

# The Role of Climate Change and Human Capital in Shaping Food Affordability in Nigeria

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## Abstract

This study examines how climate change and human capital affect food affordability in Nigeria, using annual time series data spanning from 1971 to 2023. Applying the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) techniques, the analysis explores the effects of four key variables: CO<sub>2</sub> emissions (serving as a proxy for climate change), the human capital index, population growth, and GDP per capita. Food affordability is measured using the food price index. The findings indicate that CO<sub>2</sub> emissions significantly drive-up food prices, reflecting the detrimental impact of climate change on food affordability. Conversely, improvements in the human capital index through better education and healthcare are associated with reduced food prices, highlighting the role of human capital in boosting labor efficiency and lowering food costs. GDP per capita is found to enhance food affordability, while rising population growth contributes to higher food prices due to increased demand. The study recommends greater investment in human capital, the implementation of climate-resilient agricultural strategies, and effective population management policies to strengthen food affordability and promote sustainable food security in Nigeria.

**Keywords:** Climate Change, Human Capital, Food Affordability, Nigeria

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JEL Classification: C32, F34, P36

## 1. Introduction

Food security remains a major development challenge in many low- and middle-income countries, particularly in Sub-Saharan Africa. In this region, factors such as rapid population growth, environmental degradation, rising inequality, and limited human capital development continue to undermine efforts to ensure access to sufficient, safe, and nutritious food for all (FAO, 2023). Among the four pillars of food security availability, access (affordability), utilization, and stability food affordability has emerged as an increasingly critical concern. Affordability refers to the economic ability of individuals and households to purchase adequate food, and it is strongly influenced by food prices, income levels, and broader macroeconomic conditions (Firdaus et al., 2019).

In Nigeria, food affordability has become more fragile due to multiple, interconnected drivers. Climate change, marked by increasing CO<sub>2</sub> emissions, erratic weather patterns, and reduced agricultural productivity, has disrupted food supply chains and contributed to rising food prices (Ogundipe et al., 2020). At the same time, inadequate investment in human capital evident in poor access to quality education, healthcare, and agricultural extension services has constrained labor productivity, limited technological adoption, and hindered income growth, especially in rural

areas. This undermines households' purchasing power and weakens their ability to afford sufficient food (Mushtaq et al., 2024). Nigeria's rapidly growing population further intensifies the challenge. According to the United Nations (2023), Nigeria's population is expected to exceed 400 million by 2050, placing enormous pressure on food demand and straining household budgets. Meanwhile, sluggish economic growth and inflationary pressures especially those affecting staple food items have continued to erode real incomes and exacerbate food insecurity, particularly among the poor (Aboaba et al., 2020).

Given these challenges, this study aims to examine the impact of climate change and human capital on food affordability in Nigeria, using annual time series data from 1971 to 2023. Specifically, it investigates how CO<sub>2</sub> emissions, human capital development, population growth, and GDP per capita affect food prices, as a proxy for affordability. By employing the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) techniques, the study provides new empirical insights into the macroeconomic drivers of food affordability. The rest of the paper is structured as follows: Section 2 presents the literature review; Section 3 outlines the methodology; Section 4 discusses the results and findings; and Section 5 concludes with policy recommendations.

## **2. Literature Review**

Several studies have examined the determinants of food security across different regions. For example, Sola et al. (2016) investigated the impact of limited access to modern energy on food access in Sub-Saharan Africa, where three-quarters of the population rely on biomass fuels for cooking and heating. The findings revealed that fuelwood scarcity affects food accessibility in multiple ways. It highlights that coping strategies for fuelwood scarcity are highly contextual, influenced by factors such as geography, household economy, and labor availability. Similarly, Chakona and Shackleton (2017) examined household food access and availability in South Africa, focusing on the physical and economic barriers that influence the ability to obtain nutrient-rich food. Through focus group discussions conducted in three towns along a rural-urban continuum, participants shared their knowledge of healthy diets, experiences of food insecurity, coping strategies, and suggestions for improving food security. A total of 91 participants, predominantly women aged 31 to 50 years, reported limited access to healthy food despite being knowledgeable about it, leading to monotonous diets. Food insecurity was widespread, with female-headed households, the unemployed, and orphaned children being most vulnerable. The study revealed a complex food system reliant on own production, collecting from open spaces, donations, and purchases, exacerbated by unemployment, low income, and resource shortages.

Waha et al. (2018) explored the relationship between farming diversity and food security in Africa, focusing on both household-level and continental-scale diversification potential. At the household level, using agricultural surveys from over 28,000 households across 18 African countries, the study finds that greater farming diversity helps households better meet their consumption needs, but only to a certain extent. The success of farming diversity is also influenced by factors like off-farm income, income from farm sales, market orientation, livestock ownership, and land resources. On the continental scale, the study analyzes the relationship between rainfall, rainfall variability, and farming diversity, identifying areas with optimal conditions for agricultural diversification, particularly in regions with 500–1,000 mm of annual rainfall and 17%–22% rainfall variability. Fraval et al. (2019) investigated food access deficiencies and their relationship with rural

livelihoods and food sourcing behaviour in sub-Saharan Africa (SSA). Utilizing a large sample of 6,353 rural land-holding households, the research identifies food access and diet diversity deficiencies during both "flush" and "lean" periods, with a focus on the lean period for food security of access. Findings indicate that 39% of households were severely food insecure in terms of food access, and 49% were likely deficient in micronutrients during the lean period. The study highlights that vulnerability to food insecurity and micronutrient deficiencies varies by household composition, agricultural livelihood, and agro-ecological zone. It also finds that households with livestock had lower prevalence of severe food insecurity and higher diet diversity scores.

Gebre (2021) explored the relationship between food insecurity and climate change vulnerability in East Africa, focusing on Ethiopia, Kenya, and Tanzania. Using primary data collected in 2018/19, the study employs the Household Food Insecurity Access Scale (HFIAS) to measure food insecurity and an ordered probit econometric model to analyze factors influencing food insecurity prevalence. The findings reveal that 52% of households in the region are food-secure, while 15% and 26% are mildly food-secure and moderately food-insecure, respectively. Seven percent of households are severely food-insecure. The study's results indicate that exposure to climate change extremes, such as crop losses, significantly contribute to the prevalence of food insecurity in these countries. Additionally, the research highlights the importance of households' adaptive capacity in reducing food insecurity. Households' assets demographic/human, social, financial, physical, and natural—also play a crucial role in mitigating food insecurity. These factors contribute to a household's ability to manage the impacts of climate change, thereby improving food security across the three countries. Tuomala and Grant (2022) investigated how access to food through retail supply chains impacts food security among the urban poor in South Africa. Using urban metabolic flows as the theoretical framework within supply chain management (SCM), the field study was conducted in a South African township, involving 59 semi-structured interviews. The findings suggest that societal factors play a crucial role in food distribution, both in terms of spatial aspects (i.e., the location of retail outlets) and nutritional considerations (i.e., the quality and quantity of available food).

In the specific context of Nigeria, Oluwatayo and Ojo (2019) examined the effect of Information Communication Technology (ICT) on food insecurity among farming households in Nigeria, using data from the 2013 General Household Survey Panel (GHS-Panel) that includes 2,240 households. The study found that 43% of farming households were food insecure, with an average household size of 7 and the most commonly used ICT devices being radio, television, and mobile phones. Households with access to ICT were less food insecure, and the probit regression analysis identified determinants of food insecurity such as household size, location (rural or urban), zone of residence, distance to the market, marital status, and access to ICT. Similarly, Kassy et al. (2021) assessed the food security status and the factors affecting food security among households in Enugu State, Nigeria. A descriptive cross-sectional study was conducted with 800 households in Enugu State. The findings revealed that 61.1% of households were food-insecure. Key factors influencing food security included wealth index, membership in a cooperative society, insufficient money to purchase food, and limited access to marketplaces. Common coping strategies among households included skipping meals (77%), reducing meal quantity (92.6%), purchasing less preferred meals (72.3%), and borrowing food or money (31.3%). The study concluded that food insecurity was primarily driven by poverty, lack of cooperative membership, and limited access to marketplaces.

Adekoya et al. (2023) explored the impact of access to cooking energy on household food security in Nigeria, using data from the nationally representative Living Standards Measurement Study covering the period from 2010/2011 to 2015/2016. Household food security was assessed using the Household Dietary Diversity Score (HDDS) and the Household Food Insecurity Access Scale (HFIAS), while the major cooking fuel type used by households served as a proxy for cooking energy access. The study utilized Generalized Estimating Equations (GEE) for inferential analysis. The findings revealed that traditional biomass cooking fuels, such as firewood, grass, and charcoal, are still predominantly used by households across Nigeria. The analysis indicated that households using cleaner cooking energy sources enjoyed more diverse diets and had lower HFIAS scores compared to those relying on biomass. The study emphasizes the need to improve access to cleaner cooking energy sources, which would reduce carbon emissions, enhance health outcomes, and improve food and nutrition security.

Ilori et al. (2024) explored the link between food insecurity, food purchasing patterns, and perceptions of the food environment among residents of urban slums in Ibadan, Nigeria. Conducted with 590 randomly selected households in two urban slums, the study used the Household Food Insecurity Access Scale and the Coping Strategy Index to assess food insecurity and coping strategies. It also evaluated food procurement patterns, vendor types, and perceptions of the food environment. Key findings include a high prevalence of food insecurity, with 88% of households affected and 40.2% experiencing severe food insecurity. Restrictive coping strategies were common, with 32.5% of households limiting food portions and 28.8% reducing meal frequency. Most households bought food frequently, primarily from formal and informal markets, rather than wholesalers or supermarkets, and few households grew their own food or raised livestock (3.2%). The study found that food-insecure households perceived less access to the food environment, with a 10% increase in perceived access for every unit decrease in food insecurity. The most common foods purchased were fish (72.5%), bread (60.3%), rice (56.3%), and yam and cassava flours (50.2%). Food-secure households, however, purchased fruit, dairy, and vegetable proteins more often. The study concludes that food insecurity is a significant public health issue in Ibadan's urban slums.

A notable gap in the literature is the limited attention paid to food affordability a critical but often underexplored dimension of food security. While many studies have examined household food insecurity and coping strategies, few have explicitly analyzed how macro-level factors like climate change and human capital development influence food prices and households' ability to purchase adequate food. This neglect of affordability limits the comprehensiveness of food security research and policy. Therefore, this study contributes to the literature by shifting the focus to food affordability in Nigeria, specifically examining how climate change (proxied by CO<sub>2</sub> emissions) and human capital development affect the cost of food. By addressing this underexplored aspect of food security, the study aims to inform more balanced and inclusive policy responses that account not only for the availability of food but also for its economic accessibility.

### **3. Methodology**

#### **3.1 Theoretical Framework**

This study adopts the Malthusian theory of population as the theoretical framework for analyzing the impact of climate change and human capital on food affordability in Nigeria. This framework is further expanded to include other determinants of food affordability, not solely population

growth but also environmental factor (climate change) and socioeconomic factor (human capital), and GDP per capita as control variable. Malthus (1798) posited that population grows geometrically, while food production grows arithmetically, potentially leading to food shortages. Although modern agricultural advancements challenge this premise, rapid population growth in developing countries like Nigeria may constrain agricultural production and undermine food security. This theoretical foundation guides the formulation of the study's econometric model(s), incorporating climate change and human capital alongside other determinants of food security in Nigeria.

### 3.2 *Models Specification*

Building on the Malthusian theory of population, the functional form of the baseline model is expressed as:

$$FAF_t = f(POPG_t) \quad (1)$$

Where: FAF = Food Affordability, POPG = Population Growth (annual percentage growth in population). In line with previous related studies, such as Enilolobo et al. (2022), this study extends the Malthusian framework by incorporating an environmental factor (climate change, represented by CO<sub>2</sub> emissions) and a socio-economic factor proxied by human capital index (HCI) to offer a comprehensive understanding of the factors affecting food affordability. Consequently, the baseline model is reformulated as:

$$FAF_t = f(POPG_t, CO2_t, HCI_t, GDPP_t) \quad (2)$$

Where: FAF = Food affordability, POPG = Population Growth, CO<sub>2</sub> = Carbon Dioxide Emissions, and HCI = Human Capital Index. The econometric model is represented as:

$$FAF_t = \alpha_0 + \alpha_1 POPG_t + \alpha_2 CO2_t + \alpha_3 HCI_t + \alpha_4 GDPP_t + \varepsilon_t \quad (3)$$

In Equation (3),  $\alpha_0$  represents the constant term, which captures the baseline level of food affordability (FAF) when all explanatory variables are equal to zero. The coefficients  $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$  and  $\alpha_4$  quantify the effects of population growth (POPG), carbon dioxide emissions (CO<sub>2</sub>), human capital (HCI), and GDP per capita respectively, on food affordability. Each coefficient measures the expected change in food affordability resulting from a one-unit/percentage change in the corresponding independent variable, holding other variables constant. Finally,  $t$  represents time and  $\varepsilon$  denotes the error term, which captures all other unobserved influences and random disturbances that may affect food affordability but are not explicitly included in the model.

### 3.3 *Variables Description, Measurement and Sources of Data*

The dependent variable in this study is the second dimension of food affordability), which focuses on the overall food access within a country. This dimension is measured using food price index. The data for this variable is obtained from the FAO (2024). The primary independent variables include population growth, climate change, and human capital, which are critical determinants of food security. Population growth is measured as the annual percentage change in the population, reflecting the demand-side pressures on food systems. Similarly, CO<sub>2</sub> emissions, representing the impact of climate change, are measured in metric tons per capita. Human capital, a composite measure of the quality of education and health in a population, is constructed using Principal

Component Analysis (PCA) of two variables: The data for these variables are also obtained from the World Bank (2024), and their standardized values are combined to generate the Human Capital Index (HCI). The summary of variable codes, descriptions, measurement, expected signs, and sources of the data are presented in Table 1.

Table 1: Variables Description, Measurement and Data Sources

Codes	Variables Description and Measurement	Sign	Sources
FAF	Food Price Index	N/A	FAO (2024)
POPG	Population growth (annual %)		World Bank (2024)
CO2	Carbon dioxide (CO2) emissions per capita (t CO2e/capita)	-	World Bank (2024)
HCI	Human Capital Index	-	World Bank (2024)
GDPP	GDP Per capita (annual %)	+	World Bank (2024)

Note: NA = Not applicable

Source: Researcher's compilations (2025)

### 3.4 Estimation Techniques: FMOLS and DOLS

Before proceeding with the estimations and analysis of the model specified in section 3.2, unit root and cointegration tests are conducted. Given the time series nature of the data, it is essential to ensure that the variables are stationary to avoid spurious results. Therefore, Zivot and Andrews (1992) and Perron (1997) unit root tests that allow for structural breaks in the time series are employed. These types of unit root tests are designed to capture the presence of one-time structural shifts such as economic crises, policy reforms, or technological changes that can bias traditional tests toward non-stationarity. After confirming the integration of order the variables, cointegration analysis was conducted to determine if a long-term equilibrium relationship exists among the variables in the specified model. Cointegration suggests that even if variables are individually non-stationary, their linear combination may be stationary, indicating a long-run relationship. For this purpose, the Autoregressive Distributed Lag (ARDL) model for bounds test developed by Pesaran *et al.* (2001) was used.

After confirming the cointegration relationship among the variables in the specified model, this study employs the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) estimation techniques to examine the long-run relationship between climate change, human capital, and food affordability in Nigeria. These techniques are particularly suitable for analyzing cointegrated time series data, as they address the issues of endogeneity and serial correlation that often affect conventional OLS estimates in the presence of non-stationary variables.

FMOLS, developed by Phillips and Hansen (1990), modifies the traditional OLS estimator to account for serial correlation and endogeneity by applying semi-parametric corrections. This technique provides asymptotically unbiased and efficient estimates of the long-run parameters, making it robust for small sample sizes and suitable when the regressors are integrated of order one,  $I(1)$ , and cointegrated.

DOLS, introduced by Stock and Watson (1993), complements FMOLS by including leads and lags of the first-differenced regressors in the model. This dynamic specification helps correct for endogeneity and serial correlation through parametric adjustments. DOLS is particularly useful for small samples and provides unbiased and consistent long-run coefficient estimates under cointegration. The use of both FMOLS and DOLS allows for the robustness of results and cross-validation of the estimated coefficients. These techniques are well-suited for this study, given the

time series nature of the data and the need to obtain reliable long-term estimates of how climate change and human capital influence food affordability in Nigeria.

## 1. Results and Discussion

### 4.1 Results of Descriptive Statistics

This section summarizes the statistical features of the variables used in the study, as presented in Table 4.1. These descriptive statistics include measures of central tendency (mean, median, maximum and minimum), dispersion (standard deviation), and distribution (skewness and kurtosis), alongside the results of the Jarque-Bera test for normality. The result show that the food affordability (FAF) has a mean value of 88.563, indicating moderate food affordability on average, with a standard deviation of 25.166, suggesting significant variability across observations. Environmental impact is proxied by Carbon Dioxide (CO<sub>2</sub>) Emissions, which has a mean value of 0.779 metric tons per capita. CO<sub>2</sub> emissions exhibit positive skewness (0.955) and a kurtosis of 3.773, highlighting a slightly skewed distribution with some outliers. Socio-economic factors are also considered.

**Table 4.1: Descriptive Statistics**

Variables	Mean	Median	Max.	Min.	Std. Dev.	Skew.	Kurt.	Jarque-Bera	Prob.
FAF	88.563	91.953	144.510	53.433	25.166	0.248	1.938	3.032	0.220
CO2	0.779	0.766	1.391	0.482	0.210	0.955	3.773	9.369	0.009
HCI	0.263	0.449	1.406	-3.346	1.169	-1.397	4.171	20.264	0.000
POPG	2.652	2.674	3.121	2.093	0.244	-0.558	3.400	3.102	0.212
GDP	0.691	1.378	12.210	15.759	5.334	-0.730	4.364	8.815	0.012

*Source: Researcher's computation (2025), using E-Views 13.*

The Human Capital Index (HCI), reflecting educational attainment and health, has a mean of 0.263 and is negatively skewed (-1.397), with a high kurtosis value (4.171), suggesting the presence of significant outliers. Population Growth (POPG), with a mean of 2.652% annual growth, displays low variability (standard deviation of 0.244) and a relatively symmetric distribution. GDP per capita, has a mean value of 0.691 and minimal skewness (-0.730), suggesting a fairly uniform distribution. The Jarque-Bera test result indicate that while two variables (FAF and POPG), exhibit distributions close to normal, other three variables, significantly deviate from normality. This detailed statistical overview provides crucial insights into the data's properties, serving as a foundation for the subsequent empirical analysis.

### 4.2 Results of Unit Root Tests

This section presents the results of unit root tests conducted to examine the stationarity properties of the variables. Zivot-Andrews (1992), and Perron (1997) tests were used to examine the stationarity of each variable and the results are presented in Table 4.2.

**Table 4.2. Results of Unit Root (Zivot-Andrews & Perron) Tests**

Variables	Zivot-Andrews (1992)		Break Date	Perron (1997)		Break Date
	Level	1 <sup>st</sup> Difference		Level	1 <sup>st</sup> Difference	
	t-Statistic	t-Statistic		t-Statistic	t-Statistic	
FAC	-5.793**	-----	2007	-5.794**	-----	2006
CO2	-8.545**	-----	1981	-6.066	-----	1980
HCI	-4.469	-5.239**	1983	-4.871	-6.197***	1982
POPG	--5.131**	-----	2007	-6.138**	-----	1995
GDPP	-7.334**	-----	2000	-7.167	-----	1999

Notes: Both Zivot-Andrews and Perron tests are conducted with intercept and trend. Asterisks (\*\*\*) and (\*\*) indicate significance at 1% and 5% level, respectively.

Source: Researcher's computation (2025), using E-Views 13.

Table 2 presents the results of the Zivot-Andrews (1992) and Perron (1997) unit root tests, both of which account for the possibility of structural breaks in the time series data. These tests are particularly useful when conventional unit root tests (ADF and PP) may fail to detect stationarity due to unaccounted structural changes such as policy shifts, economic crises, or external shocks. The Zivot-Andrews test results show that only one variable (HCI) is non-stationary at level but become stationary after first differencing, indicating it is integrated of order one, I(1). However, the remaining four variables are stationary at level, suggesting they are I(0). Similarly, Perron's test confirms that HCI is I(0). The mixed order of integration across the variables highlights the need to adopt the ARDL bounds testing approach for cointegration analysis, as it is well-suited for models where variables are integrated at different orders.

### 4.3 Results of ARDL Bounds Test for Co-Integration

Having established the order of integration of the variables and ensure their stationarity property, which confirmed that the variables are either integrated of order zero I(0) or order one I(1), the next step is to conduct co-integration test to determine whether long run (equilibrium) relationship exist between food affordability and explanatory variables in the model. Table 4.3 presents the results of the ARDL bounds test for the model. The F-statistic and critical values are used to determine the presence of a long-run (cointegration) relationship among the variables.

**Table 3: Result of ARDL Bounds Tests**

	Test Statistic		Critical Values	
	Value	Significance	I(0)	I(1)
F-statistic	6.167***	5%	3.12	4.25
k	5	1%	3.93	5.23

Note. k = no. of independent variables, \*\*\* and \*\* denotes a rejection of the null hypothesis of no co-integration at 1% and 5% significance level respectively.

Source: Researcher's computation (2025), using E-Views 13.

The result of the ARDL bounds test for co-integration presented in Table 3 provide critical insights the long-run relationships between food affordability and the explanatory variables. The test uses

the F-statistic to compare with the critical value bounds at 5% and 1% significance levels. If the F-statistic exceeds the upper bound ( $I(1)$ ) at a given significance level, the null hypothesis of no co-integration is rejected, indicating the presence of a long-run equilibrium relationship. The result show that, the F-statistic (6.167) exceeds the critical values at both 1% (5.23) and 5% (4.25) significance levels, strongly rejecting the null hypothesis. This result confirms the existence of a co-integrating relationship between food affordability and the explanatory variables in the long run.

#### 4.4 Results of the Estimated Coefficients of Food Affordability Model

This section presents the results of estimated coefficients, focusing on long-run relationship between food affordability (FAF) and its key determinants: population growth (POPG), climate change (CO2), human capital index (HCI), and GDP per capita. The results as presented in table 4.4, are divided into two parts: FMOLS in panel A and DOLS in panel B. The results show that ppopulation growth in both FMOLS (coefficient = 2.991, p-value = 0.001) and DOLS (coefficient = 0.729, p-value = 0.000) estimators, exerts a positive and significant effect on the food affordability proxied by food price index. This reinforces the conclusion that rising population pressures increase food prices, thereby reducing food affordability. The stronger coefficient in FMOLS suggests that under a fully modified estimation, the impact may be even larger. In Nigeria, where rapid population increases, especially in urban and peri-urban areas have outpaced the development of effective food distribution systems, the strain on transportation networks and market infrastructure often results in uneven food access. This is evident in states such as the densely populated Lagos and Kano, where increased demand has led to congestion and logistical bottlenecks, thereby limiting the accessibility of food in markets.

Similarly, the results for CO<sub>2</sub> emissions are also robust across all models. FMOLS (coefficient = 0.432, p-value = 0.000) and DOLS (coefficient = 0.390, p-value = 0.043) indicating that higher carbon emissions are associated with higher food prices, likely through climate-related disruptions to food production. The significant negative coefficients for CO<sub>2</sub> emissions suggest that the erratic weather patterns and extreme climatic events such as droughts and floods that are increasingly common in Nigeria disrupt not only agricultural output but also the efficiency of food distribution networks. This effect implies that even after initial agricultural shocks, the ripple effects on infrastructure and supply chains further constrain food access for vulnerable populations, particularly in rural areas where resilience is limited.

Table 4.4: Results of Estimated Coefficients (FMOLS and DOLS)

Panel A: FMOLS				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPG	2.991	1.178	2.539	0.001
LNCO2	0.432	0.139	3.119	0.000
HCI	-3.116	0.400	-7.797	0.000
GDPP	1.322	0.700	1.889	0.065
DUM	-4.420	1.680	-2.631	0.000

C	4.708	0.771	6.109	0.000
R-squared	0.547			
Adjusted R-squared	0.516			
Panel B: DOLS				
POPG	0.729	0.144	5.063	0.000
LNCO2	0.390	0.185	2.105	0.043
HCI	-0.525	0.189	-2.778	0.009
GDPP	-0.422	0.146	-2.896	0.006
DUM	1.170	0.406	2.880	0.007
C	14.604	37.783	0.387	0.701
R-squared	0.776			
Adjusted R-squared	0.754			

*Source: Researcher's computation (2025), using E-Views 13.*

Human capital consistently shows a negative and significant effect in both FMOLS (coefficient = -3.116) and DOLS (coefficient = -0.525). This consistent negative relationship suggests that, improvements in education and health infrastructure significantly contribute to lowering food prices. The impact of GDP per capita is also consistently negative across the models. In FMOLS, GDPP shows a coefficient (-1.322, p-value = 0.065), and similarly, in the DOLS model, GDPP is also negative (coefficient = -0.422, p-value = 0.006), suggesting that per capita income tends to decrease food prices and enhances food affordability. In Nigeria, initiatives aimed at improving educational and healthcare outcomes have begun to yield dividends in terms of better-informed and more efficient food supply chain management. This is consistent with theoretical perspectives like Sen's entitlement approach, which stresses that enhancing individual capabilities is crucial for overcoming barriers to food access. Empirical studies by researchers such as Odunze et al. (2016) and Osabohien et al. (2018) corroborate these findings, highlighting that investments in human capital can lead to more resilient food distribution systems, ultimately improving food accessibility.

The dummy variable results show a consistently positive impact on food prices across the models. In FMOLS and DOLS, DUMs are positive and significant (4.420 & 1.170), indicating that structural breaks, such as economic crises or major policy changes, led to higher food prices. In the sense that structural changes, in the long term, contributed to market adjustments that increased food prices. Regarding model fit, the R-squared values are relatively strong: 0.547 for FMOLS and 0.776 for DOLS, indicating that approximately 55% and 78% of the variation in food accessibility, respectively, are explained by the included variables. The higher R-squared in DOLS

suggests a better overall explanatory power, likely due to the model's correction for endogeneity and serial correlation.

## 5. Conclusion and Recommendations

This study investigated the impact of climate change and human capital on food affordability in Nigeria, using annual time series data from 1971 to 2023. The analysis employed Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) to capture the long-run relationships among key variables including population growth, CO<sub>2</sub> emissions, human capital, GDP per capita, and structural changes. The results provide robust evidence that population growth has a significant and positive effect on food prices, thereby reducing affordability. CO<sub>2</sub> emissions, a proxy for climate change, also exert a significant positive impact on food prices across both models. This reinforces the notion that climate variability, including floods and droughts, disrupts agricultural productivity and supply chains, making food less affordable, especially for vulnerable rural populations. On the other hand, human capital consistently demonstrates a significant negative relationship with food prices. This implies that investments in education and health improve individual capabilities and enhance the efficiency of food production and distribution systems, thereby reducing costs and improving access. GDP per capita also showed a negative association with food prices, indicating that higher income levels are linked to better food affordability. As households gain more purchasing power, they can afford more diverse and nutritious diets, and demand-side pressures are more efficiently managed through market mechanisms. Based on the findings, the following recommendations are proposed:

- i. Strengthen food distribution infrastructure in rapidly urbanizing areas to mitigate the inflationary impact of population growth on food prices. Investments in rural-urban transport networks, storage facilities, and market integration are essential.
- ii. Accelerate climate adaptation strategies in agriculture. This includes supporting climate-resilient farming practices, irrigation schemes, and early warning systems to buffer the effects of CO<sub>2</sub>-induced climate disruptions on food supply.
- iii. Enhance human capital development by increasing public investment in education, healthcare, and vocational training. A healthier and more educated population contributes to more efficient agricultural systems and better food security outcomes.
- iv. Promote inclusive economic growth by supporting income-generating opportunities and small-scale agro-enterprises, which can improve household purchasing power and food access.
- v. Stabilize food policy environments by ensuring that structural reforms and macroeconomic policies are accompanied by social safety nets and food price stabilization mechanisms to cushion vulnerable populations.

In conclusion, while most existing studies tend to focus predominantly on food availability, this study emphasizes food affordability as a crucial and often neglected dimension of food security. By highlighting the significant roles of climate change and human capital, the research contributes to a more holistic understanding of the structural determinants of food insecurity in Nigeria and provides actionable insights for policymakers and development practitioners.

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