# EFFECTS OF CLIMATE CHANGE ON CROP PRODUCTION IN NIGERIA

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**Abstract**
*Climate change has emerged as one of the most significant challenges to sustainable agricultural production globally, with pronounced effects on crop productivity. This study examines the major factors influencing climate change and their direct and indirect impacts on crop production. Key factors explored include temperature rise and heat stress, rainfall variability and drought, extreme weather events, pests and disease outbreaks, and soil degradation. The analysis highlights how these elements disrupt photosynthesis, alter growing seasons, affect water availability, damage farm infrastructure, reduce soil fertility, and increase crop vulnerability to pests and diseases. The implications for food security are profound, as climate change threatens both national and local food supply, posing risks to economic stability and livelihoods. The study concludes by emphasizing the urgency of adopting climate-resilient farming practices, strengthening early warning systems, and promoting sustainable land and water management strategies to mitigate the adverse effects of climate change on agriculture. The study recommended that farmers should be encouraged to adopt drought-resistant and early-manuring crop varieties, crop rotation and intercropping to enhance productivity despite changing climate conditions. The study further recommended that agricultural extension services that provide farmers with timely and relevant weather forecast should be established and strengthened to aid decision making.*

**Keywords**: Climate change, crop production, temperature rise, rainfall variability, food security, soil degradation.

## Introduction

Climate change has emerged as one of the most critical challenges to global agricultural systems, influencing crop productivity through changes in temperature, rainfall patterns, and the frequency of extreme weather events. Its impacts are particularly pronounced in developing countries like Nigeria, where agriculture is largely rain-fed and highly sensitive to climatic variability. According to Alehile et. al., (2025), climate change is a phenomenon arising from human activities that leads to increased temperatures and irregular rainfall patterns, posing a significant threat to food security. The resulting shifts in weather conditions affect planting seasons, crop yields, and food availability, thereby posing threats to food security and rural livelihoods. Understanding the specific factors influencing climate change's impact on crop production is therefore essential for sustainable agricultural planning in Nigeria. This provides the basis for exploring the interplay between climate variability and crop performance.

Climate variability manifests through unpredictable rainfall patterns, prolonged droughts, and heat stress, all of which directly affect crop growth and

productivity (Giweze, et al., 2024). These changes not only reduce the yield of staple crops such as yam, cassava, and maize but also exacerbate soil degradation and pest outbreaks. With most rural farmers relying on traditional farming methods, limited access to irrigation, and minimal climate adaptation technologies, the vulnerability of the agricultural sector is heightened. This situation calls for a deeper examination of the agricultural systems' adaptive capacity in the face of ongoing climatic shifts.

Climate shifts often disrupt traditional farming practices, alter growing seasons and affects agricultural productivity. These shifts observed specific changes in local or regional weather patterns that are widely as a broader phenomenon of climate change. The implications of climate change on agriculture extend beyond yield reductions to include land degradation, biodiversity loss, and reduced soil fertility. Omokaro, 2025 revealed that environmental degradation, often worsened by unsustainable farming practices, interacts with climate change to intensify production constraints. As a result, crop production systems in Nigeria face multi-dimensional threats that require integrated and sustainable management approaches. This makes it necessary to consider both environmental and socio-economic factors when discussing climate change impacts on agriculture.

Environmental factors refer to the external physical, chemical, and biological conditions or influences that affect the growth, development, and survival of living organisms, as well as the functioning of ecosystems. According to Alehile, et al., (2025), environmental factors influence climate change by extension, crop production. Accordingly, changes in environmental quality driven by human activities such as deforestation, overgrazing, land degradation, and unsustainable agricultural practices significantly alter local and regional climatic conditions. These activities increase greenhouse gas emissions, disrupt the natural carbon cycle, and reduce vegetation cover, leading to higher surface temperatures and shifts in rainfall patterns. Environmental degradation results in reduced soil fertility, altered hydrological cycles, and increased vulnerability to droughts and floods. For instance, deforestation for agricultural expansion not only eliminates carbon sinks but also exposes soils to erosion, while pollution from industrial and agricultural sources can affect water and air quality essential for healthy crop growth. These environmental changes are often driven by socio-economic factors such as population growth, demand for increased food production, poverty, and the pursuit of economic gains through commercial farming or industrial development. In view of this, farmers in developing countries experiencing environmental degradation are compelled to prioritize survival strategies in order to sustain their livelihood.

Farmers especially in developing regions may prioritize short-term economic survival over long-term environmental sustainability, creating a cycle where environmental degradation and socio-economic pressures reinforce each other. According to Anyoha et al. (2013), socio-economic factors such as farmers' income level, access to credit, educational background, farming experience, and household size significantly influence how farmers perceive and respond to climate change in crop production. These factors determine the capacity of farmers to

adopt adaptive strategies, invest in resilient practices, and mitigate the adverse impacts of changing climatic conditions.

Given these challenges, researchers have increasingly emphasized sustainable and climate-smart agricultural practices as critical responses to these threats (Muoghalu & Akanwa, 2021). Practices such as ecological intensification, biological farming, and the adoption of resilient crop varieties have the potential to reduce the vulnerability of farming systems while maintaining or even improving productivity. However, the adoption of these innovations depends on policy support, farmer education, and investment in agricultural research. This understanding creates a logical foundation for examining the key factors that shape the influence of climate change on crop production.

## Concept of Climate Change

Climate change refers to long-term shifts in temperatures and weather patterns, primarily caused by natural processes and increasingly by human activities such as the burning of fossil fuels, deforestation, and intensive agricultural practices. These activities increase the concentration of greenhouse gases (GHGs) in the atmosphere, leading to global warming and altering climatic systems (Alehile, Salami, & Otohinoyi, 2025). The Intergovernmental Panel on Climate Change (IPCC, 2021) defines climate change as a statistically significant variation in the mean state of the climate or its variability that persists for an extended period, typically decades or longer. In Nigeria, climate change has manifested through rising average temperatures, unpredictable rainfall patterns, prolonged droughts, and increased incidences of extreme weather events, all of which have implications for agriculture and rural livelihoods. According to Alehile *et* al. (2025), climate change in Nigeria is not only a scientific reality but also a socio-economic challenge, as it directly affects food security, water resources, and public health.

Climate change is interconnected with environmental degradation and biodiversity loss. Unsustainable land use, overgrazing, and urban expansion have exacerbated the vulnerability of ecosystems to climate variability (Reynolds *et* al., 2015). In agricultural zones, particularly in sub-Saharan Africa, the impact of climate change is amplified by limited access to adaptive technologies and inadequate policy frameworks to support farmers in mitigation and adaptation strategies. Understanding the concept of climate change goes beyond identifying its physical manifestations; it requires recognizing its socio-economic consequences, policy implications, and the urgent need for coordinated global and local actions to address its causes and mitigate its impacts.

## Climate Change and Agricultural Systems

### Relationship Between Climate and Crop Growth Cycles

Climate is a fundamental determinant of agricultural productivity because it influences every stage of a crop's growth cycle from germination to harvest. Temperature, rainfall patterns, humidity, and solar radiation collectively dictate plant physiological processes such as photosynthesis, nutrient uptake, and flowering (Reynolds *et* al., 2015). Changes in climatic parameters can alter planting seasons, shorten or lengthen maturation periods, and affect yield quality and quantity. For instance, an

increase in temperature may accelerate crop maturity but reduce grain filling time, thereby lowering yields. Alehile, et al (2025) further noted that shifts in rainfall distribution and the occurrence of prolonged dry spells can disrupt traditional cropping calendars, forcing farmers to adapt through changes in planting dates or crop varieties.

**Vulnerability of Agriculture to Climate Variability**

Agricultural systems, particularly in developing countries like Nigeria, are highly vulnerable to climate variability due to their dependence on rain-fed farming and limited adaptive capacity. Variability in rainfall, temperature extremes, and increased frequency of extreme weather events such as floods and droughts significantly threaten food production (Ayanlade et al., 2023). Smallholder farmers, who form the backbone of Nigeria's agricultural sector, often lack access to irrigation, climate information services, and financial resources, making them disproportionately affected. Climate variability interacts with other stressors such as soil degradation, pest outbreaks, and market instability, compounding the challenges faced by farmers.

**Importance of Climate-Resilient Farming**

Building climate-resilient agricultural systems is essential to sustaining crop production under changing climatic conditions. Climate-resilient farming involves adopting practices, technologies, and crop varieties that can withstand climatic shocks and variability (Alehile et al., 2025). This includes strategies such as conservation agriculture, improved irrigation systems, integrated pest management, and the use of drought-tolerant or heat-resistant crops. Ayanlade et al. (2023) argue that combining traditional knowledge with modern innovations, including precision agriculture and climate forecasting tools, can enhance farmers' adaptive capacity. Resilient systems not only help maintain productivity but also contribute to food security, income stability, and environmental sustainability.

**Factors Influencing Climate Change and Their Effects on Crop Production**

**1. Temperature Rise and Heat Stress**

One of the most prominent consequences of climate change is the steady rise in average global temperatures, which has profound implications for crop production. Increased temperatures can impair photosynthesis by causing stomatal closure in plants, reducing carbon dioxide uptake, and ultimately lowering yields (Alehile, Salami, & Otohinoyi, 2025). Heat stress also affects pollination, as high temperatures can cause pollen sterility, particularly in crops such as maize, rice, and wheat (Reynolds, Waddington, & Braun, 2019). Additionally, prolonged periods of high temperatures alter growing seasons, often shortening crop maturity periods and leading to mismatches between crop phenology and favorable climatic windows.

**2. Rainfall Variability and Drought**

Rainfall variability manifested as unpredictable onset, duration, and intensity of rains has a direct impact on water availability for crops. Inadequate rainfall or prolonged droughts can lead to significant moisture deficits, which impair plant growth and reduce yields (Alehile et al., 2025). Such variability also disrupts

planting schedules, as farmers can no longer rely on traditional seasonal patterns, leading to delayed planting and poor germination. In extreme cases, drought shortens the growth period, making it difficult for crops to reach maturity before water stress sets in.

### 3. Extreme Weather Events

The frequency and intensity of extreme weather events such as floods, storms, and heatwaves have increased under climate change conditions. According to Alehile et al., (2025), these events cause immediate and severe damage to farmlands, destroying crops and infrastructure. Floods, for example, result in loss of soil fertility through erosion and nutrient leaching, while storms can physically damage crops and disrupt harvests.

### 4. Pests and Disease Outbreaks

Rising temperatures and altered rainfall patterns have facilitated changes in pest migration patterns and extended breeding seasons for many agricultural pests. This has led to increased crop vulnerability to pests such as fall armyworm and locusts (Alehile et al., 2025). Similarly, warmer and more humid conditions favour the spread of fungal and bacterial diseases, which can devastate yields if left unmanaged.

### 5. Soil Degradation and Desertification

Climate change contributes significantly to soil degradation, reducing its fertility through processes such as erosion, salinization, and organic matter depletion. Extreme heat and reduced vegetation cover increase desertification risk, particularly in semi-arid regions. These changes are often linked to climate-induced land use changes, where degraded farmlands are abandoned, forcing agricultural expansion into marginal lands with lower productivity (Alehile et al., 2025).

### Implications for Food Security – Threats to National and Local Food Supply

Climate change poses significant risks to food security at both national and local levels, particularly in agrarian economies like Nigeria where agriculture is a major source of livelihood and food production. Food security, as defined by the FAO, entails having consistent physical, social, and economic access to sufficient, safe, and nutritious food to meet dietary needs and preferences for an active and healthy life. However, climate-induced disruptions in agricultural systems threaten all four dimensions of food security availability, access, utilization, and stability. At the national level, climate change affects food availability through its influence on crop yields, harvest quality, and production stability. Rising temperatures and erratic rainfall patterns shorten the growing seasons, reduce photosynthetic efficiency, and contribute to increased pest and disease outbreaks, thereby lowering the total output of staple crops such as maize, rice, and cassava (Alehile, Salami & Otohinoyi, 2025). Additionally, recurrent droughts and floods disrupt large-scale farming, leading to fluctuations in supply that can cause food price inflation and reduce affordability for vulnerable populations.

At the local level, smallholder farmers who dominate rural agricultural production are particularly at risk. Rain-fed farming, which is highly dependent on predictable seasonal patterns, is becoming increasingly unreliable due to shifting rainfall onset and cessation. This unpredictability reduces the ability of rural households to plan planting and

harvesting schedules effectively, resulting in lower yields and food shortages within the community (Reynolds et al., 2015). Moreover, post-harvest losses often increase when extreme weather events damage storage facilities and transportation infrastructure, further undermining local food availability.

The combined impact of reduced production, higher post-harvest losses, and increased production costs threatens not only the quantity but also the nutritional quality of food available in both rural and urban markets. As Sabo et al. (2023) emphasize, climate-induced declines in food supply have long-term implications for public health, economic stability, and social cohesion, potentially increasing the risk of malnutrition, poverty, and migration pressures. Climate change directly undermines food security by disrupting crop production, destabilizing food markets, and limiting both physical and economic access to food. Without climate-resilient agricultural policies and adaptive strategies, the national and local food supply will remain highly vulnerable to climate variability.

## Conclusion

Climate change is increasingly shaping the future of agricultural productivity, with significant implications for farmers and society at large. Changes in temperature, rainfall patterns, extreme weather events, pest outbreaks, and soil degradation have disrupted crop growth cycles, altered planting and harvesting periods, and reduced overall yields. These impacts threaten farmers' livelihoods, especially in rural areas, and pose serious risks to food security. Addressing these challenges requires the adoption of climate-resilient farming practices, improved irrigation systems, sustainable soil management, and the use of accurate weather forecasting in agricultural planning. Without timely and coordinated action, the effects of climate change will continue to intensify, deepening hunger, poverty, and economic instability. Building a more sustainable and resilient agricultural system is therefore essential for safeguarding future food production.

## Recommendations

The following recommendations were made

1. Farmers should be encouraged to adopt drought-resistant and early-maturing crop varieties, conservation agriculture, crop rotation, and intercropping systems to enhance productivity despite changing climatic conditions.
2. Government and agricultural agencies should invest in small-scale and large-scale irrigation systems to reduce dependence on unpredictable rainfall and ensure year-round crop production.
3. Establish and strengthen agricultural extension services that provide farmers with timely and reliable weather forecasts, seasonal predictions, and early warning systems to aid decision-making.
4. Policymakers should develop and enforce policies that support climate change adaptation in agriculture, including subsidies for climate-smart inputs, access to credit facilities, and incentives for sustainable farming methods.

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