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Impact of Climate Change on Agricultural Crop Production in Nigeria: A Reality or Fallacy?

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Abstract

Over time, climate change has significantly affected agricultural crop production, leading to food shortages in some regions of the world. Consequently, international organizations like the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) urge nations to adopt measures that mitigate the impact of climate change, supporting Sustainable Development Goal 2: ending hunger by 2030. This study investigates whether the impact of climate change on agricultural crop production in Nigeria is a reality or fallacy. Using historical data from 1960 to 2022, the study employed time series analysis to examine trends and correlation analysis to assess the relationship between climate change and crop production. Findings reveal that temperature changes significantly impact the production of rice, green corn, fresh cassava, wheat, and sorghum in Nigeria, while there is no significant relationship with millet production. Additionally, results indicate a positive relationship between adequate precipitation and crop production in Nigeria. The study concludes that climate change does indeed impact agricultural crop production in Nigeria, meaning potential risk for food security if left unaddressed. It recommends among other actions, that the Ministry of Agriculture prioritize increasing crop yields by educating rural farmers on suitable crop varieties and cultivation practices aligned with climate trends.

Introduction

Climate change refers to long-term shifts in the average atmospheric conditions over periods ranging from decades to millions of years, impacting the physical environment, socioeconomic conditions, and human activities (World Health Organization, 2023). Globally, around 3.6 billion people already reside in regions highly vulnerable to climate change (IPCC, 2022). Agriculture, as a key sector for food production, is particularly affected by climate change, leading to food insecurity. Declining crop yields, especially in regions with high food insecurity, are expected to push more people into poverty. According to the World Bank (2022), climate change impacts crop yields and is capable of pushing 43 million people in Africa below the poverty line by 2030. In the Sahel region, where 65% of the population is engaged in agriculture, climate change has severely impacted livelihoods, leading to poverty, health challenges, compromised hygiene, and limited access to essential services (FAO, 2016).

The impacts of climate change are felt globally, influencing agricultural productivity and affecting farmers' livelihoods across continents. Studies in Europe, Asia, Middle East, and Africa, particularly Nigeria, have shown that climate change leads to reduced crop yields, lower farmer incomes, higher input costs, and broader impacts on farmers' livelihoods (Nastis et al., 2012; Ye et al., 2013; Sambo & Sule, 2023; Kolapo & Kolapo, 2023). Rising sea levels increase vulnerability to flooding and waterborne diseases, threatening agriculture and livelihoods (USAID, 2023). High temperatures and irregular precipitation adversely affect the production of staple crops such as rice, maize, cassava, and millet. Numerous studies, particularly those of Rayamajhee et al. (2021), Asha et al. (2012), Apata (2010), Akinseye et al. (2020), and Chadalavada et al. (2021), have demonstrated that rising temperatures reduce crop yields, whereas adequate precipitation tends to support agricultural productivity.

To mitigate these impacts, farmers are adopting various adaptive strategies. Researchers recommend climate-resilient practices such as planting drought-tolerant crops, optimizing planting schedules, diversifying crop types, growing early-maturing varieties, and utilizing irrigation systems (Gebre et al., 2023; Grados et al., 2024). Chadalavada et al. (2021) suggest planting climate-tolerant crops like sorghum, while

Shoukat et al. (2024) emphasize adjusting planting times, optimizing irrigation, and efficient nitrogen use for wheat production as ways to adapt to climate change.

The evidence indicates that climate change affects agricultural productivity worldwide, necessitating urgent and proactive measures to sustain food security. The present study therefore examines whether climate change impacts crop yield in Nigeria or if such impacts are overstated. The study relies on Nigerian climate change data and crop production yield from the years 1960-2022, which were sourced from the World Bank for the investigation. The main contributions to the present study are as follows:

- The study used Python-based data utilization techniques to show the trends of climate change and stable crops from 1960 to 2022.
- Correlation analysis was used to demonstrate the relationship between climate change and staple crop production.
- The study provides policy recommendations that offer insights on increasing crop production in Nigeria. Outcomes from this study may be extended to other countries facing similar threats from climate change.

LITERATURE REVIEW

Theoretical review

Many theories have been theorized by academicians to describe the impact of climate change and one theory which serve as an underpin to the present study is vulnerability theory. The American feminist scholar Professor Martha Albertson Fineman introduced the concept of vulnerability in 2008 (Fineman, 2008). Vulnerability is defined as "the state or possibility of being attacked or harmed, either physically or emotionally." Fineman's vulnerability model asserts that vulnerability is a constant and universal aspect of the human condition. According to Fineman, everyone is inevitably prone to harm and injury, whether through minor setbacks or catastrophic events. Gordon-Bouvier expanded on this concept in 2020, emphasizing its importance in understanding human resilience and social responsibility. In the context of this study, high temperatures and lack of rainfall negatively impact crop production, leading to food insecurity due to reduced crop yields. Studies by Roy et al. (2024) and Das et al. (2024) emphasize that climate change affects not only agricultural output but also the livelihoods of farmers, intensifying economic and social vulnerabilities within farming communities.

The risk society theory also provides a theoretical foundation for this study. Developed by Ulrich Beck in 1986 (Chouraqui, 2016), this theory posits that the organizational structures of modern societies are increasingly shaped by concerns over emerging risks, such as those posed by climate change (Beck, 1992). Consequently, a systematic approach is needed to manage the instabilities and threats associated with climate change. For farmers, climate change presents a substantial risk that, if unmanaged, can result in reduced agricultural yields. Empirical studies by Thapa and Dhakal (2024) and Shoukat et al. (2024) show that farmers employ various strategies, including irrigation systems and optimized planting schedules, to mitigate climate-related risks. Through these adaptive strategies, farmers are able to maintain sufficient crop production despite environmental challenges.

Theory of resilience is another theory which serves as underpin to the present investigation. The theory was introduced by Norman Garmezy and Michael Rutter in 1970 (McAslan, 2014). The resilience theory examines how systems can absorb shocks and adapt to changes, such as climate events, without collapsing. In the context of climate change impacts on agricultural production implies that farmers face serious problems on crop yield thereby seeking for alternative measures to improve their livelihoods.

Assessing the impact of climate change on agricultural production

A plethora of studies have been conducted to determine the impact of climate change on agricultural food production. Studies have indicated that temperature or precipitation patterns impact crop yields. For instance, Rayamajhee et al. (2021) studies highlighted the vulnerability of rural agricultural households in Nepal to climate change. Employing the stochastic frontier function approach, their findings underscored the significant negative effects on rice production resulting from alterations in both average and extreme precipitation and temperatures. However, the study placed emphasis on threats posed by irregular extreme rainfall patterns and a sustained rise in average temperatures.

In a study, Asha et al. (2012) reported yield declines for crops like sorghum, maize, and cotton in Karnataka's rainfed regions, with small-scale farmers heavily affected by reduced rainfall. This reduction in crop yield may have a negative impact on farmers' income from the farm, thereby preventing the farmer's ability to purchase farm input for subsequent farming periods. This was corroborated by Kar & Kar (2008) studies, which found that inconsistent rainfall in Orissa lowered poor farmers' incomes, suggesting that irrigation investments could mitigate revenue loss.

In another study, Massagony et al. (2023) applied the feasible generalized least squares (FGLS) model to examine the effects of climate change on rice production in Indonesia using historical data from 1986 to 2016. Their results revealed that increases in temperature and precipitation have an adverse impact on rice production, whereas higher relative humidity has a positive impact. This outcome was inconsonant with the work of Nastis et al. (2012) in Greece, who used a 28-year climate and agricultural input dataset to study climate change's economic impacts on agriculture. They reported that rising temperatures had already reduced agricultural productivity, with a negative temperature elasticity of -0.77, while increased rainfall showed a positive productivity elasticity of 0.20.

Akinseye et al. (2020) conducted a study to improve sorghum productivity under changing climatic conditions in West Africa. Using the Agricultural Production Systems Simulator (APSIM), they assessed how climate change could impact early- and medium-maturing sorghum varieties under various management practices. The study utilizes data from Mali and Nigeria, which were used to calibrate and validate the model, with simulations for near-future (2010–2039) and mid-century (2040–2069) climate scenarios based on RCP 8.5 projections. Sensitivity analysis on key crop traits and different sowing dates helped evaluate adaptability. Results showed that early sowing dates enhanced yields for early-maturing sorghum, while July sowing was optimal for medium-maturing varieties, suggesting practical adaptation strategies for smallholder farmers in response to climate change.

Chadalavada et al. (2021) studied how sorghum mitigates climate variability and change on crop yield and quality. The study reviews the impact of climate change on sorghum, a climate-resilient crop, and explores sorghum's potential to mitigate food insecurity by improving yields and quality under stress conditions associated with climate change. Sorghum demonstrates resilience to various climate stressors, making it a suitable crop for arid and semi-arid regions. Also, heat, drought, and waterlogging negatively impact sorghum yield and quality, particularly in reproductive stages.

Apata (2010) analyzed the effects of climate change on Nigerian agriculture, with a focus on food production and adaptation strategies at the farm level. Using data from 850 respondents across six geopolitical zones, along with secondary sources, the study employed a multinomial logit model to examine adaptation determinants and a simulation model to assess food production and population growth under various climate scenarios (1971–2000). Findings indicate that climate change impacts agriculture unevenly across Nigeria: The Southern region benefits more from climate variability, while the Northern region faces adverse effects. The study highlights the need for region-specific adaptation measures to bolster agricultural resilience and ensure food security in the face of climate challenges. The work was in line with the Sambo & Sule (2023) study, which concluded that climate change has negative consequences on Lake Chad food security and agricultural productivity.

From the reviewed literature, most studies in Nigeria and outside focus on a particular region to examine the impact of climate change on agricultural production. These indicate that there is a gap, as the present study seeks to look at climate change impact on the agricultural production in Nigeria as a whole using historical data from 1960 to 2022.

METHODOLOGY

Research Design

This study employed a descriptive research design to investigate the impact of climate change on agricultural food production in Nigeria from 1960 to 2022. This approach is mostly used in climate-agriculture studies to examine long-term trends (Oluwatimilehin and Ayanlade, 2021; Ifeanyi-Obi et al., 2017). By analytically describing changes in temperature, precipitation, and crop yields over decades, this design allows robust and context-rich insights that are consistent with established research practices (Ojo and Baiyegunhi, 2020; Olayemi and Ogunkoya, 2020).

Data Sources

The present study relies exclusively on secondary data sources in order to guarantee accurate and comparable results. Nigerian climate variation data, such as annual mean temperature (°C) and annual precipitation (mm/h), were harvested from World Bank data and are organized such that they are in line with IPCC-recommended indicators for examining climate variation and changes. Also, the crop production, such as rice, green corn, fresh cassava, wheat, millet, and sorghum, is measured in tons and follows the FAO standards measurement indicator for crop production.

Data Preparation

The harvested data was organized into an annual time series format ranging from the year 1960 to 2022. Also, missing data were treated using linear interpolation where appropriate, while crop production was measured in tons.

Analytical Framework

The study utilized time-series analysis to detect the long-term effect of climate trends on agricultural production, while Pearson Correlation Analysis was used to measure the direction and the strengths of the relationship between climate change variables and crop production. The study adopts a 95% confidence level for testing the level of significance of the statistical reliability.

Analytical Tools

In order to examine the long-term trends of the effect of climate change on crop production, the study uses a Python-based data visualization approach. The harvested data was structured using the Pandas library, which allows tabular data to be efficiently handled and manipulated. The study uses matplotlib to generate multiple-axis line charts, which allows climate data to be visual simultaneously with the crop productions. Also, SPSS version 27 was used to test the study relationship.

RESULTS AND DISCUSSION

Analysis of the agricultural production and climate change pattern

Figure 1 presents the analysis of rice production and climate change patterns from 1960 to 2022. The average annual precipitation and temperature changes over this period were 33.27 mm/h and 27.15°C, respectively. Notably, rice production has shown an upward trend, reaching its peak in 2022 with a total production of 776,646,1456. However, decreases in rice production were observed in 1972 (yield of 307,289,867 tons), 1987 (461,438,818 tons), and 2002 (571,377,491 tons). During these years, temperatures ranged from 26.84°C to 27.38°C, and rainfall varied from 32.81 mm/h to 33.27 mm/h. This analysis suggests that rice production in Nigeria has generally increased, with climate conditions remaining within suitable thresholds (i.e., 20-30°C). The observed declines in certain years may be attributed to factors other than climate patterns. The overall increase in production could be linked to supportive government policies aimed at boosting agricultural output, particularly in rice farming. Additionally, the minimal rise in temperature and stable precipitation levels may contribute to the favorable conditions for rice production. These findings align with Massagony et al. (2023), who concluded that stable precipitation positively influences rice crop yields.

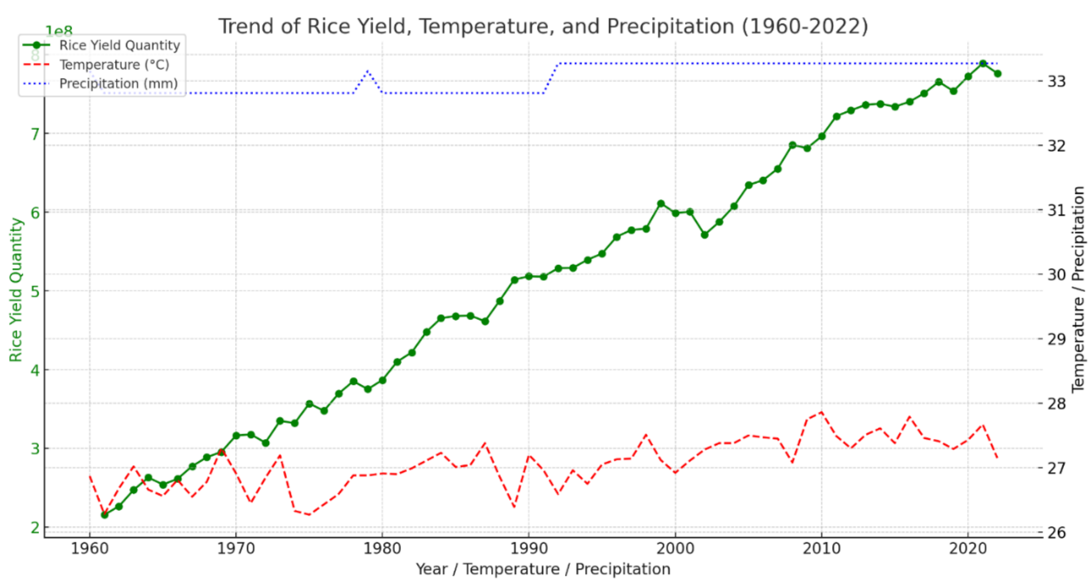

Figure 1: Climate change pattern on rice production (Sources: Authors survey, 2024).

Figure 2 presents the analysis of green corn production and climate change patterns from 1960 to 2022. The data reveal fluctuating trends in green corn production in Nigeria, with a notable example in 1962, where production was at 4,210,950 tons but decreased to 4,122,875 tons in 1963. These fluctuations continued through the years, with temperature and precipitation ranging from 26.84°C to 27.38°C and 32.81 mm/h to 33.27 mm/h, respectively. Green corn production peaked in 2015, reaching a total of 11,691,857.64 tons, during which the temperature was 27.38°C and precipitation was 33.27 mm/h. However, production began to decline in the years following 2015. Between 2015 and 2022, the temperature pattern ranged from 27.38°C to 27.79°C, surpassing the optimal threshold (18–24°C) for green corn growth. The study concludes that changes in temperature impact green corn production in Nigeria, with temperatures above the optimal range likely contributing to recent declines in yield.

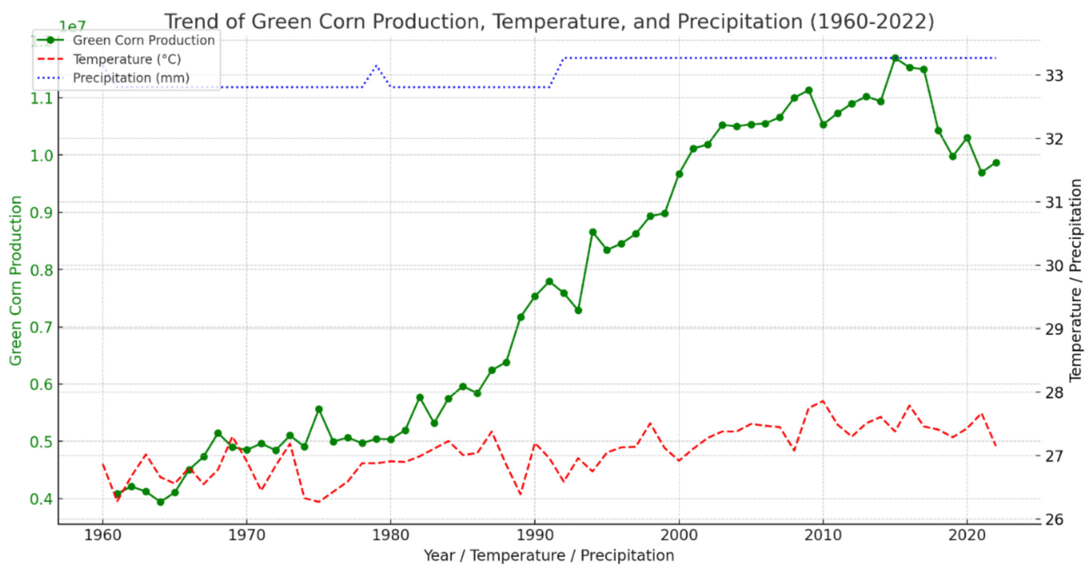

Figure 2: Green corn production and climate change pattern (Sources: Authors computation, 2024)

Figure 3 presents the analysis of fresh cassava production and climate change patterns from 1960 to 2022. Over this period, temperature and precipitation levels remained within the ranges of 26.28°C to 27.38°C and 33.15 mm/h to 33.27 mm/h, respectively. Fresh cassava production showed fluctuating trends, with the lowest production recorded in 1960 (7,384,000 tons) and the highest in 2018 (65,350,850 tons). During this time, temperature increases stayed within 26.28°C to 27.15°C, which falls within the suitable tolerance range (25°C–35°C) for cassava. This suggests that temperature changes alone do not account for the observed fluctuations in cassava production in Nigeria. Declines in production may instead be explained by other factors, such as increased banditry and a shift in farmer interest from cassava to other crops like rice.

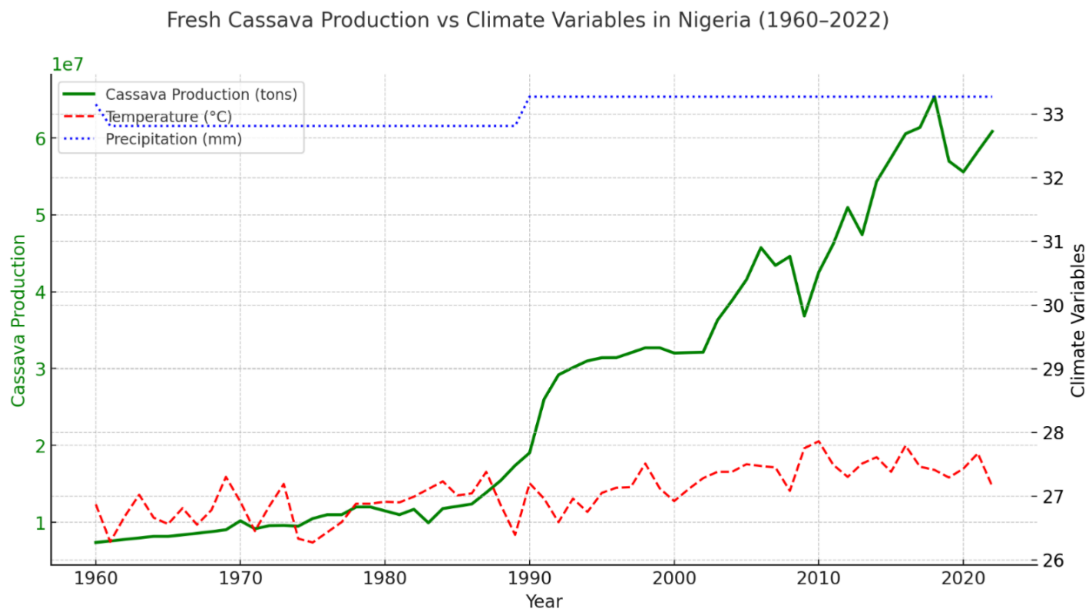

Figure 3: Fresh cassava production & climate change pattern (Sources: Authors computation, 2024)

Figure 4 shows the analysis of wheat production and climate change patterns from 1960 to 2022. The data show that wheat production in the first three years (1960-1962) was at 16,000 tons, increasing to between 16,000 and 20,000 tons from 1963 to 1965. During this period, temperature changes ranged from 26.56°C to 26.87°C, with a constant annual precipitation of 33.81 mm/h. In 1984, wheat production experienced a sharp increase, reaching a total of 113,000 tons. This upward trend continued until 1986, followed by a significant decline in 1987, when production dropped to 50,000 tons. Throughout this time, the temperature remained steady at 27.38°C, with annual precipitation still at 33.81 mm/h. The fluctuating trends in wheat production continued until 2022. When comparing temperature patterns with the decline in wheat production in Nigeria, it appears that climate change may be a contributing factor. Since wheat thrives best in temperatures between 15°C and 25°C, deviations from this optimal range could negatively impact production.

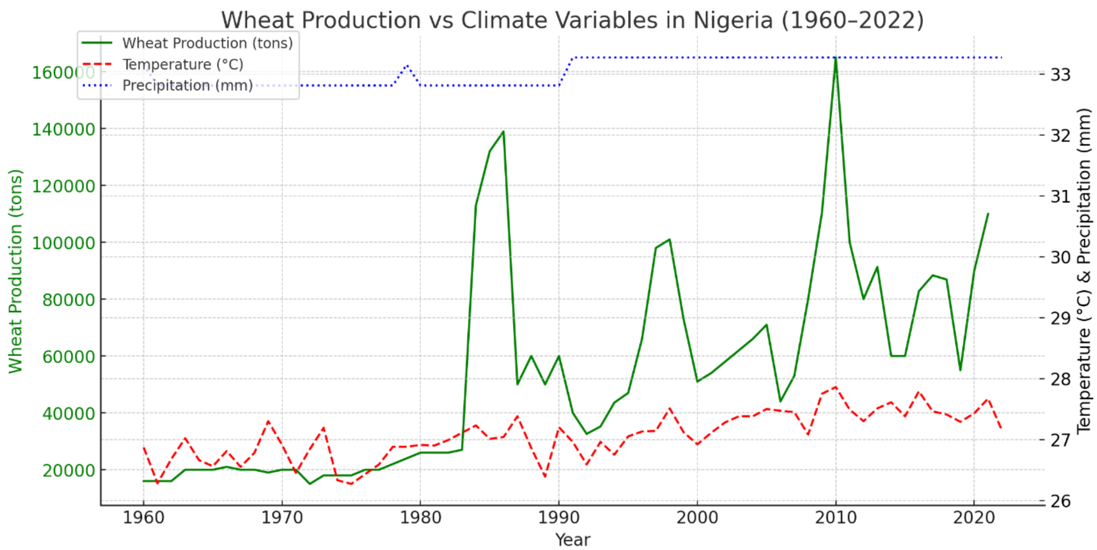

Figure 4: Wheat production and climate change pattern (Sources: Authors computation, 2024)

Figure 5 presents the analysis of millet production and climate change patterns from 1960 to 2022. The data indicates that millet production in Nigeria has fluctuated over the years, with a significant increase in 2018, reaching a total of 18,779,340 tons. During this same year, the annual temperature peaked at 27.41°C, accompanied by an annual precipitation of 33.27 mm/h. However, the following year saw a sharp decline in millet production, dropping to 1,925,075 tons. This downward trend in millet production continued, albeit at a less significant rate, from 2019 to 2021. A notable resurgence occurred in 2022, with production rising to 19,410,220 tons. Throughout this period, temperatures gradually increased from 27.29°C in 2019 to 27.67°C in 2021, while the annual temperature recorded in 2022 was 27.15°C. The findings suggest an intriguing relationship between temperature and millet production: despite rising temperatures, millet production was highest during a year when temperatures decreased. This indicates that increased temperatures may negatively impact millet production in Nigeria.

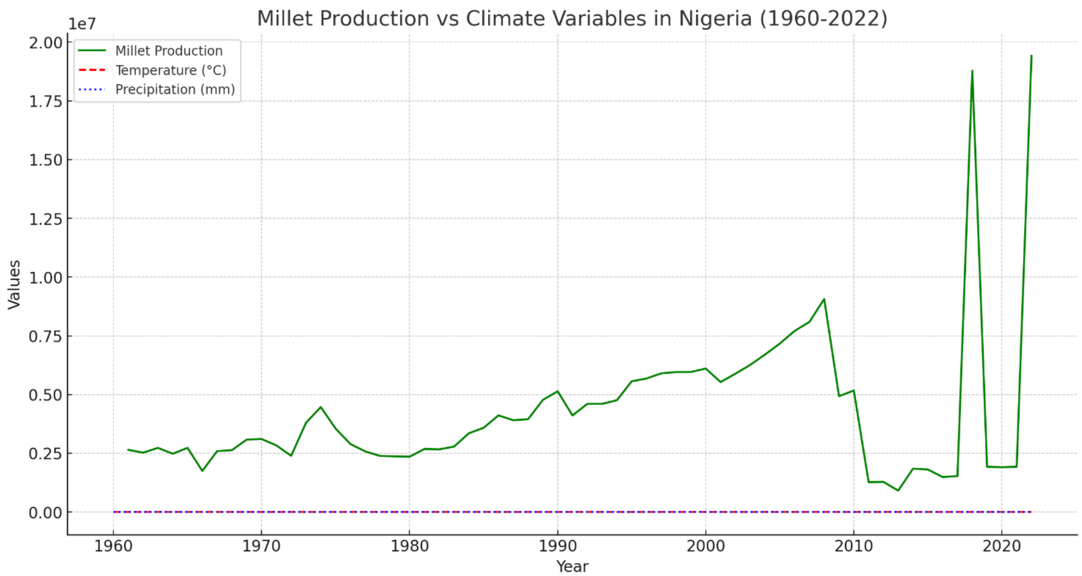

Figure 5: Millet production & climate change pattern (Sources: Authors computation, 2024)

Figure 6 presents the analysis of sorghum production and climate change patterns from 1960 to 2022. The data reveals that temperature changes during this period ranged from 26.28°C to 27.15°C, while precipitation varied between 32.81 mm/h and 33.27 mm/h. As shown in the figure, sorghum production in Nigeria has exhibited fluctuating trends, peaking in 2006 with a total output of 9,866,000 tons at a temperature of 27.47°C. The following year, production declined to 9,058,000 tons at a temperature of 27.45°C. In 2008, production experienced a slight recovery, reaching 9,318,000 tons at a temperature of 27.08°C, before a sharp drop in 2009, when production fell to 5,279,170 tons at a temperature of 27.75°C. These findings suggest that rising temperatures due to climate change negatively impact sorghum production in Nigeria. This aligns with the research conducted by Chadalavada et al. (2021), which indicates that while sorghum production is affected by climate change, the crop can withstand various climate stressors.

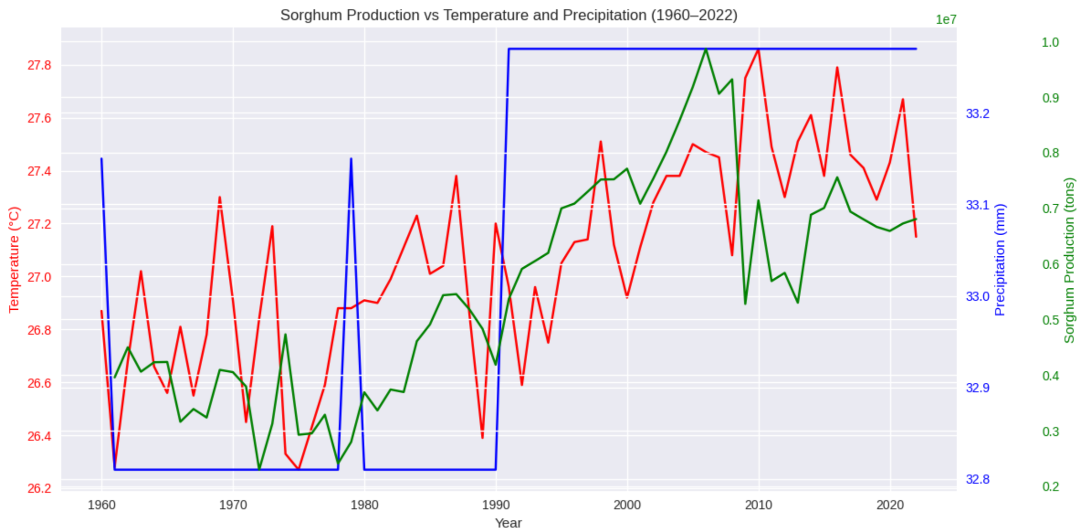

Figure 6: Sorghum production & climate change pattern (Sources: Authors computation, 2024)

Test of Hypothesis

The study two hypothesis are stated as follows;

H_{01} there is no statistically significant relationship between temperature change pattern and agricultural production.

H_{02} there is no statistically significant relationship between precipitation change pattern and agricultural production.

Analysis of the relationship between temperature change pattern and agricultural crop production

The first hypothesis examines the relationship between temperature change patterns and agricultural crop production, with results presented in Table 1. Analysis shows a strong positive correlation between temperature change patterns and the production of rice (.752), green corn (.749), fresh cassava (.715), wheat (.678), and sorghum (.606), all indicating a statistically significant relationship at confidence levels of .000 for each crop. Conversely, millet shows a weak positive correlation (.154) with temperature changes, indicating no statistically significant relationship at a confidence level of .232. These findings suggest that temperature change patterns are indeed related to crop production. Specifically, an increase in temperature tends to correlate with a decline in rice, green corn, fresh cassava, wheat, and sorghum production, while a decrease in temperature may positively impact these crops. This outcome aligns with the studies of Massagony et al. (2023) and Nastis et al. (2024), which report that rising temperatures negatively affect crop yields.

Table 1: Correlations

		Temperature	Rice	Green Corn	Fresh cassava	wheat	millet	Sorghum
temperature	Pearson Correlation	1	.752**	.749**	.715**	.678**	.154	.606**
	Sig. (2-tailed)		.000	.000	.000	.000	.232	.000
	N	63	62	62	63	62	62	62
Rice	Pearson Correlation	.752**	1	.950**	.949**	.703**	.342**	.759**
	Sig. (2-tailed)	.000		.000	.000	.000	.007	.000
	N	62	62	62	62	61	62	62
Green Corn	Pearson Correlation	.749**	.950**	1	.933**	.628**	.328**	.840**
	Sig. (2-tailed)	.000	.000		.000	.000	.009	.000
	N	62	62	62	62	61	62	62
Fresh cassava	Pearson Correlation	.715**	.949**	.933**	1	.584**	.361**	.762**
	Sig. (2-tailed)	.000	.000	.000		.000	.004	.000
	N	63	62	62	63	62	62	62
Wheat	Pearson Correlation	.678**	.703**	.628**	.584**	1	.214	.532**
	Sig. (2-tailed)	.000	.000	.000	.000		.098	.000
	N	62	61	61	62	62	61	61
Millet	Pearson Correlation	.154	.342**	.328**	.361**	.214	1	.459**
	Sig. (2-tailed)	.232	.007	.009	.004	.098		.000
	N	62	62	62	62	61	62	62
Sorghum	Pearson Correlation	.606**	.759**	.840**	.762**	.532**	.459**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	62	62	62	62	61	62	62

****. Correlation is significant at the 0.01 level (2-tailed).**

Sources: Authors computation (2024)

Analysis of the relationship between precipitation pattern and Agricultural food production

Table 2 presents an analysis of the relationship between climate change, specifically precipitation, and crop production in Nigeria. The data reveal strong positive correlations between precipitation and the production of rice (.847), green corn (.898), fresh cassava (.855), and sorghum (.818), all statistically significant at a level of .000. This suggests that precipitation is a strong predictor of these crops' yields in Nigeria, where increased rainfall positively influences their growth, while low precipitation negatively affects them. Conversely, the table shows a weaker positive correlation between precipitation and the production of wheat (.477) and millet (.360), both also significant at .000. This implies that precipitation alone does not serve as a reliable predictor for wheat and millet production in Nigeria.

Table 2: Correlation results

		Precipitation	Rice	Green Corn	Fresh cassava	wheat	millet	sorghum
Precipitation	Pearson Correlation	1	.847**	.898**	.855**	.477**	.360**	.818**
	Sig. (2-tailed)		.000	.000	.000	.000	.005	.000
	N	61	60	60	61	61	60	60
RYQ	Pearson Correlation	.847**	1	.950**	.949**	.703**	.342**	.759**
	Sig. (2-tailed)	.000		.000	.000	.000	.007	.000
	N	60	62	62	62	61	62	62
Green Corn YQ	Pearson Correlation	.898**	.950**	1	.933**	.628**	.328**	.840**
	Sig. (2-tailed)	.000	.000		.000	.000	.009	.000
	N	60	62	62	62	61	62	62
Fresh cassava	Pearson Correlation	.855**	.949**	.933**	1	.584**	.361**	.762**
	Sig. (2-tailed)	.000	.000	.000		.000	.004	.000
	N	61	62	62	63	62	62	62
Wheat	Pearson Correlation	.477**	.703**	.628**	.584**	1	.214	.532**
	Sig. (2-tailed)	.000	.000	.000	.000		.098	.000
	N	61	61	61	62	62	61	61
Millet	Pearson Correlation	.360**	.342**	.328**	.361**	.214	1	.459**
	Sig. (2-tailed)	.005	.007	.009	.004	.098		.000
	N	60	62	62	62	61	62	62
Sorghum	Pearson Correlation	.818**	.759**	.840**	.762**	.532**	.459**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	60	62	62	62	61	62	62

****. Correlation is significant at the 0.01 level (2-tailed).**

Sources: Authors computation (2024)

Discussion

Over the study period (1960-2022), Nigeria's agricultural landscape was transformed not just by climate variability, but also by changing regulatory frameworks and technology interventions that had a substantial impact on crop production trends.

Early post-independence policies stressed subsistence farming, but the 1976 introduction of Operation Feed the Nation represented a watershed moment for national food security by mobilizing farmers and providing input subsidies (Shaibu, 2024). Following that, the Green Revolution Programme (1980-1983) emphasized automation and improved seed types, resulting in increased rice and cassava production.

The Structural Adjustment Programme (SAP) of the mid-1980s promoted market liberalization, reducing government subsidies while encouraging private sector participation in agricultural input supply. While SAP had mixed results, it paved the way for further improvements. The 2001 National Agricultural Policy and the 2011 Agricultural Transformation Agenda (ATA) boosted technical adoption, including the introduction of drought-tolerant and early-maturing crop types, particularly sorghum and maize (Agele and Bolarinwa, 2018).

Technological improvements also had an important impact. The advent of the Agricultural Production Systems Simulator (APSIM) enabled climate-smart planning, assisting farmers in optimizing sowing dates and crop selection under changing climatic conditions (Abubaker et al., 2021). Irrigation expansion, particularly in northern Nigeria, reduced rainfall unpredictability, while mobile extension services increased farmer access to climate forecasts and agronomic guidance. Furthermore, the formation of the Nigerian Meteorological Agency (NiMet) and its seasonal climate prediction services enabled farmers to make better decisions, lessening their vulnerability to irregular weather. These institutional and technological developments are most likely responsible for the observed resilience in rice and cassava productions in the face of rising temperatures.

CONCLUSION

This study examines the impact of climate change on agricultural crop production in Nigeria, aiming to determine whether climate change impacts on crop production are a reality or a fallacy. Specifically, it investigates the relationship between climate change factors (i.e., temperature and precipitation changes) and the production of key crops particularly rice, green corn, fresh cassava, wheat, millet, and sorghum. Findings reveal that rising temperatures have a detrimental impact on crop production, while adequate precipitation is beneficial. The study underscores that climate change is indeed a significant reality in Nigeria, one that, if left unmanaged, may harm farmers' livelihoods through reducing crop yields and income, potentially leading to food insecurity.

Recommendations

In response to the study findings, the study recommends the following actions:

1. Nigerian farmers should adopt coping strategies to address adverse climate effects, such as implementing irrigation systems, staggering planting periods, and cultivating climate-tolerant crops. These practices would help maintain agricultural productivity and support farmers' livelihoods.
2. The government, through agencies like the Nigerian Meteorological Agency (NiMet), should regularly broadcast climate data and offer guidance programs for farmers to proactively respond to adverse weather conditions.
3. The Ministry of Agriculture should prioritize increasing crop production by sensitizing rural farmers on suitable crop varieties and cultivation practices, tailored to climate trends.

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