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Climate Variability and Food Price Systems: Trends and Growth Patterns in Nigeria

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Abstract: The persistent rise in food prices amid worsening climate variability presents a critical development challenge in Nigeria and across Sub-Saharan Africa. Despite increasing concern, few studies have provided long-term, integrated assessments of how climatic changes, particularly shifts in temperature and rainfall, affect staple food prices. Existing literature often focuses on short-term correlations or excludes trend-based growth modelling, leaving a gap in understanding the structural co-evolution of climate and food systems. This study fills that gap by empirically analysing the trends and growth patterns in climate variables and food prices in Nigeria from 1991 to 2024. Using secondary data, the study employs descriptive statistics, exponential growth models, and quadratic time trend functions to evaluate the behaviour of key climate variables and selected staple food prices. The findings reveal a significant and accelerating increase in both minimum and maximum temperatures across the study period, while rainfall exhibits a mild negative trend with increasing interannual variability. Food prices show consistent upward trends, with all four staples experiencing statistically significant growth rates and positive acceleration, especially after 2015. These results suggest a co-evolving dynamic between climate stress and food market volatility, highlighting the vulnerability of Nigeria's rain-fed agriculture and fragmented food distribution systems. The study concludes that climate variability contributes to rising food prices and market instability, with far-reaching implications for food security and rural livelihoods. It recommends targeted investments in climate-resilient agriculture, market infrastructure, and early warning systems to mitigate the compound risks of environmental and economic shocks.

Keywords: Climate Variability, Food Price Systems, Trends Analysis, Agricultural Markets, Nigeria, Growth Models.

Research Paper

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1. INTRODUCTION

The escalating interplay between climate variability and food price systems has become a dominant narrative in developmental economics, particularly within the African continent, where agricultural systems are acutely sensitive to weather fluctuations (Henri & Bruno, 2024; Onyeaka *et al*., 2024; John, 2024). In Nigeria, where over 60% of the population depends on agriculture for their livelihood, rising temperatures, erratic rainfall, and global supply chain disruptions have worsened food insecurity (Onyeaka *et al*., 2024; Omokaro, 2025; Ihugba, 2025). Agriculture remains predominantly rain-fed, and therefore highly exposed to climate shocks that impact crop yields, food availability, and ultimately, market prices.

Again, food systems in developing countries are increasingly influenced by climatic factors, especially in economies where agriculture is a dominant contributor to employment and GDP. In Nigeria, agriculture accounts for about 23% of GDP and engages approximately 70% of the rural labour force, making it highly sensitive to fluctuations in weather and climate patterns (World Bank, 2023). The sector's heavy reliance on rain-fed systems exacerbates its vulnerability to climate variability, particularly changes in rainfall onset/cessation and rising mean temperatures.

According to the Nigerian Meteorological Agency (NiMET), Nigeria has experienced a steady increase in annual average temperature of 1.1°C between 1960 and 2020, with rainfall becoming more erratic and regionally concentrated (NIMET, 2023). For instance, the Sahelian North has recorded declines in total rainfall, while the coastal South suffers from flooding due to extreme precipitation events. These climatic anomalies disrupt both planting and harvesting calendars, impacting food supply chains from farm to market.

Globally, the FAO Food Price Index showed that average food prices rose by over 52% from 2019 to 2022, attributed to supply chain disruptions from the COVID-19 pandemic, followed by the geopolitical crisis triggered by the Russia-Ukraine war, two nations that together accounted for over 25% of global wheat exports and 17% of maize (FAO, 2022). Nigeria, a net importer of cereals and key agricultural inputs like fertiliser, is particularly exposed to such external shocks. Between 2019 and 2023, the average retail price of 1kg of rice in Nigeria rose by over 120%, according to the National Bureau of Statistics (NBS, 2023).

Inflationary trends in food pricing have deepened food insecurity. As of 2023, about 25 million Nigerians are classified as food insecure, with the North East and North West zones being the most affected due to climate-induced displacement and conflict (World Food Programme/FAO, 2023). A 2022 joint report by FAO and WFP warns that climate shocks will push an additional 13 million people into hunger across Sub-Saharan Africa by 2030 if no adaptive measures are taken.

Climate variability not only influences production levels but also distorts market stability and consumer behaviour. Prolonged droughts lead to yield reductions, decreasing supply, while intense rainfall causes post-harvest losses, both of which drive up prices. As a result, households are forced to spend up to 60–70% of their income on food, compared to less than 15% in developed economies, reducing access to health, education, and other welfare services (Baiphethi & Jacobs, 2009). Furthermore, Nigeria's agricultural commodity market structure is fragmented and lacks price stabilisation mechanisms. Climate shocks in one region ripple across national supply chains, causing volatile prices for staples such as maize, millet, cassava, and rice. For instance, average monthly maize prices in Northern Nigeria increased by 48% in 2021 alone, largely due to erratic rainfall and conflict in key production belts (FEWS NET, 2022).

Despite its significant agricultural potential, Nigeria continues to experience elevated food inflation. Average consumer food prices have increased sharply since 2020, aligning with increased rainfall volatility and record-high temperatures reported by the Nigerian Meteorological Agency. A report by Mamman *et al*., (2025) used wavelet and quantile regressions to empirically link climatic shocks to core inflation in Nigeria and other West African economies, affirming that these shocks are now among the most powerful predictors of consumer price surges. Yet, public discourse and policy action in Nigeria remain dominated by short-term economic and fiscal responses to food crises, with insufficient attention paid to underlying climatic dynamics. Although several isolated studies have examined climate change or food inflation, few have empirically connected long-term climate data (rainfall and temperature) to staple food price patterns using robust statistical models. According to Ouko and Odiwuor (2023), the absence of integrated analytical frameworks is a central reason why current food security policies remain reactive and fragmented. Moreover, global shocks continue to amplify Nigeria's vulnerabilities. The COVID-19 pandemic caused massive supply chain disruptions, followed closely by the war in Ukraine, which drove up the cost of grains, fertilisers, and energy—all key inputs in the Nigerian food economy (Karume *et al*., 2024). In their joint regional study, Algieri *et al*., (2024) emphasised how external shocks, compounded by local climatic volatility, have structurally altered price formation processes in African food markets.

Three core research gaps necessitate this study. First, while prior studies have examined food prices or climatic patterns separately, integrated trend-based empirical investigations over long time horizons remain scarce. Most models fail to capture both linear and non-linear growth patterns in climatic and economic variables simultaneously. Second, as noted by Omenka *et al*., (2024), there is a lack of localised climate-price models that account for Nigeria's agro-ecological diversity and specific rainfall-temperature patterns. Lastly, the methodological toolkit often excludes advanced growth diagnostics such as exponential or polynomial trend modelling, tools that could better assess acceleration or deceleration in variable trajectories over time. This study is both timely and policy-relevant. As Fayad *et al*., (2022) note in their IMF discussion paper, food insecurity in Sub-Saharan Africa is no longer episodic; it is now chronic, and climate change is a central driver. In response, this research presents empirical evidence on long-term relationships between climate variables and food prices in Nigeria using data from 1991 to 2024. By utilising exponential growth models and polynomial trend analysis, this study introduces methodological rigour that can serve as a replicable template for similar studies across the region. It offers a clearer understanding of how food prices and climatic variables behave over decades rather than just years, enabling policymakers to differentiate between cyclical shocks and structural transformations. Furthermore, the insights from this study directly support global sustainable development goals, particularly SDG 2 (Zero Hunger) and SDG 13 (Climate Action). As Vos *et al*., (2022) emphasised in the Global Report on Food Crises, empirical modelling is essential to inform proactive, rather than reactive, responses to compound food system shocks.

The broad objective of this study is to analyse trends and growth patterns of climate variability and food price systems in Nigeria over 30 years (1991–2024).

The specific objectives are to:

1. Describe the trend of climate variables (rainfall and temperature) in Nigeria;
2. Examine the nature of food price systems and the movement of staple commodity prices;
3. Measure the growth rates in food prices and climate variables using exponential and polynomial trend models.

2. RESEARCH METHODOLOGY

This study was conducted in Nigeria, a highly climate-sensitive West African country whose economy is deeply intertwined with rain-fed agriculture and volatile food prices. Nigeria was chosen due to the strong relevance of climate variability and food price inflation to its socio-economic structure. With a population exceeding 200 million (World Bank, 2022) and covering 923,800 km², Nigeria is the most populous country and largest consumer market in Sub-Saharan Africa. It lies between 4°N–14°N latitude and 3°E–15°E longitude, bordered by Niger, Chad, Benin, Cameroon, and the Atlantic Ocean, with a coastline stretching over 800 km, offering potential for maritime activity (Figure 1). The country experiences a tropical climate with two major seasons: Wet season (April–October) characterized by high rainfall (up to 330 cm annually in the southeast), and Dry season (November–March), beginning with the Harmattan and peaking in temperature (33–38°C) during February–March. Rainfall distribution results in a humid south and arid north, leading to distinct vegetation zones including: Forests (e.g., tropical rainforests, swamps), Savannas (e.g., Guinea, Sudan, and Sahel), and Mountain regions (e.g., Jos Plateau, Mambilla, Obudu). These zones support varied agricultural activities: the savannas are crucial for grains and tubers, while the rainforest belts support cash crops like cocoa, oil palm, and rubber. Over 60% of the population is engaged in farming key food crops (cassava, maize, rice, yam, legumes) and cash crops (cocoa, groundnut, cotton). In mineral resources, oil and gas dominate the export economy (mainly from the Niger Delta), while solid minerals like coal, iron ore, limestone, and gold are distributed inland.

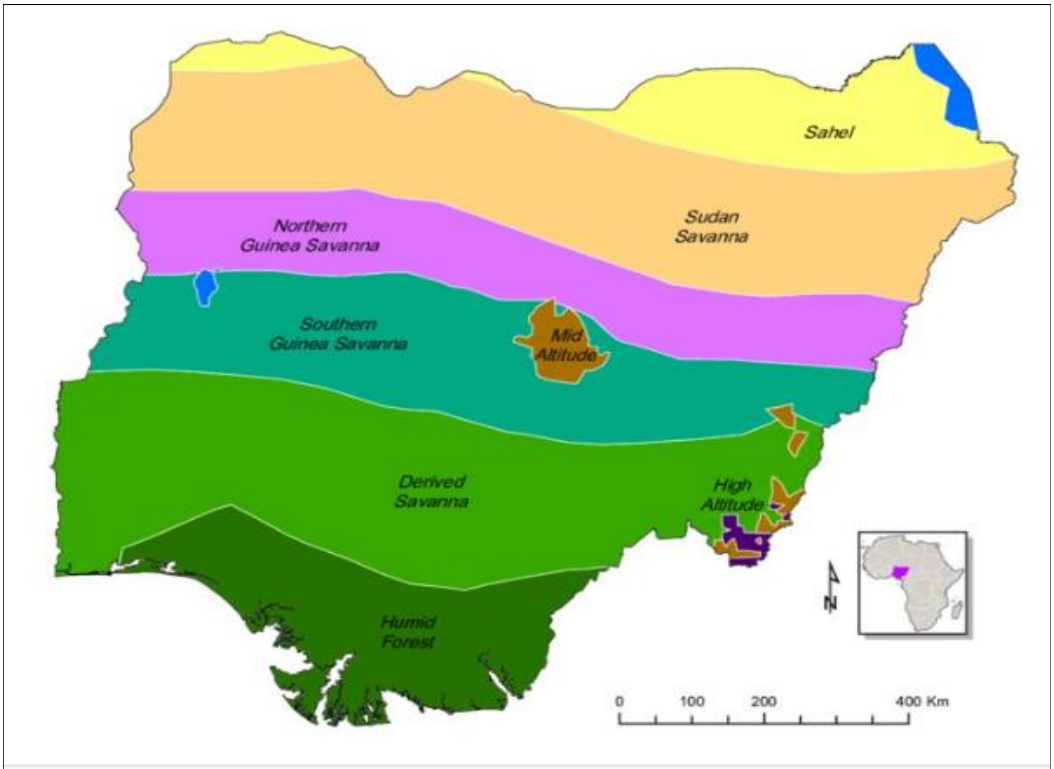

Figure 1: Map of Nigeria with Agro-climatic Zones
Source: Adapted from Omonijo *et al*., (2025)

Secondary data were used for this study in a period of 33 observations (1991 – 2024) inclusive. The data on climate variables such as records of yearly mean temperature (^{O}C) and rainfall (mm) values will be sourced from the Nigerian Meteorological Agency (NIMET) stations. Data on annual food prices (commodity prices), index of agricultural production, real gross domestic product, interest rate, and exchange rate will be sourced from the Central Bank of Nigeria (CBN) and the National Bureau of Statistics (NBS).

Analytical Techniques and Model Specification

Descriptive statistics such as graphs, frequency, charts, graphs, mean, minimum, maximum, and standard deviation will be employed to achieve objectives one (1) and two (2) stated earlier. The tool was used to describe the trend of climate variables and the food price system in Nigeria. To measure the growth rates in climate variables, and food prices (objective 3), the exponential or log-linear trend or what is variously called the -left side semi-log analysis was used, which involves the modeling of the trends in climate variables (rainfall and temperature), and food price system in Nigeria between 1991 – 2024. This is followed by Ehinmowo *et al*., (2017). The models are specified as follows:

$\ln Y = \ln Y_0 (1 + r)_t$ ………………………………. (1)

Where:

$b_0 = \ln Y_0$

$b_1 = \ln (1+ r)$

Equation (1) is rewritten as:

$\ln Y_t = b_0 + b1_t$ ……………………………………. (2)

Adding a disturbance term to equation (2), the explicit form of the model employed was derived as:

$\ln Y_t = b_0 + b_{1t} + Ui$ …………………………………. (3)

Where:

Yt = climate variables, and the food price system

b = constant term

b = Coefficient of time variable

u = Random term

$r = (e^b – 1)*100/1$

Where e is Euler’s exponential constant (2.71828).

To investigate the existence of acceleration, deceleration, or stagnation in the growth rate of climate and food price system variables, a quadratic equation in time variables is fitted to the data following Onyenweaku and Okoye, (2005) as follows:

$\ln Y_t = b_0 + b_1 t + b_2 t^2 + U_i$ …………………………. (4)

In the above specification, the linear and quadratic time terms give the secular path in the dependent variable (Y). The quadratic time term t^2 allows for the possibility of acceleration, deceleration, or stagnation in growth during the period of the study. The significant positive value of the coefficient of t^2 confirms significant acceleration in growth, a significant negative value of t^2 confirms significant deceleration in growth, while a non-significant coefficient of t^2 implies stagnation or absence of either acceleration or deceleration in the growth process for the periods.

3. RESULTS AND DISCUSSION

3.1 The Trend of Selected Climate Variables (Rainfall and Temperature)

3.1.1 Summary Statistics of the Trend of Climate Variables

Table 1 shows the summary statistics for the climate variables (Average Annual Rainfall [AAR], Average Minimum Temperature [AMT], and Average Maximum Temperature [AXT]) observed throughout the periods (1991 – 2024) under the study. The Mean Annual Rainfall (AAR) is approximately 992.99 mm, with a median of 1114.80 mm. The median being higher than the mean suggests a negatively skewed distribution, which is confirmed by a skewness of -0.48. The distribution approximates normality, as indicated by a kurtosis value of 2.25 and a Jarque-Bera test probability of 0.3448, which suggests no significant deviation from normality. The standard deviation of 426.44 mm indicates a high degree of variability in rainfall patterns. The minimum and maximum rainfall values recorded were 205.50 mm and 1782.33 mm, respectively, which reflects substantial interannual fluctuations in precipitation.

In contrast, the Average Minimum Temperature (AMT) had a mean of 21.71°C and a median of 22.30°C, indicating a relatively symmetric distribution, which is further supported by a modest skewness value of 0.25. The standard deviation of 8.98°C suggests moderate-to-high variability in minimum temperatures. The minimum and maximum values ranged from 6.20°C to 41.20°C, reflecting a wide span of observations, although the Jarque-Bera test probability of 0.7832 indicates no significant deviation from normality. This is consistent with the kurtosis value of 2.70, which suggests a distribution close to mesokurtic.

For Average Maximum Temperature (AXT), the mean was 30.17°C, slightly lower than the median of 32.70°C, suggesting a mildly left-skewed distribution. However, the skewness value of 0.009 indicates that the distribution is nearly perfectly symmetric. The standard deviation of 15.85°C reflects the highest variability among the climate variables. With extreme minimum and maximum values of 2.10°C and 61.50°C, the dataset captures a broad range of temperature extremes. The kurtosis value of 2.54 and Jarque-Bera test probability of 0.862 indicate a normal distribution with no significant excess kurtosis or skewness.

These findings highlight differing patterns among the climatic variables. Rainfall exhibits moderate variability and a near-normal distribution, while both minimum and maximum temperatures, despite their wide ranges, appear normally distributed and symmetric. This marks a contrast to many prior studies where temperature data often showed strong skewness and leptokurtic tendencies. A study by Akinsanola and Ogunjobi (2014) on rainfall and temperature variability in Nigeria supports these findings, especially in the context of fluctuating rainfall and the emergence of consistent temperature trends. Similarly, Alemayehu and Bewket (2017) documented symmetrical temperature distributions with high variance, which aligns with the statistical behaviour of AMT and AXT observed in this study. However, MacKellar *et al*., (2014) noted more pronounced skewness and kurtosis in temperature data across Southern Africa, possibly due to regional differences in climate extremes. These discrepancies emphasize the importance of localized climate analysis, particularly for applications in agriculture, food security, and environmental planning.

Table 1: Distribution by Summary Statistics of the Climate Variables

Statistic	AAR	AMT	AXT
Mean	992.99	21.71	30.17
Median	1114.80	22.30	32.70
Maximum	1782.33	41.20	61.50
Minimum	205.50	6.20	2.10
Std. Dev.	426.44	8.98	15.85
Skewness	-0.48	0.25	0.009
Kurtosis	2.25	2.70	2.54
Jarque-Bera	2.131	0.49	0.29
Probability	0.34	0.78	0.86
Sum	33761.55	738.00	1025.80
Sum Sq. Dev.	6001193.00	2660.679	8290.111
Observations	34	34	34

Note: Average Annual Rainfall (AAR), Average Minimum Temperature (AMT), Average Maximum Temperature (AXT)

Source: Author's Computation, 2025

3.1.2 Graphical Trend of the Climate Variables

The graphical trends in Average Minimum Temperature (AMT), Average Maximum Temperature (AXT), and Average Annual Rainfall (AAR) reveal significant climatic dynamics, with increasing temperatures and erratic rainfall patterns becoming more pronounced in recent decades, as observed in Figure 2. From the graph, AMT shows a clear upward trend starting around 2005, indicating warmer nights. This increase in nighttime temperatures may disrupt agricultural productivity, as many crops, such as wheat, maize, rice, and vegetables, depend on cooler nighttime temperatures for optimal growth.

Similarly, the rise in AXT after 2000, with a notable acceleration after 2015, indicates heightened daytime heat extremes. These extreme temperatures exacerbate water stress, reduce crop yields, and increase evaporation rates, particularly concerning for crops that are sensitive to high daytime temperatures. Rainfall patterns (AAR), on the other hand, display significant volatility after 2000. The period from 2009 to 2011 shows marked fluctuations, possibly indicating a severe drought. This is followed by a recovery and a sharp increase in rainfall from 2015 onwards, with particularly high rainfall observed from 2020 to 2022, reflecting a general increase in annual rainfall. However, this erratic nature of rainfall presents challenges such as flooding, soil erosion, and waterlogging during excessive rainfall and drought conditions during sharp declines, as observed in 2010.

These trends corroborate findings by Kassaye *et al*., (2021), who noted that erratic rainfall patterns and extreme weather events significantly affect staple food production, particularly in regions heavily dependent on rainfall for agriculture. Similarly, Baffour-Ata *et al*., (2021) highlighted the negative effects of extreme rainfall variability, such as water stress and flooding, leading to yield reductions in maize, rice, and cassava, especially during dry periods.

The periods of low rainfall in 2010 and high rainfall from 2020-2022 further underscore the growing unpredictability of climate conditions, making it more difficult to plan for agricultural production, manage water resources, and build resilient infrastructure. Additionally, the simultaneous increases in both temperature variables (AMT and AXT) after 2015 suggest compounding stressors, intensifying the need for adaptation strategies to mitigate the risks of these climate impacts. Adaptation measures such as improved irrigation systems, climate-resilient crop varieties, and better water management are critical to reducing the adverse effects of these climatic changes.

Moreover, studies by Ndamani and Watanabe (2015) and Ogenga *et al*., (2018) emphasize the detrimental effects of erratic rainfall during the early growing season, particularly for crops like maize and rice. These studies illustrate how heavy rainfall events can lead to soil erosion, waterlogging, and poor seedling development, while sudden declines in rainfall during critical growth stages induce drought stress, further complicating agricultural challenges.

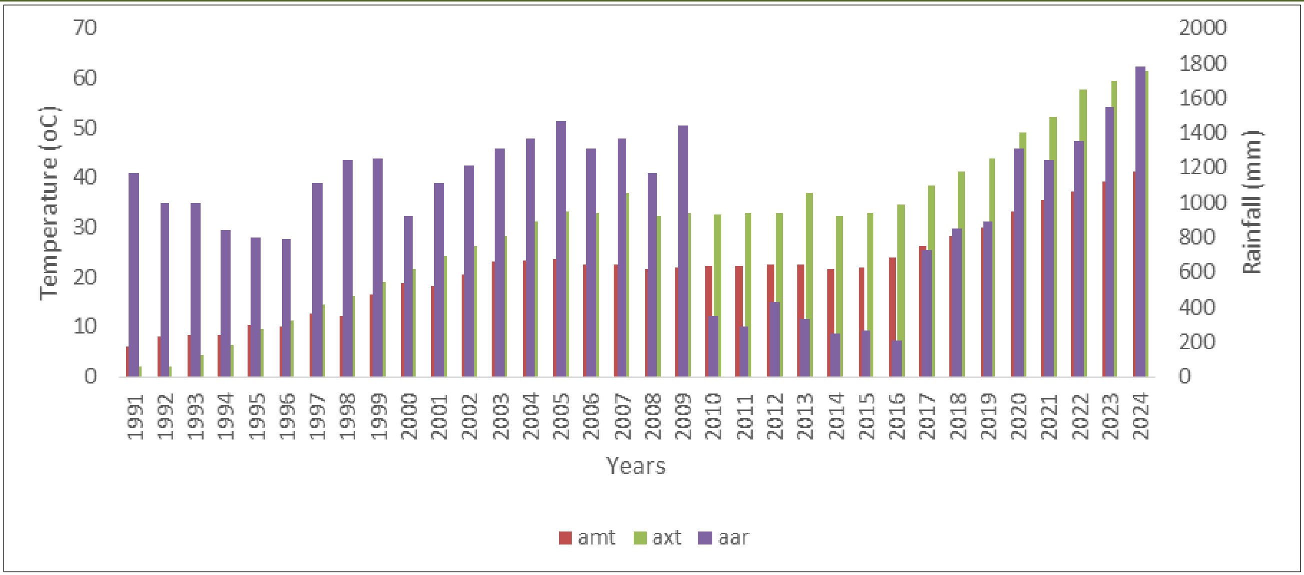

Figure 2: Graphical Trends in Selected Climate Variables

Note: Average Annual Rainfall (AAR), Average Minimum Temperature (AMT), Average Maximum Temperature (AXT)

Source: Author's Computation, 2025

3.2 Trends in Selected Staple Food Prices

3.2.1 Summary Statistics of the Selected Staple Food Prices

The summary statistics for the selected staple food prices (Yam, Rice, Garri, and Maize) are presented in Table 2 for the observed period. These statistics highlight key trends in the prices of the selected staple food commodities, which are essential for understanding market dynamics and consumer access. The mean prices for Yam, Rice, Garri, and Maize are nearly identical, with values of 76.70, 90.44, 63.04, and 74.80, respectively. However, the median values for these commodities are significantly lower, ranging from 62.50 for Garri to 77.32 for Maize. This substantial gap between the mean and median reflects the influence of high outliers, resulting in positively skewed distributions for all the staple food commodities. This pattern is consistent with studies linking price volatility to market disruptions, seasonal shortages, and macroeconomic factors like inflation and exchange rate volatility (Ajibade and Ayinde, 2020). For instance, rice price volatility has been associated with import dependency and currency fluctuations, which make it particularly vulnerable to extreme price variations (Gilbert and Morgan, 2010). Periods of political instability, supply chain breakdowns, and global food price surges often lead to sudden spikes in food prices, as highlighted by Kalkuhl, Von Braun, and Torero (2016); Afolayan *et al*., (2024).

The minimum recorded prices for the staple foods are similarly close across the commodities, ranging from 3.13 for Yam to 4.86 for Maize. This similarity in minimum prices could be attributed to government interventions, such as price floors, or the inherent nature of staple food commodities in competitive markets, where producers adjust pricing to ensure affordability and continued demand. Research on spatial market integration suggests that price convergence across regions can occur due to efficient trade networks and arbitrage opportunities (Sendhil *et al*., 2023; Bello, 2025).

The maximum prices of staple foods range from 147.20 for Garri to 272.33 for Rice, showing little variation. This phenomenon could be due to price ceilings imposed by regulatory bodies or the existence of a psychological price threshold, beyond which consumers seek substitutes (Putra *et al*., 2021). The stabilisation of maximum prices can also result from market competition, where sellers avoid excessive price hikes to remain competitive.

The standard deviations for all four staple foods are consistently high, ranging from 42.50 for Garri to 74.25 for Rice, indicating considerable variability in staple food prices. This suggests significant price volatility within the market, which has been heavily influenced by external shocks, including climatic events, such as droughts, floods, and erratic rainfall, which disrupt supply chains and production. Ajibade and Ayinde (2020) noted that regions with well-integrated markets experience lower price volatility, while fragmented supply chains result in greater fluctuations. Studies on climate-driven shocks indicate that such disruptions create long-term price instability, particularly for crops dependent on rainfed agriculture, such as maize and yam (Putra *et al*., 2021). Furthermore, Erokhin (2017) demonstrated that local price variations are often highly correlated with climatic changes and macroeconomic conditions, further reinforcing the link between weather patterns and staple food price behaviour.

All the staple food prices exhibit a high level of positive skewness, with values ranging around 2.23, indicating that the majority of prices are concentrated on the lower end, with occasional price spikes creating a long right tail. Research on food price distributions suggests that such behaviour is typical of developing economies, where periods of stability are interspersed with sharp price increases driven by supply-side constraints (Gilbert and Morgan, 2010). The kurtosis values, which range from 1.82 for Yam to 2.95 for Rice, indicate leptokurtic distributions. This suggests that extreme price variations are more frequent than would be expected under a normal distribution model, which is consistent with findings from Kalkuhl *et al*., (2016), where external economic shocks and supply disruptions amplified price volatility in global staple food markets.

The results of the Jarque-Bera test confirm significant deviations from normality for all staple food prices, with probabilities of 0.000 for Rice and Garri, reflecting the influence of extreme outliers on the distributions, likely caused by sharp market shocks, supply-demand imbalances, or import restrictions during the observation period. Sendhil *et al*., (2023) argued that such deviations often signal underlying structural weaknesses in food markets, calling for policy interventions to stabilize prices. Such measures could help prevent market imbalances that exacerbate food insecurity and affordability challenges.

Table 2: Distribution by Summary Statistics of Selected Staple Food Prices (1991–2024)

Statistic	YAM	GAARI	RICE	MAIZE
Mean	76.70	63.04	90.44	74.80
Median	70.57	62.50	67.65	77.32
Maximum	154.34	147.20	272.33	158.60
Minimum	3.13	6.70	9.12	4.86
Std. Dev.	47.72	42.50	74.25	44.61
Skewness	0.27	0.50	1.08	0.09
Kurtosis	1.82	2.13	2.95	1.96
Jarque-Bera	2.40	2.46	6.60	1.58
Probability	0.30	0.29	0.04	0.45
Sum	2607.96	2143.50	3074.88	2543.19
Sum Sq. Dev.	75147.62	59592.32	181940.10	65681.57
Observations	34	34	34	34

Source: Author's Computation, 2025

3.2.2 Graphical Trend of the Selected Staple Food Prices

Figure 3 illustrates the trends in the prices of Yam, Gaari, Rice, and Maize over the study period (1991-2024). Each line in the figure represents the time-series data for one of these staples, showcasing the fluctuations and overall trends in their prices.

Yam Prices:

The price trend for Yam shows a gradual increase during the early years, reflecting steady demand and supply conditions. This is followed by a sharp rise in prices during the 1991–1998 period, suggesting significant market disruptions, possibly due to temperature and rainfall variability, increased production costs, or supply shortages. Studies have shown that yam production is highly sensitive to temperature variations and rainfall distribution. Inconsistent rainfall patterns can lead to prolonged dry spells, negatively impacting yam tuber development and reducing overall yields (Kassaye *et al*., 2021). Conversely, excessive rainfall can cause waterlogging, leading to yam rot and post-harvest losses, which may reduce market supply and drive prices up (Nsabimana and Habimana, 2017).

Additionally, the El Niño weather phenomenon during 1991-1998 caused erratic rainfall patterns, disrupting yam production cycles and further intensifying price volatility. This climatic instability likely contributed to the observed sharp price increase. After this peak, prices dropped sharply, indicating market stabilization, possibly due to improved climatic conditions, better production methods, or government interventions. This trend of stabilization continued toward 2023, with a gradual price increase signaling market recovery.

Rice Prices:

The price trend for Rice exhibits a similar trajectory. Prices increased steadily in the initial years, with a sharp peak in the mid-period (1991–1998). Rice is highly vulnerable to climatic fluctuations, particularly rainfall patterns and temperature extremes. Excessive heat or prolonged dry periods reduce rice yields, leading to higher market prices. Rice production is water-intensive, making it especially dependent on stable and sufficient rainfall (Bandara and Cai, 2014). A shortage of water results in yield reductions, which in turn elevates prices due to supply constraints.

The observed price spike in the mid-period could be linked to supply chain disruptions or increased dependency on imports during years of erratic rainfall and temperature stress. Research indicates that during

1991-1998, several countries faced severe production shortfalls, leading to increased global rice importation costs, which impacted domestic rice prices (Brown and Kshirsagar, 2015). After the peak, the price saw a steep decline, reflecting market adjustments through improved supply conditions, government trade policies, or shifts in rice import-export regulations. From 2015 onward, the price stabilized, indicating enhanced market integration and efficiency in supply chains.

Garri Prices:

The price trend for Garri mirrors that of Yam, with a steady increase during 1980–1990 and a sharp spike mid-period (1991–1998). This sharp rise in Garri prices could be due to climate-induced reductions in cassava production (the primary raw material for Garri). While cassava is drought-tolerant, excessive heat and erratic rainfall can severely affect tuber yield, leading to production declines and price surges (Nsabimana and Habimana, 2017; Olutumise *et al*., 2024).

Additionally, flooding events during certain years could have destroyed cassava farmlands, creating supply shocks that intensified Garri price volatility (Haggblade and Dewina, 2010). The price spike from 1991–1998 may also reflect increased demand for Garri as a substitute staple, particularly during rice and yam shortages. After this peak, a sudden drop in prices was observed, mirroring the trend seen in Yam prices, likely due to market corrections or improved production conditions. From then on, prices showed a steady upward trajectory until 2023, indicating price stabilization.

Maize Prices:

The price trend for Maize follows a similar trajectory to that of other staples, with steady growth in the early years, a rapid rise mid-period, and a sharp correction afterward. The steep price increase may have been driven by drought, pests, or other production-related challenges affecting the maize supply. The sharp decline afterward indicates market stabilization, followed by a gradual upward trend in the later years, reflecting increased resilience in the maize supply chain or market adjustments to climatic and economic factors.

Across all four staples, a common pattern emerges: steady price growth in the early years, a sharp price spike mid-period, followed by a steep correction and stabilization in the later years. This pattern aligns with global market behaviours, particularly during periods of external shocks and climate variability. The steady price growth during till 1991 can be attributed to gradual demand expansion, population growth, and inflationary effects. Studies indicate that food prices tend to grow steadily over time due to factors like increasing input costs, infrastructure development, and evolving market structures (Brown *et al.,* 2012). The sharp price spikes during 1991–1998 are consistent with historical food price volatility events, often due to disruptions in agricultural supply chains, temperature and rainfall variability affecting crop yields, and trade restrictions or exchange rate fluctuations, particularly for rice (Dorward, 2012).

The post-peak price correction reflects the market's natural response to price surges, as high prices typically reduce demand, encourage alternative food choices, and trigger increased production in subsequent planting seasons (Minot, 2010). Further, government interventions through trade policies, subsidies, and food security programs often stabilize the market (Mwakiwa *et al*., 2025). The stabilization observed in prices after 2015 can be attributed to improvements in market integration, trade efficiency, and agricultural policies. Well-integrated markets experience fewer extreme price swings as price transmission mechanisms become more effective (Ajibade and Ayinde, 2020). Additionally, infrastructure improvements, mechanization, and better storage facilities have contributed to reducing seasonal price volatility in major staple food markets.

The Nigerian government has also implemented policies to promote local production and reduce dependence on imported food. The ban on rice importation in 2015 contributed to a short-term price spike, particularly as demand shifted toward locally produced varieties. Over time, as domestic production increased, supported by initiatives such as the Anchor Borrowers' Program, prices stabilized. Similarly, the COVID-19 pandemic disrupted food supply chains, resulting in sharp price increases across food staples, particularly Yam and Garri, due to supply chain inefficiencies. The gradual market recovery post-2020 helped stabilize prices.

Lastly, the Russia- Ukraine war in 2022 led to global inflationary pressures, indirectly affecting Maize and Rice prices due to higher fertilizer costs, which in turn impacted local production costs. This is reflected in the upward trend in food prices toward the later part of the study period, particularly from 2022 onward.

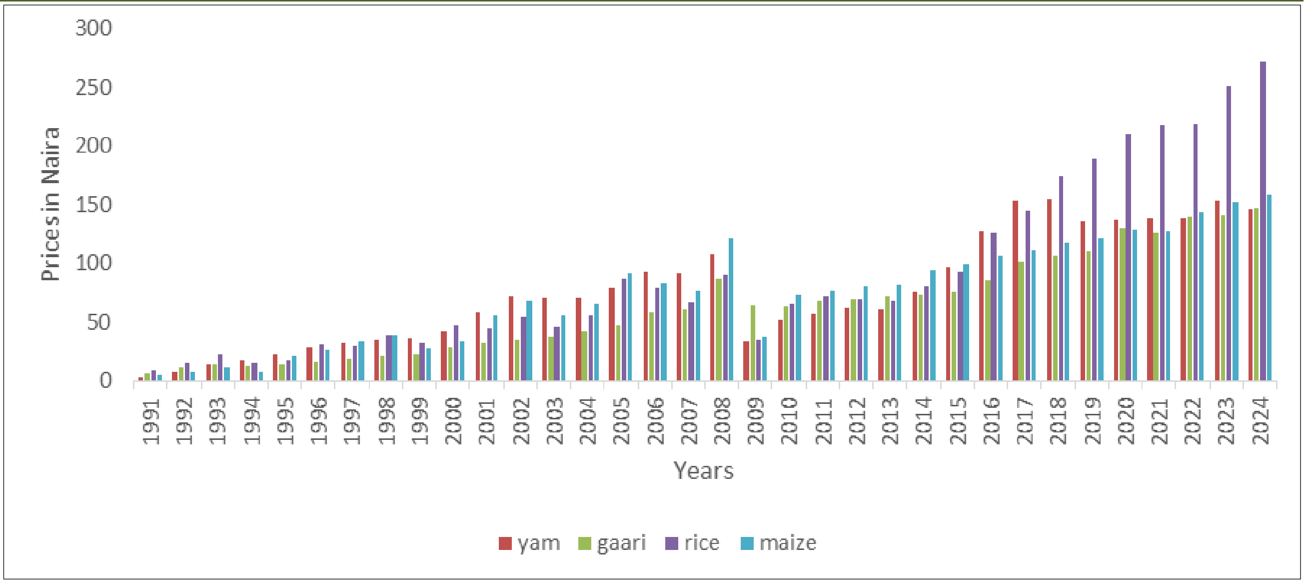

Figure 3: Graphical Trend of the Selected Staple Food Prices (1991 – 2024).
Note: Yam prices (yam), Rice prices (rice), Gaari prices (gaari), and Maize prices (maize)
Source: Author's Computation, 2025

3.3 Measuring the Growth Rates in Staple Food Prices and Climate Variables

The growth rates in the selected staple food prices and climate variables were analysed using a growth rate function. The results are presented in Table 3. The growth rates of Yam, Rice, Garri, and Maize are all positive, with calculated growth rates (r) of 8.11% per annum for Yam, 8.76% per annum for Rice, 8.55% per annum for Garri, and 8.44% per annum for Maize. The time coefficients for these staple food prices are consistently 0.078 for Yam, 0.084 for Rice, 0.082 for Garri, and 0.081 for Maize, indicating a general upward trend in the prices of these commodities over time. However, their associated F-values are quite high, ranging between 86.00 and 530.46, suggesting statistically significant growth for these prices. The R^2 values for these variables are also relatively high, ranging from 0.729 for Yam to 0.943 for Gaari, indicating that the time trends explain a significant proportion of the price fluctuations for these commodities.

The results suggest that while the growth rates for staple food prices appear to be significant, food price fluctuations are likely influenced by multiple factors beyond just time-based trends. Studies have shown that food prices in developing economies are highly responsive to external shocks, such as supply chain disruptions, climate variability, and market speculation, leading to considerable short-term volatility (Dorward, 2012; Akter and Basher, 2014). These external shocks often cause price growth to follow cyclical or event-driven patterns, which are not always captured by long-term trend models (Headey and Fan, 2008). The low statistical significance in some previous studies supports the idea that the growth of food prices is more stochastic than deterministic (Zezza *et al*., 2009).

Moreover, fuel price fluctuations, fertilizer costs, and global food prices can drive unpredictable changes in local food prices, disrupting long-term trends (Headey and Fan, 2008). Similarly, unpredictable weather patterns, including temperature fluctuations and erratic rainfall, often cause crop failures or bumper harvests, which significantly impact price trends (Cornelsen *et al*., 2015). External factors, such as government policies, price stabilization measures, and import restrictions, can distort natural market-driven growth trends (Bekkers *et al*., 2017).

For the climate variables, the growth rates exhibit more varied behaviour. Rainfall showed a negative growth rate of 1.00% per annum, with a negative time coefficient (-0.010). This decline is statistically significant, with an F-value of 0.904 and an R^2 of 0.027, indicating modest explanatory power. The results suggest a declining trend in rainfall over the observed period, which could have important implications for agricultural production and water resource availability. The growth rates for temperature variables show positive trends. The minimum temperature had a growth rate of 4.50% per annum, with a time coefficient of 0.044. This growth rate is statistically significant with an F-value of 174.72 and an R^2 of 0.845, indicating that minimum temperatures have been steadily increasing, which may have significant effects on ecosystems and agriculture. The maximum temperature exhibited the highest growth rate of 7.68% per annum, which was statistically significant at the 1% level, with an F-value of 87.40 and an R^2 of 0.732. This high significance and explanatory power suggest a strong upward trend in maximum temperatures, reinforcing concerns about global warming and its potential impacts. These findings highlight a positive growth projection for food prices and maximum temperatures, while rainfall showed a declining trend. Understanding these growth patterns is critical for developing effective policies to manage food price volatility and address the challenges posed by climate variability.

Table 3: Results of the Growth Rate Function for the Variables

Variables	Constant	t-coefficient	F-value	R^2	r
Staple Food Prices					
Yam	-153.44	0.08	86.00***	0.73	8.11
Rice	-163.81	0.08	287.62***	0.90	8.76
Gaari	-161.65	0.08	530.46***	0.94	8.55
Maize	-158.85	0.08	115.54***	0.78	8.44
Rainfall	26.87	-0.01	0.90	0.03	-1.00
Minimum Temperature	-85.92	0.04	174.72***	0.85	4.50
Maximum Temperature	-144.58	0.07	87.40***	0.73	7.68

Note: *, *** means significance at 10% and 1% levels, respectively.
Source: Author's Computation, 2025

Quadratic Time for Growth Rate Analysis

The results of the quadratic time growth rate analysis provide further insights into the dynamics of staple food prices and climate variables over the observed period, as reported in Table 4. By examining the constant, time, and time-squared coefficients, this analysis helps determine whether these variables exhibit stagnation, acceleration, or deceleration trends.

For the staple food prices (Yam, Rice, Garri, and Maize), the results indicate a significant acceleration in their growth rates. The time-squared coefficients for these commodities are positive and statistically significant, with F-values ranging from 85.51 to 522.78 and R^2 values ranging from 0.728 for Yam to 0.942 for Garri. This suggests that staple food prices have shown an upward acceleration over the period.

The growth acceleration in staple food prices can be attributed to several key factors. Government interventions, such as price control mechanisms, subsidies, and import regulations, may have created artificial price stability, but still, the general trend indicates an acceleration in prices over time (Headey and Fan, 2008; Minot, 2014). Also, stagnant agricultural productivity growth, particularly in developing economies, may result in moderate supply-driven price increases but not rapid acceleration (Diao *et al*., 2008). Demand growth for staple foods is often inelastic, meaning that even when supply remains stable, prices tend to increase gradually. Certain staple crops, like cassava and maize, are more resilient to climate variations, leading to less erratic price changes compared to perishable or high-value crops (Abbott, Hurt, and Tyner, 2008). These findings imply that despite external shocks or market dynamics, staple food prices have experienced consistent growth during the study period.

Unlike staple food prices, the trends in climate variables show significant variation. Rainfall demonstrates a negative time coefficient and a significant negative time-squared coefficient, with an F-value of 0.897 and an R^2 of 0.027, indicating stagnation in rainfall patterns over time. The negative time-squared coefficient suggests that rainfall has been experiencing a decelerating trend over the observed period, which is consistent with previous studies showing a decline in precipitation due to climate change (Funk and Brown, 2009; von Braun and Tadesse, 2012). Rising global temperatures and land degradation have contributed to shifting precipitation patterns, with some regions becoming more arid and prone to drought (Battisti and Naylor, 2009; Darnton-Hill and Cogill, 2010). The results align with the findings that El Niño-Southern Oscillation (ENSO) events have become more frequent, exacerbating the long-term decline in rainfall patterns (von Grebmer *et al.,* 2011).

In contrast, the minimum temperature exhibits acceleration with a positive time-squared coefficient that is statistically significant at the 1% level, as shown by an F-value of 173.55 and an R^2 of 0.844. This suggests that minimum temperatures have been rising over time, with a significant acceleration in temperature growth. This is consistent with global warming trends and the growing evidence that temperature increases are leading to altered weather patterns, particularly in areas where minimum nighttime temperatures have been rising steadily (Battisti and Naylor, 2009).

The maximum temperature also demonstrates acceleration, with a positive time-squared coefficient at the 1% significance level. The F-value of 86.75 and an R^2 of 0.731 indicate strong explanatory power for the trend. The results highlight the growing heat stress associated with increased daytime temperatures, which has implications for agriculture and overall climate resilience. The rising maximum temperatures can alter agricultural productivity by reducing crop yields, particularly in regions that are already vulnerable to heat waves and extreme temperatures (von Grebmer *et al*., 2011).

Table 4: Results of Quadratic Time for Growth Rate

Variables	Constant	Time coefficient	Time-squared coefficient	F-value	R^2	Remark
Food Prices						
Yam	-74.64	139.71***	1.95e-5***	85.51***	0.728	Acceleration
Rice	-79.82	17.35	2.08e-5***	287.13***	0.90	Acceleration
Gaari	-78.86	85.65***	2.05e-5***	522.78***	0.942	Acceleration
Maize	-77.35	152.11***	2.02e-5***	114.68***	0.782	Acceleration
Climate Variables						
Rainfall	16.78	-136.69	-2.49e-6	0.897	0.027	Stagnation
Minimum Temperature	-41.45	100.78***	1.10e-5***	173.55***	0.844	Acceleration
Maximum Temperature	-70.64	181.48***	1.83e-5***	86.75***	0.731	Acceleration

Note: *, **, *** means significance at 10%, 5% and 1% levels, respectively.
Source: Author's Computation, 2025

4. CONCLUSION AND RECOMMENDATIONS

This study investigated the trends and growth patterns of climate variability and food price systems in Nigeria over a 33-year period (1991–2024), using descriptive analysis, exponential growth models, and quadratic trend functions. The findings reveal significant and accelerating trends in both climate variables, particularly temperature and food prices, with important implications for agricultural stability and economic security. The trend analysis confirms that average minimum and maximum temperatures have shown consistent positive growth rates, indicating a warming climate. Conversely, annual rainfall exhibited a mild decline and stagnation, reflecting increased variability and a shift in precipitation patterns. These climatic developments are likely to disrupt crop cycles, reduce productivity, and exacerbate rural vulnerability. On the economic front, all staple food prices (Yam, Rice, Garri, and Maize) displayed statistically significant upward trends with clear signs of acceleration, particularly post-2015. This suggests that food inflation in Nigeria is not merely cyclical but structurally linked to deeper climatic and market instabilities. These results align with global observations of how climate change, combined with supply chain shocks and policy weaknesses, amplifies food price volatility. In sum, the analysis demonstrates a co-evolving pattern of climate stress and food system instability, highlighting the urgent need for multi-sectoral adaptation and resilience-building strategies. The evidence supports a call for proactive intervention, informed by empirical diagnostics, to safeguard food access and rural livelihoods in the face of an increasingly uncertain climate. In light of the study's findings, it is recommended that the government and agricultural stakeholders should promote climate-resilient farming practices, including drought-tolerant crop varieties, integrated water management, and precision agriculture. These measures are essential to offset the risks posed by rising temperatures and rainfall irregularities. Establishing localised climate and food price monitoring systems will improve the country's ability to anticipate and respond to climate-induced supply shocks. Integrating meteorological data with food market information can help guide timely interventions and reduce market panic. Again, Nigeria should invest in infrastructure and transportation networks to improve regional food distribution and minimise price differentials. Strengthening commodity boards and strategic food reserves could also help smooth short-term price volatility during climatic disruptions. Policies that reduce import dependency and encourage domestic food production and processing should be prioritised. This includes removing structural bottlenecks, reforming subsidy systems, and providing affordable access to inputs such as seeds, fertiliser, and irrigation equipment. Continued academic and institutional research into the causal and dynamic linkages between climate variables and food markets is essential. Such research should use integrated models and extend to regional and household-level impacts to inform adaptive policy frameworks. Climate change should be embedded into Nigeria's broader development, food security, and poverty reduction strategies. This includes mainstreaming climate indicators into agricultural investment plans and the National Economic Development blueprint.

Limitations of the Study

This study relies on national-level data, which may overlook regional disparities. It uses trend analysis without establishing causality and excludes other climatic variables like humidity or extreme events. Additionally, potential inconsistencies in historical data may affect accuracy. Future studies should adopt disaggregated, multi-variable, and causality-focused approaches for deeper insights.

REFERENCES

- Abbott, P. C., Hurt, C., & Tyner, W. E. (2008). What's driving food prices?
- Afolayan, T. T., Olutumise, A. I., Oguntade, A. E., Bello, T. O., Oparinde, L. O., & Oladoyin, O. P. (2024). Herdsmen-farmer conflicts and their effects on agricultural productivity and rural livelihoods. *International Journal of Agricultural Science, Research & Technology (IJASRT) in Extension & Education Systems, 14*(4), 261–273. http://ijasrt.iau-shoushtar.ac.ir

- Ajibade, T. B., & Ayinde, O. E. (2020). Food price volatility in Nigeria and its driving factors: Evidence from GARCH estimates. Agricultural Economics Research Review, 8(4), 367–385. Retrieved from https://ageconsearch.umn.edu/record/307655/
- Akinsanola, A. A., & Ogunjobi, K. O. (2014). Analysis of Rainfall and Temperature Variability over Nigeria. *Global Journal of Human-social Science.* 14(3), 1-19.
- Akter, S., & Basher, S. A. (2014). The impacts of food price and income shocks on household food security and economic well-being: Evidence from rural Bangladesh. *Global Environmental Change*, *25*, 150-162.
- Alemayehu, A., & Bewket, W. (2017). Local spatiotemporal variability and trends in rainfall and temperature in the central highlands of Ethiopia. Geografiska Annaler: Series A, Physical Geography, 99(2), 85– 98. https://doi.org/10.1080/04353676.2017.1289460
- Algieri, B., Kornher, L., & von Braun, J. (2024). The changing drivers of food inflation – Macroeconomics, inflation, and war. Retrieved from https://ageconsearch.umn.edu/record/340561/
- Baffour-Ata, F., Antwi-Agyei, P., & Nkiaka, E. (2021). Effect of climate variability on yields of selected staple food crops in northern Ghana. Climate Services, 23, 100247. Retrieved from https://www.sciencedirect.com/science/article/pii/S2666154321001071
- Baiphethi, M. N., & Jacobs, P. T. (2009).The contribution of subsistence farming to food security in South Africa. Agrekon, 48(4), 459-482.
- Bandara, J. S., &Cai, Y. (2014). The Impact of Climate Change on Food Crop Productivity, Food Prices and Food Security in South Asia. Economic Analysis and Policy, 44, 451-465. https://doi.org/10.1016/j.eap.2014.09.005.
- Battisti, D. S., & Naylor, R. L. (2009). Historical warnings of future food insecurity with unprecedented seasonal heat. Science, 323(5911), 240-244. https://doi.org/10.1126/science.1164363.
- Bekkers, E., Brockmeier, M., Francois, J., & Yang, F. (2017). Local food prices and international price transmission. *World Development*, *96*, 216-230.
- Bello, T. O. (2025). Econometric analysis of resource-use efficiency and profitability in cowpea-based farming systems of Ondo State, Nigeria. *Advances in Modern Agriculture, 6*(2), 3550. https://doi.org/10.24294/ama3550
- Brown, M. E., & Kshirsagar, V. (2015). Weather and international price shocks on food prices in the developing world. *Global Environmental Change*, *35*, 31-40.
- Brown, M.E., J.M. Antle, P. Backlund, E.R. Carr, W.E. Easterling, M.K. Walsh, C. Ammann, W. Attavanich, C.B. Barrett, M.F. Bellemare, V. Dancheck, C. Funk, K. Grace, J.S.I. Ingram, H. Jiang, H. Maletta, T. Mata, A. Murray, M. Ngugi, D. Ojima, B. O'Neill, and C. Tebaldi. (2012). Climate Change, Global Food Security, and the U.S. Food System 146 pages.Availableonlineat:
- Cornelsen, L., Green, R., Turner, R., Dangour, A. D., Shankar, B., Mazzocchi, M., & Smith, R. D. (2015). What happens to patterns of food consumption when food prices change? Evidence from a systematic review and meta-analysis of food price elasticities globally.*Health economics*, *24*(12), 1548-1559.
- Darnton-Hill, I., & Cogill, B. (2010). Maternal and young child nutrition adversely affected by external shocks such as increasing global food prices. *The Journal of Nutrition,* 140(1), 162S-169S. https://doi.org/10.3945/jn.109.112979
- Diao X., Fan S., Headey D., Johnson M., Pratt A. N., & Yu, B. (2008). Accelerating Africa's Food Production in Response to Rising Food Prices. Washington, DC: IFPRI.
- Dorward, A. (2012). The short-and medium-term impacts of rises in staple food prices. Food security, *4*, 633-645.
- Ehinmowo, O. O., Simon–Oke, O. O., Fatuase, A. I., & Akinbolasere, A. P. (2017). Currency Devaluation and Importation of Rice in Nigeria. *Journal of Economics, Management and Trade*, *18*(1), 1-9.
- Erokhin, V. (2017). Self-sufficiency versus security: How trade protectionism challenges the sustainability of the food supply in Russia. *Sustainability*, *9*(11), 1939.
- Fayad, L. K., Lanci, L., Mitra, P., Muehlschlegel, T., & Okou, C. (2022). Climate change and chronic food insecurity in Sub-Saharan Africa. International Monetary Fund. Retrieved from https://www.imf.org/-/media/Files/Publications/DP/2022/English/CCCFISSAEA.ashx
- FEWSNET (2022). Nigeria Food Security Outlook, March to September, 2021.
- Food and Agriculture Organisation [FAO], (2022). Smallholders Data portrait, Family Farming Knowledge Platform. Rome: Available online at: http://www.fao.org/familyfarming/datasources/dataportrait/farm-size/en/
- Funk, C.C. and Brown, M.E. (2009). Declining global per capita agricultural production and warming oceans threaten food security. *Food Sec.* **1**, 271–289. https://doi.org/10.1007/s12571-009-0026-y
- Gilbert, C. L., & Morgan, C. W. (2010). Food price volatility. Philosophical Transactions of the Royal Society B, 365(1554), 3023-3034. https://doi.org/10.1098/rstb.2010.0139
- Haggblade, S., & Dewina, R. (2010). Staple food prices in Uganda.Hannah Ritchie, Pablo Rosado and Max Roser (2022) - "Environmental Impacts of Food Production". Published online at OurWorldInData.org. Retrieved from:

'https://ourworldindata.org/environmental-impacts-of-food.

- Heady, D and Fan, S. (2008). Anatomy of a Crisis: The Causes and Consequences of Surging Food Prices. *Journal of Agricultural Economics*, 29:375-391.
- Henri A.A. B., & Bruno, E.O. N. (2024). Climate change and political stability in African states: the role of agricultural food price volatility. Environment, Development and Sustainability, 1-38.
- Ihugba, U. E. (2025). The Economic Impact of Climate Change on Nigeria's Agriculture and Food Security. African Development Finance Journal, 8(3), 138-168.
- John, M. (2024). Climate change, food insecurity, peace and sustainable development in East Africa: Case study of South Sudan, Sudan, Ethiopia and Kenya. In Climate Change and Socio-political Violence in Sub-Saharan Africa in the Anthropocene: Perspectives from Peace Ecology and Sustainable Development (pp. 141-165). Cham: Springer Nature Switzerland.
- Kalkuhl, M., Von Braun, J., & Torero, M. (2016). Volatile and extreme food prices, food security, and policy: An overview. OAPEN Library. Retrieved from https://library.oapen.org/bitstream/handle/20.500.12657/28088/1001906.pdf
- Karume, K., Mondo, J. M., & Kiyala, J. C. K. (2024). Drought, the war in Europe and its impacts on food insecurity in Sub-Saharan Africa, East Africa. In Sustainable Development and Resilience of Food Systems in Africa (pp. 69–90). Springer. Retrieved from https://link.springer.com/chapter/10.1007/978-3-031-48375-2_4
- Kassaye, A. Y., Shao, G., Wang, X., & Shifaw, E. (2021). Impact of climate change on staple food crops yield in Ethiopia: Implications for food security. Theoretical and Applied Climatology, 143(1-2), 121-135. Retrieved from https://link.springer.com/article/10.1007/s00704-021-03635-8
- MacKellar, N., New, M., & Jack, C. (2014). Observed and modelled trends in rainfall and temperature for South Africa: 1960-2010. *South African Journal of Science*, 110(7-8), 1–9. Retrieved from https://www.scielo.org.za/pdf/sajs/v110n7-8/14.pdf
- Mamman, S. O., Nadarajah, S., Iliyasu, J., & Hassan, M. U. (2025). Emerging contemporary monetary policy issues in Africa: An application of wavelet and quantile techniques to climatic shocks on inflation. PLOS ONE, 20(4), e0319797. https://doi.org/10.1371/journal.pone.0319797
- Minot, N. (2010). Transmission of world food price changes to African markets and its effect on household welfare.
- Minot, N. (2014). Staple food prices in Malawi. African Agricultural Markets Project. Retrieved from https://ageconsearch.umn.edu/record/58558/
- Mwakiwa, E., Wineman, A., Agyei-Holmes, A., & Fall, M. G. (2025). Price shocks and associated policy responses stemming from the Russia-Ukraine war and other global crises: Evidence from six African countries. Food Policy. https://www.sciencedirect.com/science/article/pii/S2211912425000367
- National Bureau of Statistics [NBS], (2023). Selected Food Price Watch.A monthly publication of the National Bureau of Statistics, Nigeria. Retrieved from www.nigerianstat.gov.ng.
- Ndamani, F., & Watanabe, T. (2015). Influences of rainfall on crop production and suggestions for adaptation. *International Journal of Agricultural Sciences*. Vol. 5
- Nigerian Meteorological Agency [NiMet], (2023). State of the Climate in Nigeria 2022. An annual publication of the Nigerian Meteorological Agency, Federal Republic of Nigeria, retrieved from www.nimet.gov.ng.
- Nsabimana, A., & Habimana, O. (2017). Asymmetric effects of rainfall on food crop prices: Evidence from Rwanda. *Environmental Economics Journal*, 8(3), 112-126. http://www.irbisbuv.gov.ua/cgibin/irbis_nbuv/cgiirbis_64.exe?C21COM=2&I21DBN=UJRN&P21DBN=UJRN&IMAGE_FILE_DOWNLOAD=1&Image_file_name=PDF/envirecon_2017_8_3(contin.)__8.pdf
- Ogenga, J. O., Mugalavai, E. M., & Nyandiko, N. O. (2018). Impact of rainfall variability on food production under rainfed agriculture in Homa Bay County, Kenya
- Olutumise, A. I., Ekundayo, B. P., Omonijo, A. G., Akinrinola, O. O., Aturamu, O. A., Ehinmowo, O. O., & Oguntuase, D. T. (2024). Unlocking sustainable agriculture: climate adaptation, opportunity costs, and net revenue for Nigeria cassava farmers. *Discover Sustainability*, *5*(1), 67.
- Omenka, L. C. O., Osabuohien, E. S., Urhie, E., & Ode, G. O. (2024). Geospatial and climate dynamics in West Africa: Analysing impact of weather conditions on food security in Burkina Faso and Nigeria. Research Square. https://www.researchsquare.com/article/rs-5275069/latest
- Omokaro, G. O. (2025). Multi-impacts of climate change and mitigation strategies in Nigeria: agricultural production and food security. Science in One Health, 100113.
- Omonijo, A. G., Olutumise, A. I., & Adeyeye, J. A. (2025). Mapping the effects of thermal sensation and climate conditions on tourism in the Ondo State, Nigeria. *Theoretical and Applied Climatology*, *156*(7), 1-18.

- Onyeaka, H., Nwauzoma, U. M., Akinsemolu, A. A., Tamasiga, P., Duan, K., Al-Sharify, Z. T., & Siyanbola, K. F. (2024). The ripple effects of climate change on agricultural sustainability and food security in Africa. Food and Energy Security, 13(5), e567.
- Onyenweaku, C. E. & Okoye, B. E. (2005). Trends in Cassava Output, Area and Productivity in Nigeria, 1960/61-2003/04.Proceedings of the 39th Conference of the Agricultural Society of Nigeria, Benin.
- Ouko, K. O., & Odiwuor, M. O. (2023). Contributing factors to the looming food crisis in Sub-Saharan Africa: Opportunities for policy insight. Cogent Social Sciences, 9(1), 2173716. https://doi.org/10.1080/23311886.2023.2173716
- Putra, A. W., Supriatna, J., Koestoer, R. H., & Soesilo, T. E. B. (2021). Differences in local rice price volatility, climate, and macroeconomic determinants in the Indonesian market. Sustainability, 13(8), 4465.https://doi.org/10.3390/su13084465
- Sendhil, R., Arora, K., Kumar, S., Lal, P., Roy, A., & Varadan, R. J. (2023). Price dynamics and integration in India's staple food commodities. Commodities, 2(1), 3.https://doi.org/10.3390/commodities2010003.
- Von Braun, J. and G. Tadesse (2012) 'Global Food Price Volatility: An Overview of Costs, Causes, and Solutions', ZEF Discussion Paper No. 161
- Von Grebmer, K., von Grebmer, K., Torero, M., Olofinbiyi, T., Fritschel, H., Wiesmann, D., & von Oppeln, C. (2011). Global Hunger Index The Challenge of Hunger: Taming price spikes and excessive food price volatility. Intl Food Policy Res Inst.
- Vos, R., Rice, B., & Minot, N. (2022). 2022 global report on food crises: Joint analysis for better decisions. CGIAR. https://cgspace.cgiar.org/items/b40ddd31-83e8-4fe7-9e8e-e904994c3598
- World Bank (2022). World Development Indicators, Nigeria. URL: https://databank.worldbank.org/source/world-development-indicators.
- World Bank Group, (2023). Climate Risk Profile: Nigeria. file:///C:/Users/user/Desktop/climate%20var/15918wb_nigeria%20country%20profile-web.pdf
- Zezza, A., Davis, B., Azzarri, C., Covarrubias, K., Tasciotti, L., & Anriquez, G. (2009). The impact of rising food prices on the poor.