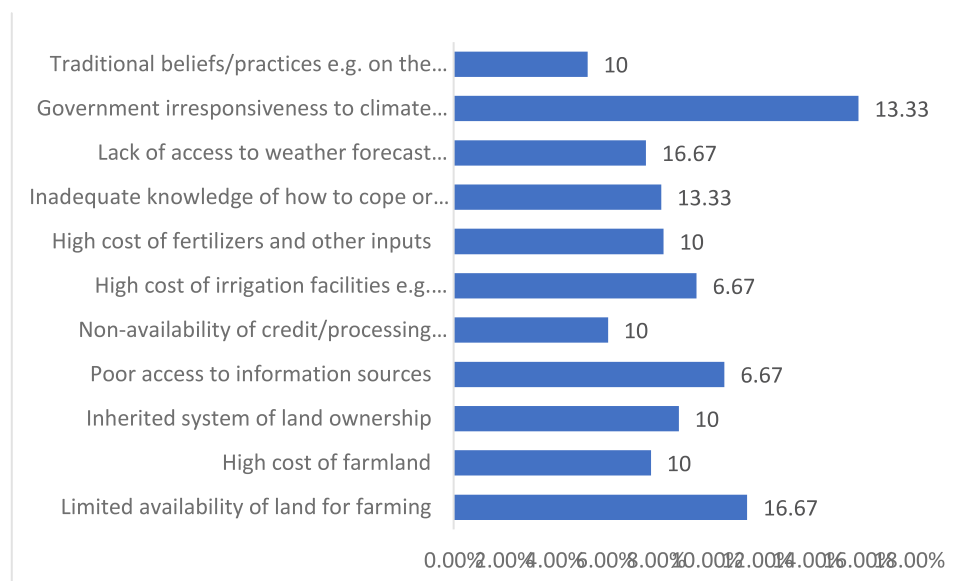


Figure 6 depicts constraints to climate change adaptation in the study area. Most of the respondents indicated that government irresponsiveness to climate change is to be blamed and this amount to about 16% of the proportion. About 8% of the proportion cited inadequate knowledge of how to cope, high cost of fertilizer and other inputs and inherited system of land ownership as constraints. About 11.6% and 10.7% of the proportion indicated that limited availability of land for farming and high cost of irrigation facilities respectively as constraints while 7% indicate lack of access to weather forecast.

Table 14: Ways Climate Problems on agriculture can be ameliorated

<i>Ways CC problems can be Ameliorated</i>	<i>Frequency</i>	<i>Percentages</i>
Adopting climate-resilient crops	25	16.67
Improve soil management	20	13.33
Efficient water management	20	13.33
Sustainable farming practices	25	16.67
Climate smart agriculture	15	10
Diversifying crop production	15	10
Investing in research and development	10	6.67
Enhancing farmer education and training	20	13.33
Developing early warning systems	10	6.67
Policy support and incentives	10	6.67
Total	150	100

Source: Authors' field survey, 2025

The table 14 above outlines key strategies to address climate change in agriculture, highlighting the most significant approaches such as adopting climate-resilient crops and sustainable farming practices, each prioritized with a frequency of 25 (16.67%). Critical areas such as improving soil

management and efficient water management follow closely, each at a frequency of 20 (13.33%), indicating their role in enhancing resilience and resource conservation. Moderately important strategies, including climate-smart agriculture, and diversifying crop production, are noted with a frequency of 15(10%), while lower-priority strategies like investing in research, developing early warning systems and policy support are assigned a frequency of 10 (6.67%). This suggests a need for greater focus and resource allocation towards these secondary strategies to ensure long-term sustainability and effective risk management in agriculture.

Presentation of Qualitative Data

Research Question	Main Theme	Sub-Themes/NVivoNodes	Participants Quotes
Q1. What are the most significant climate change impacts experienced by farmers in Uzo-Uwani LGA	Impacts on Crop Yield	Reduced Yield: Widespread reports of lower harvest volumes for staple like cassava and yam, rice etc. Crop failure Complete loss of crops due to extreme weather events like excess sun or rain	Farmer-Igga-55yrs- The yam harvested this year was terrible. The rain started late and then the sun was too hot. We got less than half of what we usually get. Farmer-Adani-Female-45yrs- The flood came and washed our farm away. Our cassava and rice farmlands were completely destroyed. It is a big loss for me and my family.
	Altered farming seasons	Unpredictable rainfall: difficulty in predicting planting and harvesting times. Prolonged dry seasons: Longer dry spells affecting crop growth	Farmer-Male-Nimbo-60years- the dry season is now longer and harsher. My vegetable farm is dying because there is no rainfall and no water for irrigation
	Increased Pests and Diseases	New Pests: Appearance of unfamiliar pests affecting crops e.g. ebola, army worm etc Increased Diseases Spread Higher incidence of plant diseases	Farm Manager-male-Agric Sci Dept, UNN-57 yrs- we are seeing new types of insects that eat the leaves of our crops. For example, ebola and army worms attacked our cocoyam and maize farms. We don't know how to fight them. the cassava/yam are being attacked by diseases which is spreading very fast. Many farmers have lost their crops to it.
Q2: What adaptation strategies are farmers in Uzo Uwani LGA currently using to respond to these climate changes?	Adaptation Strategies	Traditional Coping Mechanisms Mixed cropping:	Farmer-Male-55yrs-Nkpologu- we plant different crops in the same ridge/heap to wedge against risks. Also, when my father was alive, he taught me to plant different crops together. If one

			fails or dies, the other might still survive.
		Changing planting schedules	ICCSEE UNN Staff-male-40yrs- adjusting planting times based on perceived changes in rainfall. I now wait for the rains to settle properly before planting, it is a risk but it's better than planting too early and losing the seeds.
	Modern adaptation strategies	Adoption of new practices Drought resistant crops Use of new, hardier crop varieties Chemical inputs Increased reliance on fertilizers and pesticides	Female-Ojjor-55years-the agricultural extension worker gave us new seeds for drought-resistant maize. It has helped us get something even when the rains are not enough. Many of us now use more fertilizer because the soil is not as good as it used to be. The yields are still lower, but its better than nothing. Another coping mechanism some of us here use is to engage in non-farming activities to supplement income. Male-57yrs-Adani- another coping strategy is off-farm labor ie seeking temporary work outside of farming. "Farming alone is no longer enough to feed my family. My wife and I now sell some foodstuff in the market to make ends meet". "When the crops fail, I go to the next town to do some daily work, like carrying concrete at the construction sites. We have to do something to survive"

Discussions of Findings

Majority of the respondents (81.7%) are aware that indeed the climate is changing and that it is no longer the way it used to be. This change according to them manifested in excess rain or delay in rainfall, likewise harsh weather conditions due to increased temperature, so nothing is as moderate as it used to be. Similar finding was also reported by Akukwe et. al. (2024) on perceived effects of climate change on agricultural productivity in Igbo-Etite LGA. They specifically highlighted rainfall decline, delayed onset of rain and a prolonged dry weather as the impact of climate change faced by farmers in the area in addition to high temperatures, water source depletion, soil degradation, drudgery and stress from heat, etc.

There is no gainsaying that the climate is changing and its impact on agriculture cannot be underemphasized. Impacts of climate change experienced by farmers are: soil erosion, lack of water for human agricultural purposes and livestock use, loss of vegetation/pastures, intense weed growth, incidence of pests and diseases, distortion and destruction of wildlife ecosystems, decrease in soil fertility and health related issues of climate change which can affect production, drudgery and stress from heat. Indications from the study revealed that rainfall pattern has changed, as well as increased cost of production that resulted to poor quality and quantity of produce. This is supported by various observations and interviews granted to farmers. This is in correspondence with Agbola P., and Fayiga, A.O. (2016) on their research on Effects of climate change on agricultural production and rural livelihood in Nigeria. Also, Yuan et al (2020) on their paper climate change effects on agricultural production: The Regional and Sectoral Economic Consequences in China reported that rainfall pattern is changing as a result of climate change effects. Despite most participants having a pessimistic view of the future of climate change, there are some who believe that something can be done. Farmers in the study area are afraid, confused, angry and powerless, because of the devastating consequences of climate change. Majority of the farmers indicated the willingness to learn about climate change. They reported being eager to go for sensitization and empowerment programme. This was further strengthened by the fact that 70.1% of the participants' desire to not only learn about climate change but to take drastic action to alleviate its impact. There is growing acceptance; however, that adaptation is critical since global warming is inevitable even if radical emissions reduction policies are implemented. Local communities globally are recognized to have traditional strategies with which they mitigate the vast negative impacts of climate change on the agriculture. In this study, one important strategy used by farmers in coping with the effects of climate change is altering planting and harvesting seasons. This was revealed by 86.67% of the participants, this means that the remaining 19.33% continue with their old planting and harvesting plan. This delay tactic is aimed at making sure the crops grew before insects begin to attack.

Overall, most farmers (65.9%) use traditional adaptation techniques to cope with the impact of climate change. This method includes using wood to wage and sands of bag to wage flood. Others include the use of locally made water track but often times this method is not quite reliable.

Implications of the findings and Policy Frameworks

The findings from the research reveal significant vulnerabilities in agricultural production within Uzo-Uwani LGA, particularly with respect to changing rainfall patterns, declining soil fertility, outbreaks of pests and diseases and reduced crop yields. All of these have far-reaching agronomic, socio-economic as well as environmental implications. Therefore, important suggestions for multiple stakeholders, policymakers, local authorities and development practitioners on fostering resilient agricultural systems and sustainable rural development in the face of climate change is urgently needed.

Although there is some level of climate change awareness among farmers in the study area, gaps still remain in understanding the causes and long-term effects, indicating a need for improved educational campaigns and extension services. Increased awareness can encourage more proactive attitudes and willingness to adopt innovative farming practices. In terms of coping

strategies, local farmers employ methods such as mixed cropping and the use of drought-resistant varieties, which demonstrate valuable local knowledge. However, these strategies may not be sufficient against intensifying climate challenges, highlighting the need to complement them with scientifically validated approaches and better access to resources like improved seeds and credit. The direct impacts of climate change, including erratic rainfall, flooding and droughts, have significantly disrupted agricultural timelines and reduced crop yields, thereby threatening household food security and income stability in Uzo Uwani Local Government Area. Such disruptions increase rural vulnerabilities and may contribute to poverty and youth migration as alternative livelihoods. Policymakers must integrate climate adaptation and mitigation into local development plans and invest in early warning systems to reduce weather-related losses. Furthermore, promoting research on resilient crop varieties and efficient agricultural techniques is essential for long-term sustainability. At the community level, fostering collective adaptation measures such as cooperatives and communal resource management can strengthen resilience, especially for vulnerable groups like women and small-scale farmers who face greater risks and resource constraint overall, the findings underscore the urgent need for collaborative efforts between government, NGOs, researchers and local communities to enhance awareness, improve coping mechanisms and mitigate the adverse effects of climate change on agriculture in Uzo-Uwani LGA thereby securing livelihoods and promoting sustainable development. In practice terms, this includes the promotion of climate-smart agricultural practices, introduction of drought-tolerant crop varieties, strengthening of extension and information services and investment in small-scale irrigation and soil conservation measures to cushion farmers against climate shocks. Socioeconomic policy measures such as improved access to credit, crop insurance schemes and subsidized inputs are equally vital in enhancing farmers' adaptive capacity while institutional frameworks must ensure that climate considerations are mainstreamed into local government and national agricultural planning. Embedding these findings into coherent policy responses will not only provide immediate support to smallholder farmers in Uzo-Uwani LGA but will also contribute to Nigeria's broader objectives of sustainable rural transformation, poverty reduction and climate resilience.

Conclusion and Recommendations

Scientific investigation and assessment of the impact of climate change on the agricultural sector is essential for formulating the vision of future agriculture. The study provided explicit insight on the impact of climate change on agricultural production in Uzo-Uwani LGA of Enugu State. The study revealed that farmers in Uzo-Uwani LGA Agricultural Zone of Enugu State were experiencing the impact of climate change on their agricultural production. The findings revealed that climate change has impacted the socio-economic characteristics of farmers in the study area, while the level of awareness and knowledge about the causes of climate change remains low. Moreover, climate change hinders effective agricultural production through increased frequency of droughts, erratic rainfall patterns, water scarcity for irrigation, heightened pest and disease outbreaks, soil degradation, reduced crop yields, damage to infrastructure and increased production costs. These challenges exacerbate poverty level as a result of low net profit from agriculture, food insecurity and livelihood vulnerabilities for farming communities in the study area.

However, more interest and policy support should be directed to adaptation measures in consideration of the inevitability of global warming and the characteristics of climate-dependent

agriculture. For this, proper education and training programs for agricultural and extensions workers, public officials and the personnel from the related agencies should be developed and put into practice so that they can properly cope with climate change. It is also urgent to expand the adaptation measures of the agricultural sector that have been limited to research and development, to more active policy programs including popularization of technology and adaptation manuals to agriculture workers and proper incentive programs. As shown by the findings of the study, the farmers are highly interested in adaptation to climate change and very willing to participate in sensitization program.

References

- Agbola P. and Fayiga, A.O. (2016). Effects of Climate Change on Agricultural Production and Rural Livelihood in Nigeria. *Journal of Agricultural Research and Development*. 15(1)
- Akukwe, T.I., Mba, C.L. and Isiwu, G.R. (2024). Perceived Effects of Climate Change on Agricultural Productivity in Igbo-Etiti Local Government Area of Enugu State, Nigeria. *FUDMA Journal of Agriculture and Agricultural Technology*. 10 (1)
- Food and Agriculture Organization (2022). The State of Food and Agriculture. United Nations, Rome.
- Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2021: Impacts, adaptation and vulnerability*. Cambridge University Press.
- Intergovernmental Panel on Climate Change. (2023). Climate Change: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva, Switzerland, pp. 1-34.
- Mahmud, H.U. (2023). Factors Militating Against Agricultural Productivity of Crop Farmers in Niger State, Nigeria. *Journal of Agripreneurship and Sustainable Development*. 6(1),15-23
- Micheal, V.A. (2025). Impact of agricultural variables on GDP in Nigeria: A SARIMA approach. *African Journal of Agricultural Science and Food Research*. 14(2).
- NASA (2023). The Effects of Climate Change. Retrieved from <https://climate.nasa.gov/effects>. On 24 September, 2025
- Nwangwu, K.N., Ume, C, Onah, O.G., Chiemela, C.J. and Omeje, E.E. (2024). Can Climate Change Affect Income-Generating Activities?: Evidence from Farmers in Enugu State, Nigeria. *American International Journal of Agricultural Studies* 9(1), 1-6
- Sarrau, J, Alkaabi, K, and Hdhaiba, S.O.B. (2024). Exploring GIS Techniques in Sea Level Change Studies: A Comprehensive Review. *Sustainability*, 16, 2861. <https://doi.org/10.3390/su16072861>
- World Bank (2025). Agriculture overview: Development news, research, data. Retrieved on 10 March, 2025 from <https://www.worldbank.org>
- World Health Organization (WHO) (2021). *Climate Change and Health*. World Health Organization. Retrieved from <https://www.who.int/news.room/fact-sheets/detail/climate-change-and-health>. On 24 Se