International Journal of Developing and Emerging Economies
Vol.13, No.1, pp.19-25, 2025
Print ISSN: 2055-608X (Print),
Online ISSN: 2055-6098(Online)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development -UK

# Climate Change and Food Price Inflation: Evidence from Nigeria

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doi: https://doi.org/10.37745/ijdee.13/vol13n11925 Published January 02, 2025

**Citation:** Marafa H. (2025) Climate Change and Food Price Inflation: Evidence from Nigeria, *International Journal of Developing and Emerging Economies*, Vol.13, No.1, pp.19-25

**Abstract**: *This paper focuses on precipitation anomaly as a proxy for climate change to investigate how climate change affects food price inflation in Nigeria. An ARDL model was employed to entangle and quantify drivers behind the relationship between precipitation anomaly and food price inflation. The result shows that a 1 per cent increase in precipitation anomaly implies an increase of 0.58 per cent in food inflation in the short run. At the same time, an increase of 1 per cent precipitation anomaly implies an increase of 0.11 per cent in food inflation in the long run. This means that precipitation anomaly pushes food prices upward, which affects inflationary trend in general and monetary policy effectiveness. To keep inflation under target, policy incentive towards adaptation and mitigation of climate change should be rolled out to tame climate-induced food price inflation in both long run and short run. Additionally, policy makers ought to gauge climate perception of economic agents in anchoring inflation expectation. This is in additional to monetary policy mechanism which ought to be sensitive to precipitation anomalies and other climate related shocks and risks as they affect the primary mandate of ensuring price stability.*

**Keywords**: climate change, food , price inflation, Nigeria

## INTRODUCTION

Empirical studies have demonstrated the impacts of climate change on agricultural output (de Lima et al. 2021; Moore et al. 2017a, 2017b; labour productivity (Dasgupta et al. 2021); energy demand (Auffhammer et al., 2017; Wenz et al., 2017) and human health (Gua et al. 2016; Song et al. 2017). The resulting consequences for macroeconomic production have also been elucidated, with nonlinear impacts of average temperature (Burke et al. 2015; Dell et al., 2012; Kalkuhl & Wenz, 2020), temperature variability (Kotz et al., 2021) and various aspects of precipitation (Kotz et al. 2022) identified on aggregate economic output in historical data. Climate change is expected to imply considerable welfare losses when evaluated through both these micro-(Bressler, 2021; Moore et al., 2017a; Rode et al. 2021) and macro-economic impact channels (Burke et al. 2018, 2015; Kulkuhl & Wenz, 2020; Moore & Diaaz, 2015).

Despite these advances, the implication of climate change on inflation remains understudied. Heinen et al. (2019) studied the impact of hurricanes and floods on the monthly inflation rates of fifteen Caribbean islands. They conclude that although the average inflation impact of a hurricane is small, it can be greater for more severe events. Similarly, Cavello et al. (2014) find that even with severe supply disruption that major earthquakes can bring, prices remain stable. They attribute it to retailers avoiding price-gouging, i.e. preferring to run out of stock in response to a study disruption rather than increase prices. Peersman (2022) shows that exogenous (weather-driven) food price shocks strongly impact consumer prices in the Euro area, suggesting that inflation volatility in advanced economies may rise with an increased frequency of global extreme weather events. Similarly, Faccia et al.(2021) find that upward temperature anomalies have swift upward effects on food prices in the short term in a cross-country analysis of 48 advanced emerging economies. In another study, Ciccarelli et al. (2023) find that monthly mean temperatures affect seasonal euro area inflation patterns by raising inflation in summer and autumn and higher temperature variability significantly raising inflations. Also, Kabundi et al. (2022) studied inflation by type and intensity of cliamte shocks and find that drought tend to push inflation.

Moreover, the literature on climate change's impact on inflation focuses primarily on the agricultural sector and food prices through temperature and weather-related events. Although extreme temperature events lead to drought and poor agricultural output, productivity, output, and prices largely depend on the changing precipitation pattern for countries especially within the tropics. This paper, therefore, intends to focus on a specific aspect of climate change; the precipitation anomaly and how it affects food price inflation in Nigeria. It will provide policy recommendations for enhancing resilience and sustainable growth.

## Empirical Methodology

This study applies econometric model to disentangle and quantify drivers behind the shocks from climate risks that positively or negatively affect food inflation. Thus, the study adopts a quantitative econometric approach to investigate several empirical application variants.

## Data Analysis

Adopting a historical quantitative data approach of past activities, this paper used monthly time series data on food prices from January 2014 to January 2024. Other variables included in the model are food import and Premium Motor Spirit (PMS).

## The model

To investigate the response or reactions of Food Price Inflation (FPI) to climate change, an Autoregressive Distributed Lag (ARDL) is used. Consequently, we arrange and specify our model in the following format.

$$FPI = (PRECI, FIM, PMS) \quad (1)$$

From equation (1), FPI is the dependent variable, while PRECI (proxy for climate change), FIM (proxy for food import) and PMS (proxy cost of transportation). Thus, equation (1) indicates that FPI is influenced by climate change and the cost of transport.
With controlled variables, the equation (1) with log can be rewritten as;

InPRECI, InFIM, InPMS (2)

Expressing equation (2) in a linear form and including the constant term, the stochastic error term and the logarithm form of the model, equation (2) is transformed to become.
(InFPIt)= Ø0 + (InØ1PRECIt) + (InØ2FIMt) + (InØ3PMIt) + εt (3)

Where FPI is the log of Food Price Inflation (as the dependent variable), PRECI signifies precipation anomalies. In line with Shin (2014), the nonlinear ARDL is subjected to the bounds test of Autoregressive Distributed Lag (ARDL), and the Pesaran critical values are equally suitable and used to determine cointegration.

Thus, the general ARDL model for the study is specified;

$$\Delta LEMPit = ait + \sum_{i=0}^{k} \phi 1it \ \ \Delta LPRECIit + \sum_{i=0}^{k} \phi 3it \, \Delta LFIMit \ + \sum_{i=0}^{k} 4it \, \Delta LPMIit \ \ \sum \ \ + \Delta LFPIit + \gamma 1it + \gamma 1itLFPI1it \ + \gamma 2it \, \Delta LPRECIit + \gamma 3it\Delta LFIMit \ + \gamma 4it \, \Delta LPMIit + \mu it \ \ (4)$$

Where ($\Delta FPI$ and $LFPI$) are dependent variables in the first differences and levels, and ($\Delta PRECI$, $\Delta FIM$, and $\Delta PMS$) are independent variables in the model in the first difference and levels, indeed, $\phi 1it \ldots \phi 4it$ ... $\gamma 1it \ldots$. $\gamma 4it$ are the parameters of variable, and $\mu it$ *is* the error term of the model.

## RESULTS AND DISCUSSION OF FINDINGS

The Unit root test was applied to determine the stationary levels of the variables. Unit root test results showing the stationary levels of the variables are given in Table 1.

**Table 1; Unit Root Test**

| | Level | | 1st Difference | |
|---|---|---|---|---|
| **Variables** | **C** | **C&T** | **C** | **C&T** |
| FPI | 0.24855 | 0.379426 | 0.0001 | 0.02593 |
| FIM | 0.013773 | 0.012831 | 0.0004 | 0.001 |
| PRECI | 0.245749 | 0.527567 | 0.000395 | 0.001 |
| PMS | 0.025749 | 0.129567 | 0.00020 | 0.001 |

** >=0.5% expresses the level of significance.

Based on the results, the variables become stationary at both levels, and the first difference. This revealed that the series is integrated of order I (1) at a 5% significance level for the ADF. The optimal lag length applied was based on the Akaike Information Criterion (AIC), and bandwidth was chosen automatically using the Newy-West Method. All tests are based on trend, and trend and intercept equation at both level and first difference. According to the unit

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root test results obtained, there is no obstacle in applying the ARDL boundary test method to test the long- and short-term relationship between the variables. A cointegration test was run to test the correlation between coefficients. The result shows a probability value of less > than 5 %, while Statistics is greater than the critical value. Therefore, we reject the null hypothesis and conclude that there is cointegration between variables.

**Table 2; Short term coefficients from ARDL test**

| Variables | Coefficients | T- Statistic |
|---|---|---|
| FPI | 0.58311749 | 3.1123417*** |
| FIM | 0.16510437 | 0.1786741*** |
| PRECI | 0.70551289 | 0.0852656*** |
| PMS | 0.50551289 | 0.0652656*** |

***1%, ** %5%, *10% express the level of significance

The results show that a 1% increase in precipitation anomaly increases food price inflation by 0.58 per cent, as 1 per cent increase in precipitation anomaly increases food imports by 0.16 per cent. It also shows that a 1 per cent increase in PMS increases food inflation by 0.50 per cent. The long-term test results and coefficient values obtained from the ARDL model are given in Table 3.

**Table 3: term coefficients from the ARDL test**

| Variables | Coefficients | T- Statistic |
|---|---|---|
| FPI | 0.11862181 | 0.5280482*** |
| FIM | 0.30942821 | 1.94509867*** |
| PRECI | 12.6076575 | 1.44610369*** |
| PMS | 0.60761575 | 1.24610339*** |

***1%, ** %5%, *10% express the level of significance

According to long-term results, an increase of 1 per cent in precipitation anomaly raises food prices by 0.11 per cent. Additionally, an increase of 1 per cent in precipitation anomalies raises food import by 0.30 per cent. While a 1 per cent increase in PMS raises food prices by 0.60 per cent. This means that precipitation anomaly pushes food prices upward, which affects inflationary trend in general and monetary policy effectiveness.

## CONCLUSION

This paper examined the relationship between climate risks and food price inflation in Nigeria. It started by testing for the presence of unit root in. The results for the model are significant at 0.05. The paper proceeds to analyze the error correction model and the long-run test. Before drawing inference, the paperestablished the validity of the models through different diagnostic tests- serial correlation and model specification. The probability values of all the tests are greater than the 0.05 level, confirming the validity and reliability of the models. Generally, a 1 per cent increase in precipitation anomaly implies an increase of 0.58 per cent in food inflation in the short run. Meanwhile, an increase of 1 per cent in precipitation anomaly implies an increase of 0.11 per cent in food inflation in the long run. To keep inflation under target, policy incentive towards adaptation and mitigation of climate change should be rolled out to tame the impact of climate-induced food inflation in both long run and short run. Additionally, policy makers ought to gauge the climate perception of economic agents in anchoring inflation expectation. This is in additional to monetary policy mechanism which must be sensitive to precipitation anomalies and other climate related shocks and risks as they affect primary mandate of ensuring price stability.

**Declarations**
I declare that there is no competing financial or non-financial interest that might have influenced the work in this paper.

The views expressed herein are solely those of the author and does not reflect the views of the affiliated institution (Central Bank of Nigeria).

Additionally, I declare that no funding was obtained for this study.

The dataset used in this paper are available from the author on request.

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