



Assessing the Impact of Climate Variability on Agricultural Productivity in Nasarawa State, Nigeria

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Abstract

Climate variability has become a global concern due to its far-reaching effects on agricultural productivity and human livelihoods. This study investigates the impact of climate variability on agricultural productivity in Nasarawa State, Nigeria. A total of 600 copies of the structured questionnaire gathered were administered to farmers using the stratified random sampling technique. Data collected were analysed using frequency, percentages, Likert scale, and regression, and the results were presented in tables. Results of the analysis show that a significant proportion of respondents (35%) believed that rising temperatures, erratic rainfall patterns (40%), and soil degradation (40%) affect agricultural productivity. Regression analysis shows that a temperature increase ($\beta = 0.35$, $p < 0.001$) with a negative coefficient of 0.35 suggests that as temperatures increase, agricultural productivity decreases. Erratic Rainfall ($\beta = 0.45$, $p < 0.001$) shows the negative impact of erratic rainfall on agricultural productivity, which is statistically significant (p value < 0.001). The coefficient for soil degradation ($\beta = 0.30$, $p < 0.001$) shows that soil degradation significantly impacts agricultural productivity in Nasarawa State. It is, therefore, recommended among others that farmers should integrate climate-smart agricultural practices such as crop rotation, intercropping, and water conservation techniques to improve yields under changing climatic conditions.

Keywords: Climate variability, Agricultural productivity, Nasarawa state, Nigeria

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1. INTRODUCTION

The importance of agricultural activities in man's coexistence cannot be overstressed, as it plays an imperative and vital role in man's survival and existence. The development of agriculture depends heavily on some climatic factors, which play varying essential roles in its outgrowth and evolution over time (Akinniran, Ezekiel, Ganiyu, and Adeyemo, 2013). Likewise, among the sectors of the economy of every nation, agriculture as an activity is extremely vulnerable to climate variability. This phenomenon is because the sustainability of agricultural activities and production systems depend enormously on weather variables (Monteiro, 2017).

Climate variability has been widely recognised as a significant driver of agricultural productivity declines, particularly in regions highly dependent on rainfed agriculture. Climate variability affects agricultural productivity through variations in temperature, rainfall

patterns, and extreme weather events (FAO, 2022). Studies indicate that increased temperatures lead to reduced crop yields, while irregular rainfall affects planting seasons and crop maturation (Olayemi et al., 2021). Changes in temperature, rainfall patterns, and the increased frequency of extreme weather events such as droughts and floods are key factors that negatively impact crop production (FAO, 2022). According to the Intergovernmental Panel on Climate Variability (IPCC, 2021), temperature increases are expected to reduce crop yields globally, particularly in tropical and subtropical regions, where the impact of climate variability is often most pronounced.

Africa is highly vulnerable to climate variability due to its dependence on rainfed agriculture and limited adaptive capacity. Changes in temperature and precipitation patterns have contributed to desertification, soil

degradation, and increased frequency of droughts in many parts of the continent (African Union, 2022). In West Africa, including Nigeria, irregular rainfall has caused prolonged dry spells and reduced water availability for irrigation, affecting staple crops such as maize, millet, and rice (World Bank, 2021).

Several African countries are facing severe climate variability-induced challenges. In Ethiopia, recurrent droughts have led to widespread crop failures, livestock deaths, and food shortages, affecting millions of people (UNDP, 2023). Kenya has experienced prolonged droughts and unpredictable rainfall, resulting in reduced agricultural yields and increased food prices, worsening food insecurity (FAO, 2023). In Mozambique, extreme weather events such as cyclones and flooding have destroyed farmlands and displaced communities, making food production highly unstable (World Bank, 2022). Similarly, in Chad and Sudan, desertification and land degradation have limited agricultural productivity and heightened competition over scarce resources, leading to conflicts and displacement (African Union, 2022). Conflicts over scarce agricultural resources have further compounded these challenges, exacerbating food crises in the region (FAO, 2022).

Agricultural production in Nigeria suffers from yield uncertainties as a result; it has taken a declining role in the economy despite the fact that it contributes a reasonable percentage of the Nigerian economy (Ayoade, 2018). Agriculture is the main source of food and raw materials and a major employer of labour, employing about 60% of the population. It is a rainfed system and hence vulnerable to climate variability. Dominant crops cultivated in the country include yam (*Dioscorea*), cassava (*Manihot esculenta*), maize (*Zea mays*), millet (*Pennisetum americanum*), okra (*Abelmoschus esculentus*), rice (*Oryza glaberrima*), oil palm (*Elaeis guineensis*), among others.

Nigeria is experiencing significant impacts of climate variability on its agricultural sector, which contributes about 25% to the country's GDP (National Bureau of Statistics, 2023). Rising temperatures and shifting rainfall patterns have led to lower crop productivity, particularly in northern Nigeria, where desertification is advancing rapidly (Nigerian Meteorological Agency, 2022). Flooding has also become a recurrent problem, with devastating effects on farmlands, infrastructure, and rural livelihoods (Federal Ministry of Agriculture and Rural Development, 2022).

Despite all recent technological and scientific development, climate remains a major factor influencing agricultural production in Nigeria due to its dependence on climatic elements. In other words, crop yields, particularly for cassava, yam, and guinea corn, are still affected by climate despite the availability of advanced technologies and scientific agricultural practices. In Nasarawa State, farmers face similar challenges, with climate variability-induced droughts, floods, and soil degradation threatening agricultural sustainability

(Nasarawa State Agricultural Development Programme, 2023).

Farmers in Nasarawa rely heavily on rainfed agriculture, making them highly susceptible to changing rainfall patterns. Prolonged dry spells have reduced crop yields, leading to food shortages and price volatility (Nwafor, 2020). Additionally, excessive rainfall has caused flooding, destroyed farmlands and led to postharvest losses. These factors contribute to food instability and increased poverty rates in the state.

In Nasarawa State, Nigeria, the agricultural sector is facing mounting challenges due to the evolving climate conditions. Studies by Adebayo and Yusuf (2023) reveal that the state has experienced significant disruptions in its farming activities due to recurrent droughts and flooding events. These extreme weather occurrences have been associated with climate variability and are a direct threat to the stability of staple crop production, including maize, yam, and rice, which are essential for both local consumption and income generation. These findings align with the work of Olayemi et al. (2021), who observed that erratic rainfall patterns have shifted planting seasons, leading to misalignments in crop cycles, ultimately affecting the maturity of crops and yields.

Furthermore, temperature increases exacerbate water scarcity, leading to reduced soil moisture availability, which is crucial for crop growth. As Njoku et al. (2022) report, the reduction in soil moisture, combined with the increased frequency of extreme heat events, has contributed to lower agricultural productivity in Nasarawa State. Therefore, this study was carried out to assess the impact of climate variability on agricultural productivity in Nasarawa State, North Central Region of Nigeria.

1.2 Statement of the Problem

Climate variability poses a significant threat to global food security by disrupting agricultural productivity and access to nutritious food. The Intergovernmental Panel on Climate Variability (IPCC, 2021) states that rising temperatures and extreme weather events such as droughts, floods, and storms have both direct and indirect negative effects on food production systems. These factors lead to reduced crop yields, soil degradation, and increased pest and disease outbreaks, which exacerbate food insecurity worldwide.

In Nigeria, interannual rainfall variability has emerged as a primary source of tension for farming and crop production. Unpredictable weather conditions have led to declining agricultural productivity, negatively impacting the availability and affordability of food. Specifically, climate-induced droughts and floods have reduced yields, leading to increased hunger levels, particularly among rural populations. In Nigeria, studies have also shown that climate variability has severe implications for food security. Nwajiuba (2019) found that unpredictable weather conditions in Nigeria have led to declining agricultural productivity, negatively impacting food

availability and affordability. Ebele and Emodi (2016) emphasise that climate variability-induced droughts and floods have reduced crop yields, leading to food shortages and increased hunger levels, particularly among rural populations.

The situation in Nasarawa State is increasingly critical, as food security is under threat from irregular rainfall and prolonged dry spells. These climatic changes result in poor harvests and inflated food prices, worsening malnutrition among vulnerable groups. Furthermore, there is a significant lack of adaptive strategies and policies to mitigate these climate-induced risks within the state, such as drought-resistant crop varieties and improved irrigation techniques. While existing research has explored these effects in various regions of Nigeria, there remains a notable gap concerning the specific nexus between climate variability and food security in Nasarawa State. This study, therefore, seeks to examine the impact of climate variability and food security in Nasarawa State, Nigeria.

1.3 Research Questions

The study provided answers to the following questions:

- i. How does climate variability impact food security in the study area?
- ii. Examine the relationship between climate variability and food security in the study area.
- iii. What coping and adaptation strategies do farmers employ to mitigate climate-induced food insecurity in the study area?

1.4 Objectives of the Study

The study aims to investigate the impact of climate

variability and food security in Nasarawa State, Nigeria. The specific objectives are to:

- i. Assess the impact of climate variability on agricultural productivity in the study areas.
- ii. Examine the relationship between climate variability and food security in the study area.
- iii. Identify the adaptive strategies adopted by farmers to mitigate the effects of climate variability on food production in the study area.

1.5 Research Hypotheses

The hypotheses tested in this study are in line with the research questions and objectives as shown below:

- i. There is no significant impact of climate variability in Nasarawa State.
- ii. There is no significant relationship between climate variability and food security. Nasarawa State
- iii. What coping and adaptation strategies do farmers employ to mitigate climate-induced food insecurity in the study area?

1.6 Study Area

Nasarawa State is located between latitudes 7° and 9° N and longitudes 7° and 10° E. It shares boundaries with Benue State to the south, Kogi State to the west, the Federal Capital Territory (FCT) to the northwest, Kaduna and Plateau States to the northeast, and Taraba State to the southeast (Figure 1). Nasarawa State has a total land area of 12,000 square kilometres and is divided into thirteen (13) Local Government Areas (LGAs).

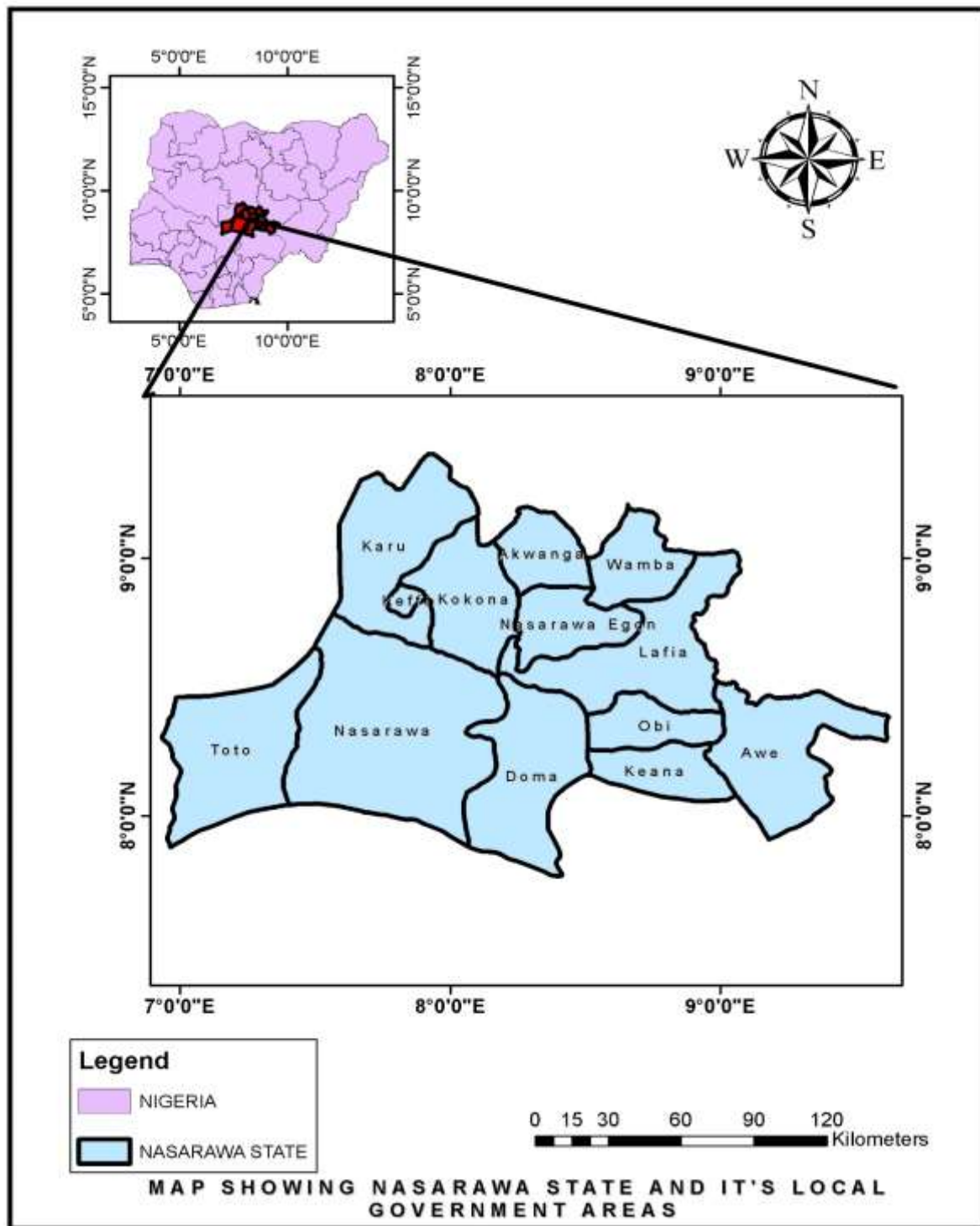


Figure:1: Nigeria Showing Nasarawa State
Source: NASRDA Abuja, 2025

2. LITERATURE REVIEW

Several studies have examined the impact of climate variability on agriculture in Nigeria, with specific insights from Nasarawa State. Agashua (2016) assessed the effect of rainfall variability on the production of yam in the UKUM local government area of Benue State, Nigeria.

Using rainfall data from the Nigerian Meteorological Agency's Ibi station and yam yield from BNARDA, Makurdi, he correlated these rainfall and yam yield data. The Agashua's study showed that the difference in the annual rainfall in the study area within the period of study

(1995-2012) was very minimal. This implies that there was a little disparity in the amount of rainfall in the study area within the period of study. However, the author also pointed out that there has been an increasing trend in the annual rainfall in the UKUM. He found that the increase in rainfall in the study area led to a rise in yam yield. The study showed a negative relationship between annual rainfall and yam yield in the study area.

Apata (2012) studied the effects of global climate variability on Nigerian agriculture: An Empirical Analysis. The researcher used both primary and secondary data for this study. Secondary data came from the National Core Welfare Indicator (NCWI), National Living Standard Survey (NLSS), National Consumer Survey (NCS), Demographic Health Survey (DHS), National Population Commission (NPC) and National Bureau of Statistics (NBS). The primary data consists of 900 respondents (150 respondents from each zone), but only 850 responses were useful. This study analysed the determinants of farm-level climate adaptation measures in Nigeria, using a multinomial choice model in all six zones in Nigeria. Also, a simple, nationally aggregated, stochastic simulation model was constructed to investigate the effects of rapid climatic change on agriculture (grain production) and the human population in Nigeria. Findings from this study indicated that agricultural impacts of climate variability in Nigeria are uncertain. The total average impact may be positive or negative depending on the climate scenario. But in most scenarios, it was shown that climate variability will have an overall positive impact on Nigeria's agriculture. The study found out that there is a lack of effective access to information on climate variability; thus, there is a need for effective and reliable access to information on changing climate, and this implies that education to improve awareness of the potential benefits of adaptation is an important policy measure for future adaptation and mitigation strategies.

Damshakal (2015) analysed the relationship between rainfall variability and potato yield in Mangu L.G.A. of Plateau State. The author correlated annual rainfall and potato yield to determine the relationship between the two variables in the study area. The author found out that rainfall amounts have increased over the years between 2005 and 2014 in the study area. Rainfall characteristics and potato yield have varied over years of study; the conclusion drawn from the study showed that there was no relationship between rainfall amount and potato yield in the study area. Potatoes depend on water for growth; however, rainfall is not the only factor responsible for the yield of potatoes in the study area. Other factors, like soil and temperature and a variety of other climatic factors, are responsible for the fluctuations in the yield of potatoes in the studied area.

Exenberger and Pondorfer (2011) studied the impact of climate variability on agriculture in sub-Saharan Africa with specific emphasis on rainfall and temperature. In their research, it was noted in their analysis that the interaction between rainfall and agriculture resulted in

considerable heterogeneity in the country's level of response to rainfall. More precisely, the highest and most significant impacts were found in the Central Region, followed by the Sudan-Sahel Region. A small, moderately significant effect was found in the Indian Ocean regions as well.

Francis and Geoffrey (2014) examined climate variability and crop production in Nigeria. The researchers examined the relationship between climatic variation and crop output in Nigeria from 1981 to 2008 using the time-varying ARCH model of crop production function. Analysis of the incidence of rainfall and temperature variation from the long-term average indicates that it is insignificant. Estimates of the trends of rainfall and temperature suggested a gradual decline in volume of rainfall and record of temperature in Nigeria in the present and near future. ARCH model estimates showed that a variation in rainfall and temperature from the long-term means has significant effects on crop output, while the exponential increase in rainfall has a detrimental effect on crop output.

Nwaobiala and Nwosu (2014) analysed the effect of climate variability on cassava farmers' output in Cross River State, Nigeria, from 1980 to 2010. Results obtained from the study using the Cobb-Douglas production function showed that farm size, quantity of fertiliser, labour and depreciation of capital inputs had a significant effect on the output of cassava in the study area. The combined effects of all the explanatory socio-economic variables explained 54.78% of the total variability of cassava output, which was statistically significant at the 1.00 percentage level of probability. The combined effects of all the explanatory socioeconomic variables explained 65.05% of the total variability of cassava output, which was statistically significant at the 1.00 percentage level of probability. This confirms that cassava is drought resistant and can thrive under extreme weather conditions. Infrequent training on climate variability, non-access to meteorological data, labour shortage, inefficient extension systems and the traditional land tenure system were identified as problems cassava farmers encounter in coping with the effects of climate variability.

Yakubu (2015) assessed the impact of rainfall variability on tuber crops (yam and cassava) in Kaduna State of Nigeria. The study used data from the Kaduna State Ministry of Agriculture for a period of 15 years (1996-2010). Descriptive and inferential statistics, particularly the Pearson product moment correlation coefficient, were used to analyse the data. The results indicated that yam yield had a direct relationship with rainfall with a correlation coefficient of 0.195, and cassava yield had an inverse relationship with rainfall with a correlation coefficient of 0.001, implying that an increase in rainfall led to increased and decreased yields of yam and cassava, respectively. The study concluded that variations in the amount of rainfall have a significant effect on the yield of tuber crops (yam and cassava) in the studied area.

Collectively, these studies underscore the significant impact of climate variability on agricultural productivity in

Nigeria. They highlight the challenges faced, including limited resources, inadequate information, and policy constraints. Addressing these challenges requires comprehensive policy interventions, capacity building, and the provision of necessary resources to enhance the resilience of farming communities to climate variability.

3. METHODOLOGY

3.1 Method of Data Collection

Data was collected through the following methods:

a) Primary Data:

Semi-Structured Interviews: Individual interviews were conducted with farmers, policymakers, and agricultural extension officers to gain insights into their perceptions of climate variability. Also, numerical data was collected to identify patterns, correlations, and trends in agricultural productivity in relation to climate variability. This was achieved through the following: **Survey Questionnaires:** Copies of structured surveys were administered to a representative sample of farmers, gathering data on crop yields and income levels.

b) Secondary Data:

Meteorological records from relevant agencies (Nasarawa State University Weather Stations) and

agricultural reports, policy documents, and previous studies were obtained and used for the study.

3.2 Sample Size

The sample size was determined using the Yamane formula based on the farmers' record that was obtained from the Nasarawa State Ministry of Agriculture. A minimum of 600 respondents from the thirteen (13) local governments were targeted to ensure statistical significance and avoid bias.

4.3 Analytical Techniques

Descriptive statistics (Likert scale of measurement) were carried out to assess the impact of climate variability on agricultural productivity.

Regression analysis was done to determine the relationship between climate variables and agricultural productivity.

4. RESULTS AND DISCUSSIONS

Understanding the specific impacts of climate variability on agricultural productivity is critical to creating targeted policies and strategies to enhance resilience and promote sustainable agricultural practices in Nasarawa State. By investigating this relationship, the study can provide valuable insights for policymakers, farmers, and stakeholders to adapt to climate variability and mitigate its negative effects on agriculture.

Table 5.1: Impact of Climate Variability on Agricultural Productivity

Climate Factor	No Impact (1)	Low Impact (2)	Moderate Impact (3)	High Impact (4)	Total Responses (%)
Temperature Increase	12%	18%	35%	35%	600 (100)
Erratic Rainfall Patterns	10%	22%	40%	28%	600 (100)
Soil Degradation	8%	25%	39%	28%	600 (100)
Pests and Diseases	15%	20%	40%	25%	600 (100)
Access to Farming Inputs	7%	15%	38%	40%	600

The result on table 5.1 shows that a significant proportion of respondents (35%) believed that rising temperatures have a high impact on agricultural productivity in Nasarawa State. This is consistent with findings by Schlenker and Roberts (2009), who argued that temperature increases reduce crop yields, particularly in regions like sub-Saharan Africa, where farmers are highly dependent on rainfed agriculture.

Most respondents (40%) feel that erratic rainfall patterns have a moderate impact on agricultural productivity. This is consistent with Challinor et al. (2014), who highlighted that changing rainfall patterns disrupt the growing season, making it difficult for farmers to predict the best times for planting and harvesting crops.

Respondents perceive soil degradation to have a moderate impact (39%) on agricultural productivity. FAO (2020) suggests that soil erosion, loss of soil fertility, and

desertification are increasing because of climate variability, leading to reduced agricultural output in many regions.

A large percentage (40%) of respondents recognised that pests and diseases, which are exacerbated by changing temperatures and rainfall, moderately affect agricultural productivity. The prevalence of pests and diseases is a common challenge noted in agricultural studies, as Müller et al. (2014) pointed out the increased vulnerability of crops to pests in a changing climate.

A significant portion of respondents (40%) indicated that access to farming inputs (such as seeds, fertilisers, and tools) has a high impact on agricultural productivity. This points to the need for improved infrastructure and policy interventions, as Ecker et al. (2012) argue that access to such resources is essential for climate adaptation in agriculture.

Table 5.2: Regression Analysis of Impact of Climate Variability Factors on Agricultural Productivity

Variable	Coefficient (β)	Standard Error	tvalue	pvalue
Intercept	2.50	0.15	16.67	<0.001
Temperature Increase	0.35	0.10	3.50	<0.001
Erratic Rainfall	0.45	0.12	3.75	<0.001
Soil Degradation	0.30	0.08	3.75	<0.001
Pests and Diseases	0.40	0.11	3.64	<0.001
Access to Farming Inputs	0.50	0.14	3.57	<0.001

Source: Author's Construct, 2024

The regression analysis in Table 5.2 shows that temperature increase ($\beta = 0.35$, $p < 0.001$) with a negative coefficient of 0.35 suggests that as temperatures increase, agricultural productivity decreases. This is in line with research by Schlenker and Roberts (2009), who demonstrated that temperature rises directly reduce crop yields, especially in developing regions.

The coefficient of erratic rainfall ($\beta = 0.45$) shows a negative impact on agricultural productivity which is statistically significant (p value < 0.001). This confirms the findings of Challinor et al. (2014), who found that unpredictable rainfall patterns disrupt planting and harvesting schedules, leading to reduced agricultural productivity.

The coefficient for soil degradation ($\beta = 0.30$) shows that soil degradation significantly impacts productivity, which is statistically significant (p value < 0.001). This supports the findings of FAO (2020), who warned that soil erosion and nutrient depletion result in declining agricultural yields over time. Farmers cope with changing rainfall patterns. Challinor et al. (2014) underscore the importance of such adaptations in reducing climate vulnerability in agriculture. Soil degradation ($\beta = 0.30$, $p < 0.001$) is already affecting agricultural productivity, suggesting the need for sustainable land management. Encouraging practices like crop rotation, agroforestry, and organic farming can help restore soil health and maintain long-term productivity, as noted by FAO (2020).

Pests and diseases ($\beta = 0.40$, $p < 0.001$) have a negative impact on agricultural productivity. This is consistent with Müller et al. (2014), who reported that changing climatic conditions create more favourable environments for pests, which adversely affect crop yields. As pests and diseases are exacerbated by climate variability, strengthening pest control programmes and developing resistant crop varieties are essential steps to

mitigate these impacts, in line with the recommendations of Müller et al. (2014).

The positive coefficient of access to farming inputs ($\beta = 0.50$, $p < 0.001$) suggests that improved access to seeds, fertilisers, and farming equipment can increase agricultural productivity. This aligns with Ecker et al. (2012), who emphasised the importance of improving access to agricultural resources to support adaptation to climate variability.

The negative effect of rising temperatures on agricultural productivity is a major concern. Efforts to increase climate resilience, such as the adoption of heat-resistant crops and efficient irrigation systems, could mitigate some of these negative effects. Schlenker and Roberts (2009) found that temperature increases reduce yields, making these adaptive strategies crucial in Nasarawa State.

Since erratic rainfall is seen as a significant factor influencing agricultural productivity, improving water management strategies like rainwater harvesting and efficient irrigation systems can help improve farmers' access to agricultural inputs, especially for smallholder farmers; this is critical to boosting productivity in the face of climate challenges. Ecker et al. (2012) highlight that increasing input access is key to building agricultural resilience.

The findings of this study suggest that climate variability has a significant impact on agricultural productivity in Nasarawa State, Nigeria. By focusing on improving agricultural resilience through better climate adaptation practices, access to inputs, and sustainable land management, Nasarawa State can reduce the negative impacts of climate variability on food security. Implementing these strategies will help protect agricultural productivity and ensure food security for vulnerable populations in the state.

Table 5.3: Strategies of Mitigating Effects of Climate Variability

Main Adaptive Strategy	Frequency (N = 600)	Percentage
Changing crop varieties	150	25
Altering planting/harvesting seasons	120	20
Water conservation methods	100	16.67
Diversification of livelihoods	120	20
Soil conservation practices	110	18.33

Table 4.7 shows that the most common adaptive strategy is changing crop varieties (25%). This suggests that farmers are increasingly relying on drought-resistant and climate-tolerant crops to cope with changing environmental conditions. The finding that changing crop varieties is the most common adaptive strategy adopted by 25% of respondents in Nasarawa State is highly significant, reflecting a broader global trend of farmers adapting to climate variability through the use of climate-resilient crop varieties. This suggests that farmers are responding to the growing uncertainties in climate patterns such as prolonged droughts, irregular rainfall, and extreme weather events by shifting to crops that can withstand these challenges more effectively. A study by Nchanji (2020) notes that climate-smart agriculture, which includes the use of drought-resistant varieties, is an essential approach for mitigating the impacts of climate variability in Africa. In regions like Nasarawa State, adopting drought-tolerant crop varieties allows farmers to adapt to increased temperature and variability in rainfall patterns. Also, Madu and Igwe (2021) also emphasise that the diversification of crop varieties and shifting towards more resilient crops are among the most widely adopted adaptation strategies in West Africa. Furthermore, FAO (2020) highlights that the introduction of climate-resilient crops is a core strategy in sustainable agriculture. In their report, the FAO points out that these crops are a primary means of adaptation, especially in arid and semiarid regions like Nasarawa State, where water scarcity is a significant concern. More so, Olorunfemi (2022) argues that the improved seed varieties tailored to local climatic conditions are one of the most effective tools for adapting to climate variability.

The finding that 25% of farmers in Nasarawa State are adopting changing crop varieties as their primary adaptive strategy highlights the significance of crop diversification in response to climate variability.

Diversification of livelihoods and altering planting seasons are reported by 20%, each of which indicates that farmers are not solely relying on agriculture but also exploring other sources of income, likely due to the uncertainty brought by climate variability. The finding that 20% of farmers in Nasarawa State are adopting livelihood diversification and altering planting seasons as adaptive strategies to mitigate the effects of climate variability suggests that farmers are increasingly seeking to spread

their risk and reduce their dependency on agriculture alone due to the growing unpredictability and challenges brought about by climate variability.

The diversification of livelihoods suggests that farmers are not relying solely on crop production but are spreading their economic risks by engaging in other sources of income. This economic resilience is particularly critical in the face of climate variability, where agriculture alone can no longer guarantee stable returns (Madu & Igwe, 2021). By engaging in nonfarming activities, farmers are less likely to suffer catastrophic income losses during poor agricultural seasons.

The 20% of respondents who are altering their planting seasons are reacting to climate unpredictability by adjusting their farming activities. This suggests that climate variability is forcing farmers into short-term adaptive strategies, rather than long-term planning. Such frequent adjustments can lead to instability in yields, as farmers may not have access to reliable weather forecasts or information to guide their decisions effectively (Olorunfemi, 2022).

Water conservation methods and soil conservation practices show relatively moderate adoption by 16.67% and 18.33% of the respondents. This suggests that while these practices are known, they may not be as widely adopted due to cost, complexity, or insufficient The findings of moderate adoption rates for water conservation methods (16.67%) and soil conservation practices (18.33%) suggest a gap between awareness and implementation, which could have significant implications for agricultural sustainability and resource management. Several factors could contribute to these relatively low adoption rates, including cost, complexity, and insufficient knowledge.

In conclusion, climate variability has a multifaceted impact on agricultural productivity in Nasarawa State, primarily through variations in temperature, rainfall patterns, and the occurrence of extreme weather events. These changes have led to reduced crop yields, economic losses, and heightened vulnerability for farmers, exacerbating food insecurity in the region. The findings of this review underscore the importance of developing climate-smart agricultural practices and strategies to mitigate the adverse impacts of climate variability on agricultural productivity.

Recommendations

Based on the findings of this study, the following recommendations were made:

- ❖ The government should create climate-resilient crop varieties and improve agricultural technologies suited to local conditions to establish robust early warning systems for weather events for farmers to plan effectively and reduce risks associated with floods, droughts, and other extreme weather phenomena.
- ❖ NGOs and development partners play a pivotal role in bridging gaps between policy and practice. They should focus on capacity-building initiatives, offering training programmes on climate-smart farming, improved irrigation, pest management, and sustainable land use.
- ❖ It is crucial that farmers should embrace climate-smart agricultural practices, such as crop rotation, intercropping, and water conservation techniques like rainwater harvesting and soil conservation methods.
- ❖ There should be continuous monitoring and evaluation of climate adaptation programmes, which will help ensure their effectiveness and allow for adjustments based on feedback and evolving needs.

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