THE IMPACT OF MONETARY POLICY AND CLIMATE CHANGE ON INCOME INEQUALITY IN NIGERIA

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Abstract
Income inequality in Nigeria persists despite decades of monetary interventions and growth policies, and is increasingly compounded by climate-related shocks. While these drivers are often examined separately, this study offers a novel perspective by jointly analyzing how monetary policy and climate change interact to shape inequality. Using annual data from 1986–2024 and the Autoregressive Distributed Lag (ARDL) model, the study assesses the short- and long-run dynamics among the Gini index, monetary policy rate (MPR), GDP growth, and climate indicators. Unit root tests show mixed integration orders, while ARDL bounds tests reveal no significant long-run relationship. Short-run estimates, however, indicate that a higher MPR significantly raises inequality, implying that monetary tightening disproportionately affects vulnerable groups. GDP growth also exhibits a marginally positive effect on inequality, reflecting "growth without inclusion," while climate variables are insignificant in the short run. The findings suggest that monetary policies must integrate equity objectives. The Central Bank of Nigeria should expand targeted credit schemes and promote financial inclusion, while government authorities should invest in climate-resilient agriculture, irrigation, and disaster-risk reduction to cushion vulnerable populations. Coordinated policies are essential to ensure that macroeconomic stability does not exacerbate inequality.

Keywords: ARDL Climate Change, Income Inequality, Kuznets Monetary Policy Rate

JEL Classification: D63, E52, E62, O60, Q56.

1. Introduction

Income inequality remains a major challenge in developing countries, especially in Sub-Saharan Africa. In Nigeria, despite substantial economic growth, wealth distribution is highly uneven, with a small elite controlling most resources while the majority live in poverty (World Bank, 2024). Macroeconomic measures like monetary policy and external shocks, such as climate change, significantly influence this inequality. Monetary policy, through interest rate adjustments, money supply regulation, and inflation control, is central to economic stabilisation and growth (Mishkin, 2023). However, evidence shows that it often favours wealthier individuals and large firms with better access to credit, thereby worsening income inequality (Coibion et al., 2022). At the same time, climate change poses serious risks to Nigeria's development. Rising temperatures, erratic rainfall, flooding, and desertification reduce agricultural productivity, disproportionately hurting rural low-income households dependent on farming (UNDP, 2023; Kifle et al., 2024).

These shocks increase food prices, reduce purchasing power, and threaten jobs in climate-sensitive sectors (Olaniyi & Bamidele, 2023).

While studies have examined monetary policy and climate change separately, little is known about their combined effects on income inequality in Nigeria. Monetary policy alone has not solved the inequality problem, as measures like interest and exchange rate management tend to benefit capital owners and urban businesses more than rural poor populations (Kifle et al., 2024). Meanwhile, climate change deepens disparities by undermining food security and rural livelihoods. Together, these dynamics may counteract each other, complicating efforts at inclusive development. This study addresses this gap by investigating how monetary policy and climate change impact income distribution in Nigeria. Specifically, it seeks to answer questions like: How does Nigeria's monetary policy affect income inequality? How does climate change influence wealth inequality? What is the combined effect of monetary policy and climate change on income inequality? In this regard, the objectives of this study are: to examine the impact of monetary policy on income inequality in Nigeria, to assess the effects of climate change on wealth inequality, and to explore the interaction between monetary policy and climate change in shaping income inequality.

2.0 Review of Related Literature

2.1 Conceptual Review

2.1.1 Income Inequality

Income inequality refers to the disproportionate allocation of earnings, wealth, and resources among individuals, households, or organistions within a population. The Gini coefficient, Palma ratio, and income quintiles can be utilized for measurement, with elevated Gini values indicating increased inequality. Inequality obstructs social mobility and sustains poverty, with institutional impediments such as restricted access to school, jobs, and financial resources significantly contributing to the issue. When capital returns exceed economic growth, wealth becomes concentrated among the affluent, with tax and inheritance legislation affecting the degree of inequality. Although moderate inequality can stimulate innovation, severe disparities impede skill development and long-term economic prosperity. In Nigeria, Adeleke and Mohammed (2024) identify inadequate education, limited financial access, and labor market disparities as key drivers of inequality, particularly affecting women, rural populations, and informal sector workers. Despite government efforts to promote inclusivity, the wealthiest Nigerians hold most financial resources while many live in extreme poverty (UNDP, 2023). Climate change, financial crises, and regional disparities, especially between the richer south and poorer north, further deepen inequality (Kifle et al., 2024). Akinbobola and Saibu (2023) highlight urbanisation, ineffective wealth redistribution policies, and weak social safety nets as worsening factors, especially in rural high-poverty areas. Overall, Nigeria's persistent inequality reflects historical, structural, and policy shortcomings. Addressing it requires equitable, targeted policies that tackle both economic and environmental disparities.

2.1.2 Monetary Policy

Monetary policy refers to the deliberate actions taken by a country's central bank to regulate the supply of money and credit in the economy to achieve macroeconomic stability. It is broadly classified into expansionary monetary policy, which increases money supply and lowers interest rates to stimulate investment and employment, and contractionary monetary policy, which

reduces money supply and raises interest rates to curb inflation (Mishkin, 2023; Blanchard & Johnson, 2022). The main instruments of monetary policy are categorized into quantitative tools, such as open market operations, cash reserve ratios, and monetary policy rates, which influence the overall liquidity in the economy, and qualitative tools, such as credit rationing and sectoral credit allocation, which target specific sectors for growth (Friedman, 1968; Bernanke & Gertler, 1995). In Nigeria, the Central Bank of Nigeria (CBN) applies these instruments to stabilize prices, maintain exchange rate balance, and promote economic growth (Lawal &Yusuf, 2022). However, the conceptual effectiveness of monetary policy goes beyond stabilisation, as its outcomes depend on structural factors such as the level of financial inclusion, the strength of transmission mechanisms, and the balance between the formal and informal sectors (Akinbobola & Saibu, 2023). Thus, conceptually, monetary policy is not only a tool for macroeconomic management but also a framework that shapes credit allocation, inflation control, and overall income distribution in the economy.

2.1.3 Climate Change

Climate change refers to long-term alterations in the Earth's average temperature, precipitation patterns, and the frequency of extreme weather events, largely driven by human activities such as fossil fuel combustion, deforestation, and industrial emissions (UNDP, 2023). Conceptually, it is distinguished from short-term weather fluctuations because it reflects persistent and cumulative shifts in climatic conditions over decades. Climate change is manifested in phenomena such as global warming, rising sea levels, desertification, flooding, and changes in agricultural productivity, all of which have wide-ranging social and economic implications (Stern, 2007; Tol, 2009). In developing countries like Nigeria, the concept of climate change is most evident through its impact on livelihoods and inequality. Desertification in the north, recurrent flooding in coastal regions, and erratic rainfall patterns disrupt agricultural production, which is the main source of income for a large share of the population (Olaniyi & Bamidele, 2023; Adeleke & Mohammed, 2024). Vulnerable groups, such as smallholder farmers and low-income households, face heightened risks because they lack the resources to adapt to climate shocks. Thus, conceptually, climate change is not only an environmental challenge but also an economic and social issue, as it deepens poverty, reduces food security, and widens inequality in Nigeria (Onuoha & Egwuonwu, 2023; Kifle et al., 2024).

2.2 Theoretical Review

The theoretical review provides the intellectual foundation for analysing how monetary policy and climate change influence income inequality. Several theories offer explanatory frameworks for the relationships among these variables. This section focuses on the Environmental Kuznets Curve (EKC) and the Climate Justice Theory, highlighting their key proponents and relevance to the Nigerian context.

2.2.1 Environmental Kuznets Curve (EKC)

The Environmental Kuznets Curve (EKC) links economic development with environmental stress and inequality. Extending Kuznets' (1955) inverted-U hypothesis, Grossman and Krueger (1995) argue that pollution and climate pressures rise in early growth stages but decline as institutions strengthen. In Nigeria, industrialisation and urbanisation intensify climate shocks—flooding, desertification, and reduced agricultural yields—that disproportionately affect low-income groups. Monetary policy plays a pivotal role in this context: tight policies raising interest rates restrict credit to small farmers and informal enterprises while favouring capital-intensive sectors less exposed to climate risks. Within the EKC, this interaction between monetary policy and

climate shocks amplify inequality in the early stages of development before eventual stabilisation.

2.2.2 Climate Justice Theory

Climate Justice Theory highlights the unequal burden of climate change on those least responsible and least equipped to cope. Vulnerable groups, especially rural farmers and informal workers in Nigeria, face reduced livelihoods from climate shocks while restrictive monetary policies raise borrowing costs, limiting adaptation. High interest rates push banks to favour urban, capital-intensive sectors, further excluding climate-sensitive industries and widening disparities. Conversely, inclusive monetary frameworks that channel concessional credit to agriculture and small businesses could mitigate these inequities. Together with the EKC, Climate Justice Theory explains how monetary policy and climate shocks jointly drive inequality: climate shocks depress productivity, monetary tightening restricts credit, and inequality worsens. This synthesis supports including interaction terms between monetary policy and climate indicators in the empirical model.

2.3 Empirical Review

2.3.1 Empirical Studies on Monetary Policy and Income Inequality

Olaniran and Olomola (2024) examined the relationship among monetary policy, financial development, and income inequality in Nigeria from 1980 to 2022, utilising Vector Autoregression (VAR); findings revealed that disturbances in monetary policy and financial development exacerbate income inequality, prompting the authors to advocate for an emphasis on financial stability. Nadabo et al. (2024) examined the Financial Kuznets Curve in Nigeria from 1986 to 2022, utilising ARDL and Toda-Yamamoto causality analysis; they identified an inverted U-shaped correlation between financial development and inequality, concluding that equitable growth in the financial sector is essential for diminishing income disparities.

Khan et al. (2023) evaluated the impact of monetary policy on inequality in ten developing economies in Asia and Africa from 1990 to 2020, employing panel ARDL and FMOLS methodologies. The study revealed that an increased money supply diminished inequality, while inflation exacerbated it, concluding that synchronised policies aimed at enhancing money supply growth and regulating inflation can mitigate income disparities. Ajakaiye and Babatunde (2023) assessed Nigeria's monetary policy approach for inclusive growth between 2000 and 2022 using both descriptive statistics and econometric modelling, specifically employing regression techniques to examine the relationship between monetary policy instruments, inflation, and growth inclusivity. Their analysis showed that while monetary policy has been effective in maintaining price stability, its capacity to promote inclusive growth is limited by structural bottlenecks. They concluded that monetary policy in Nigeria must become more proactive and sector-focused, with greater emphasis on directing credit to productive and labour-intensive sectors.

Akinbobola and Saibu (2023) examined the impact of interest rate and money supply fluctuations on income inequality in Nigeria, utilising quarterly time-series data from 1995 to 2020. The study, utilising a vector error correction model (VECM), determined that interest rate volatility exacerbates income inequality by restricting loan availability for small-scale entrepreneurs and the informal sector. They determined that stable and inclusive monetary frameworks are crucial for reducing economic disparities.

Biswas and Ahamed (2023) performed a panel study on ten developing nations to evaluate the influence of financial inclusion on the efficacy of monetary policy. Utilising system GMM from

2004 to 2020, they found that enhanced financial inclusion amplifies the effect of monetary policy on inflation. Coibion et al. (2022) analysed the distributional impacts of monetary policy in the United States with a household-level panel dataset from 1980 to 2018. The study utilised a structural vector autoregression (SVAR) model and discovered that contractionary monetary policy shocks exacerbate income inequality by disproportionately diminishing employment among low-income families. The authors determined that the redistributive impacts of monetary policy are mostly contingent upon labour market reactions and asset ownership.

Apanisile (2021) analysed expected and unexpected monetary policy shocks in Nigeria from 2000 to 2019, utilising a Dynamic Stochastic General Equilibrium (DSGE) framework; the research revealed that both types of monetary shocks diminished income inequality and concluded that transparency in policymaking could mitigate the inequality gap. Nosike and Ojobor (2021) examined Africa and Asia utilising panel SVAR from 1990 to 2018; the study discovered that the constriction of monetary policy exacerbates income and consumption disparity, underscoring the significance of inadequate financial inclusion in intensifying these consequences. Mumdaz and Theophilopoulou (2017) presented data from many economies indicating that contractionary monetary policy shocks exacerbate income and consumption disparity through SVAR models. Although the study encompassed Nigeria, it determined that the effects of such inequality are enduring across nations.

2.3.2 Empirical Studies on Climate Change and Income Inequality

Kifle et al. (2024) explored how climate risk and wealth disparity are related in Sub-Saharan Africa, including Nigeria, from 1996 to 2022. The study used a dynamic panel Generalised Method of Moments (GMM) model to show that more exposure to climate shocks (such as droughts and floods) makes inequality worse by hurting agricultural productivity and rural lives more than other areas. The study found that strategies to help people adapt to climate change should focus on the most vulnerable groups to reduce inequality. Using GLS panel regressions, Ewolo et al. (2025) examined how climate change directly affected income inequality in 38 Sub-Saharan African nations from 1991 to 2020. They discovered that climate vulnerability makes inequality worse, with GDP per capita, population, and agricultural dependency acting as mediators. They suggested that development, social security funding, and agricultural resilience should all be climate-aligned. Letta et al. (2024) used long-term data from Nigerian household surveys and causal machine learning approaches (2015–2023) to look for "climate immobility traps." The study concluded that recurrent climate shocks and low assets keep rural families in poverty. It said that asset-building and adaptive capability need immediate policy support. Using system GMM, Springer et al. (2024) looked at how climate vulnerability is linked to sovereign debt risk in Vulnerable Twenty Group 20 (V20 nations), including Nigeria, from 2015 to 2020. They found that being more vulnerable makes debt pressure worse, which makes it harder for governments to pay for climate adaptation that reduces inequality. They called for debt relief and better climate finance.

Nwankwo and Okechukwu (2023) employed spatial econometric models to look at the impact of monetary policy on income distribution in Lagos and Port Harcourt from 2005 to 2022. They found that urban climate risks, like floods and heatwaves, hit low-income slum regions harder than other locations. Sulaiman et al. (2023) examined the combined effect of monetary policy and climate change on inequality, using data from Nigerian states from 2000 to 2020, and found that climatic stress in agriculture hurt rural incomes and that monetary policy did not help the areas that were affected. The study made use of SVAR and decided that climate-aware monetary policies that are aimed at specific areas are necessary to reduce inequality in rural areas. Olaniyi and Bamidele (2023) examined how climate change affected Nigeria's food security and the well-being of households from 1990 to 2020. Using a computable general equilibrium (CGE) model,

the study found that climate-related drops in agricultural output caused food prices to rise, which hurt low-income households more than others. They concluded that making agriculture more climate-resilient is important for keeping poor people from getting even poorer. Onuoha and Egwuonwu (2023) looked into how floods caused by climate change affect poverty that is passed down from one generation to the next in southern Nigeria. They used survey data from 2018 to 2022. The study used a mixed-methods approach that included logistic regression and qualitative interviews. It concluded that repeated floods make it hard for schools, health facilities, and small enterprises to run, which leads to long-term economic inequality. The authors concluded that national development policies should include climate justice frameworks.

Ogbeide-Osaretin et al. (2022) used Dynamic OLS on yearly data to look at Nigeria from 1980 to 2020 and see how temperature (as a proxy for climate change) and the Gini coefficient were related in both directions. The results show a U-shaped link, which means that higher temperatures at first lower inequality but then make it worse. The study concludes that population control, jobs, education, and modern energy provision are all important for breaking this cycle. Apanisile and Okoro (2022) looked at rural Nigeria over a period of twenty years (2000–2020) using a combination of interviews and mixed-methods regression. Changing rainfall patterns caused people to leave permanently, which slowed down the buildup of human capital and made the income difference between rural and urban areas wider. They suggested that rural adaptation initiatives could help reduce inequality. Toll (2022) used panel regression and VAR models to look at the impact of monetary policy and climate change on inequality across 158 countries from 1995 to 2019. They found that climate vulnerability is strongly linked to rising income inequality in developing countries, which is seven times higher than in advanced economies. Albu and Albu (2020) looked at countries in the European Union and concluded that more carbon emissions are linked to more income disparity. Their panel analysis (2000–2017) demonstrates that emissions-related inequality mechanisms may also apply to poor nations, even though they are not in Nigeria. This shows how important it is to redistribute wealth in a green way.

2.4 Research Gaps

The literature on the relationship between monetary policy, climate change, and income inequality in Nigeria remains limited, with several notable gaps. Most studies on monetary policy and inequality focus on macroeconomic effects of interest rates, and money supply on growth and stability (Akinbobola & Saibu, 2023), but rarely disaggregate impacts by income groups, regions, or sectors. The differential effects on rural versus urban populations or formal versus informal sectors remain underexplored, and existing analyses often overlook distributional and spatial dynamics. Similarly, while climate change's impacts on agriculture and food security are well-documented (Olaniyi & Bamidele, 2023; Onuoha & Egwuonwu, 2023), few studies link climate variability directly to long-term income inequality across socioeconomic groups. Climate-related research often isolates outcomes like food security, employment, or migration, without integrating these into a broader inequality framework, and neglects intergenerational effects on human capital, labour access, and wealth transfer.

Research examining the combined effects of monetary policy and climate change on inequality in Nigeria is scarce. The relationship between the two, such as how monetary measures may mitigate or worsen climate-induced inequality, remains largely unexplored. Initial studies (Olaniran and Olomola, 2024; Sulaiman et al., 2023) looked at these links but lacked in-depth analysis of interaction effects and policy trade-offs. Most work uses national-level data, overlooking household-level or regionally disaggregated evidence, and climate justice perspectives are often ignored despite evidence that the poorest bear the greatest burdens (Onuoha & Egwuonwu, 2023). Methodologically, much of the literature relies on linear

econometric models, which may not capture the complex, nonlinear dynamics between climate shocks, monetary variables, and inequality. Advanced approaches such as spatial econometrics, causal machine learning, and multi-sector general equilibrium models are rarely applied. Future studies should fill these gaps by focusing on distributional and regional effects, integrating climate and monetary interactions, applying equity-focused frameworks, and adopting more innovative analytical methods

3.0 Methodology

3.1 Theoretical Framework

This study is anchored on the Keynesian theory of income distribution, the Monetarist perspective, and the Climate–Economy interaction framework. The Keynesian theory emphasises the role of aggregate demand, employment, and government intervention in influencing income distribution. It suggests that expansionary monetary policies can stimulate output and employment, but may also generate inflationary pressures that disproportionately affect low-income groups. The Monetarist perspective, on the other hand, underscores the central role of money supply and interest rates in maintaining price stability, while also highlighting the unintended distributional consequences of monetary tightening, which often benefit capital owners over wage earners. The Climate–Economy interaction framework recognises that climate variability directly affects economic outcomes such as agricultural productivity, food security, and labour supply, thereby influencing income inequality in climate-sensitive economies like Nigeria. Together, these theories provide the foundation for examining how monetary policy and climate change jointly shape income distribution.

3.2 Model Specification

Building on these theoretical understandings, the study develops an econometric model adapted from Lawal and Yusuf (2022). The model specifies income inequality, measured by the Gini coefficient, as a function of monetary policy variables and climate change indicators. It incorporates the monetary policy rate, inflation, GDP growth rate, and climate change measures, while also accounting for the joint impact of monetary policy and climate change through an interaction term. This framework enables the analysis of both the independent and combined effects of monetary policy and climate change on income inequality in Nigeria. In line with the theoretical framework, the relationship between income inequality and the explanatory variables is expressed in a **functional form** as:

$$GINI = f(MPR, CLIM, GDPGR, \text{MP} * \text{CLIM}) \quad \text{..... (1)}$$

Where:

GINI = Income Inequality (Gini coefficient)

MPR = Monetary Policy Rate

CLIM = Climate Change Indicator

GDPGR = Gross Domestic Product Growth Rate

MP*CLIM = interaction between monetary policy and climate change

The econometric representation of the model is expressed as:

$$GINIt = \beta o + \beta 4MPRt + \beta, CLIMt + \beta\ GDPGRt + \beta 4MP * CLIM + Ut \text{..............} (2)$$

Where:

- βo = Intercept term
- $\beta 4 - \beta_5$ = Coefficients of the explanatory variables
- Ut = Error term

The ARDL model form is represented as:

$$GINI_t = \beta o + \Sigma\beta 4GINI_{t-i} + \Sigma\beta, MPR_{t-i} + \Sigma\beta\ CLIM_{t-i} + \Sigma\beta 4GDPGR_{t-i} + \Sigma\beta_5 MP * CLIM_{t-i} + \varepsilon_t \text{..........................}\mathbf{(4)}$$

Where *εt* represents the stochastic disturbance term assumed to be normally distributed with zero mean and constant variance, *i* represents the number of lags chosen using a statistical criterion.

3.3 Technique of Analysis

This study employs the Ordinary Least Squares (OLS) estimation technique alongside the ARDL Bounds testing approach to establish both short-run and long-run relationships among the variables. The OLS technique will be used for initial parameter estimation. It is the best linear unbiased estimator under the classical linear regression assumptions and provides a basis for preliminary diagnostics. The stationarity properties of the data will be examined using the Augmented Dickey-Fuller (ADF) tests to determine the order of integration for each variable. This step is critical for ensuring that the variables do not produce spurious regression results. The ARDL Bounds test developed by Pesaran et al. (2001) was employed to test for the existence of a long-run equilibrium relationship among the variables.

a priori Expectation

Monetary Policy Rate (MPR) is expected to have a positive or negative effect, depending on the transmission mechanism. Climate change indicators (CLIM) are expected to increase inequality due to climate shocks affecting the poor.

Table 1: Theoretical Expectations of Explanatory Variables on Income Inequality

Variable	Theoretical Effect on Inequality	Expected Sign
Monetary Policy Rate (MPR)	Ambiguous: Higher MPR restricts credit and jobs (↑ inequality), but may reduce inflationary pressures that benefit the poor (↓ inequality).	± (likely + in Nigeria)
GDP Growth Rate (GDPGR)	Growth concentrated in capital-intensive sectors (―growth without inclusion‖) raises inequality, though inclusive growth could reduce it.	± (likely + in Nigeria)
Climate Change Indicators (CLIM)	Climate shocks disproportionately harm vulnerable groups (farmers, rural households), reducing incomes and widening disparities.	+

3.4 Sources of Data

The study utilised annual time series data from 1986 to 2024, sourced from the World Development Indicators (WDI, 2024), Central Bank of Nigeria (CBN) Statistical Bulletins (2024), and National Bureau of Statistics (NBS, 2024). Annual frequency was chosen because it provides consistent and comparable measures of key macroeconomic and social indicators such as the Gini index, monetary policy rate, GDP growth, and climate-related variables while minimising the noise in higher-frequency data. The period of 1986–2024 was selected to capture both historical and contemporary dynamics: 1986 marks the start of the Structural Adjustment Programme (SAP), which fundamentally reshaped Nigeria's monetary and economic policies, while extending the coverage to 2024 incorporates recent policy interventions and intensifying climate shocks. This long horizon ensures a comprehensive analysis of the joint influence of monetary policy and climate change on inequality over nearly four decades. A detailed breakdown of the variables and the sources is presented below;

Table 2: Detailed breakdown of the variables, description and the sources of data

Variable	Description	Proxy/Measure	Source
Income Inequality (GINI)	Measures income distribution	Gini Coefficient	World Bank (2024)
Interest Rate (INTR)	Monetary policy rate	Annual %	Central Bank of Nigeria (CBN, 2024)
Broad Money Supply (M2)	A measure of liquidity in the economy	Percentage of GDP	CBN
Climate Change (CLIM)	Climate variability and environmental stress	CO, emissions, rainfall patterns, temperature anomalies	World Bank, UNDP Reports
GDP Growth Rate (GDPGR)	Economic performance control variable	Annual %	World Bank, NBS

4.0 Research Results

4.1 Descriptive Statistics

The descriptive statistics show high variability in Nigeria's income inequality and climate conditions, while monetary policy and GDP remain relatively stable.

Table 3: Results of Descriptive Statistics

	LGINI	MPR	CLIM	LMP*CLIM	GDPGR
Mean	12.5465	14.4792	21.3230	20.1944	10.5113
Median	12.4626	14.0000	16.6900	20.2251	10.5314
Maximum	15.0934	26.0000	76.5900	23.9016	11.3544
Minimum	12.1687	6.2500	8.9500	16.6653	9.6315
Std. Dev.	0.4880	3.8922	15.0078	2.3777	0.5874
Skewness	3.6892	0.6367	2.3644	0.0416	-0.0097
Kurtosis	20.14874	4.1815	7.9242	1.6007	1.4306
Jarque-Bera	566.3467	4.9039	75.7426	3.1930	4.0027
Probability	0.0000	0.0861	0.0000	0.2025	0.1351
Sum	489.3137	564.6900	831.6000	787.5826	409.9423
Sum Sq. Dev.	9.0510	575.6995	8558.9300	214.8466	
Observations	39	39	39	39	

Source: Authors' Computation, 2025

The Gini coefficient averages 12.55 with occasional extreme shifts. The Monetary Policy Rate (MPR) averages 14.48%, reflecting both expansionary and contractionary phases, with moderate variability and near-normal distribution. Climate change indicators show severe variability and unpredictable shocks, with strong skewness and non-normality. The interaction term between monetary policy and climate change (mean = 20.19) is moderately variable and near-normal, emphasising their combined influence on inequality. GDP growth rate averages 10.51 with modest fluctuations, indicating steady but uneven growth. The results highlight that inequality and climate stress in Nigeria are volatile and shock-prone, while monetary policy and GDP exhibit greater stability.

4.2 Correlation Matrix

A correlation matrix is used to show the nature and the degree of correlation between the dependent variable and the independent variable of the model

Table 2: Results of Correlation Matrix

	LGINI	MPR	CLIM	LMP_CLIM	GDPGR
LGINI	1				
MPR	-0.0568	1			
CLIM	-0.13135	0.229479	1		
LMP_CLIM	-0.24977	0.181478	0.467118	1	
GDPGR	0.687395	-0.38474	-0.21137	-0.38979	1

Source: Authors' Computation, 2025

The correlation results indicate that income inequality in Nigeria has weak negative associations with MPR and climate change, while the interaction of monetary policy and climate change shows a moderate negative effect, suggesting potential for coordinated policy to reduce inequality. A strong positive correlation exists between inequality and GDP growth rate, reflecting the growth–inequality paradox common in developing economies.

4.3 Variance Inflation Factor

Table 3 shows the variance inflation factor for the variables under study, which is used to test for the presence of multicollinearity.

Table 3: Results of Variance Inflation Factor

	Coefficient	Uncentred	Centred
Variable	Variance	VIF	VIF
MPR	0.000596	40.37134	2.655601
CLIM	7.21E-05	14.66979	4.775656
LMP*CLIM	0.033567	41.85867	5.790354
GDPGR	0.017140	573.0964	1.738619
C	2.596317	783.3121	NA

Source: Authors' Computation, 2025

The VIF analysis shows no severe multicollinearity among the explanatory variables, using the centred VIF, since all values are below the critical threshold of 10. MPR (2.66) and GDPGR (1.74) display very low multicollinearity, while CLIM (4.78) and the interaction term (5.79) indicate moderate correlation, reflecting their linkages.

4.4 Test for Stationarity

The augmented Dickey-Fuller test was adopted in this study to test for the null hypothesis of a unit root, tested against the alternative of no unit root at a 5% level of significance. If the null hypothesis is rejected, it can be concluded that the variables are stationary at levels. The results of the unit root test are presented in Table 4

Table 4: Results of Unit Root Test (ADF) Result

Variables	Level	Prob	Critical	First diff	Prob	Critical	Remark
LGINI	1.080976	0.9966	-2.941145	-5.816674	0.0026	-2.943427	I(1)
MPR	-3.278607	0.0230	-2.941145	-	-	-	I(0)
CLIM	-2.865484	0.0592	-2.943427	-5.250059	0.0001	-2.943427	I(1)
GDPGR	-0.950234	0.7605	-2.943427	-3.525146	0.0127	-2.943427	I(1)
MP*CLIM	-2.288023	0.1809	-2.941145	-5.623356	0.0000	-2.943427	I(1)

Source: Authors' computation, 2025

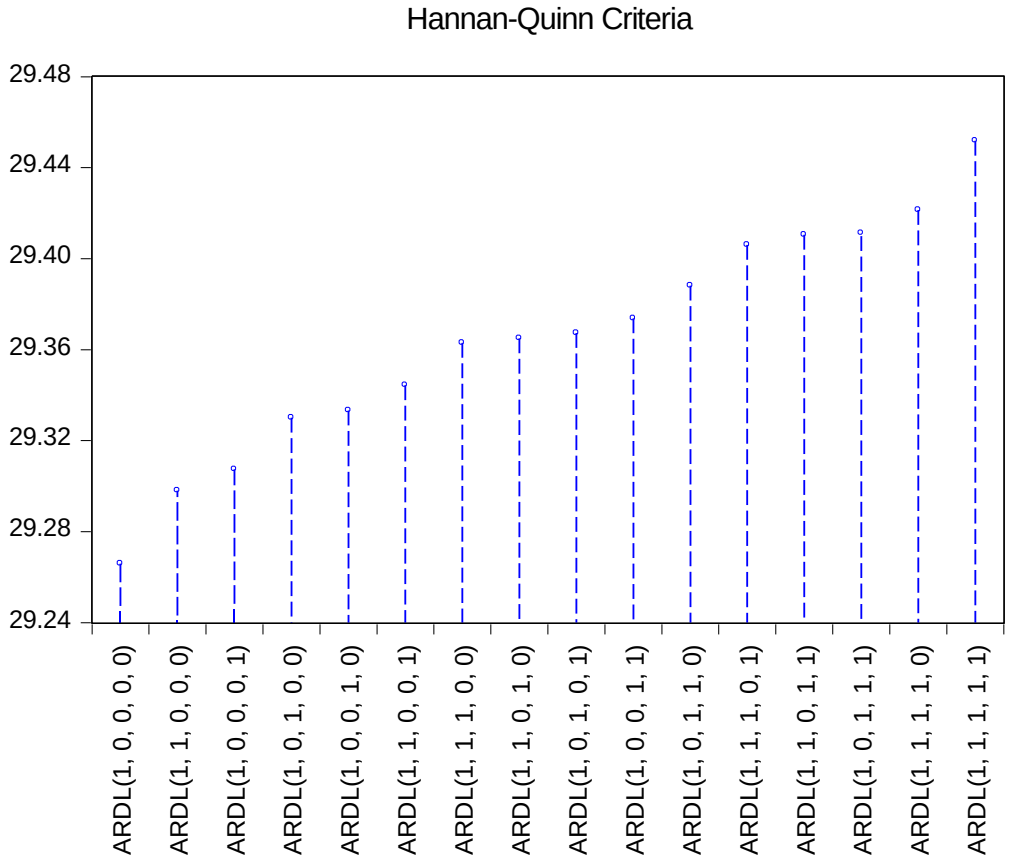
The ADF unit root test results show that income inequality, climate change (CLIM), GDP growth rate, and the interaction term are non-stationary at level but stationary after first differencing, making them *I(1)*. In contrast, the interest rate is stationary at level, *I(0)*. With variables integrated at both *I(0)* and *I(1)*, the ARDL model is appropriate.

4.5 Determination of Lags

As this study only uses data that is collected once a year, OLS regression is used for lag one through lag two. Due to the 39 years of observation used in this study, there is only one maximum lag length included in the model. Figure 1, which follows, displays the results. In this study, the

Hannan-Quinn selection criterion was utilised to determine or pick the optimal lag. The Table below displays the findings.

The lag length is shown in the table using the Hannan-Quinn Criterion (HQC). The Hannan-Quinn Criterion is a measure of the statistical model's quality of fit and is frequently used as a requirement for model selection among a finite collection of models. It is used to indicate the best lag selection. From Figure 1, the best lag selection model is at lag (1,0,0,0,0) because it has the lowest HQC value compared to other lag structures, indicating that this specification minimises information loss and provides the most parsimonious and statistically reliable model fit.



4.6 Bound test for cointegration

The results of the bound testing approach for the long-run cointegrating relationship among the variables in the model are presented in Table 6.

The ARDL Bounds Test results show that the F-statistic (1.5069) falls below the lower bound at all significance levels, meaning the null hypothesis of no long-run relationship cannot be rejected. This indicates no significant long-term equilibrium link between monetary policy, climate change, and income inequality in Nigeria. The findings suggest the variables interact only in the short run, thus, further analysis was focused on short-term policy effects while considering alternative models or variables for potential long-run dynamics.

Table 6: Results of ARDL Bounds Test

Null Hypothesis: No long-run relationship exists

Test Statistic	Value	K
F-statistic	1.506912	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Authors' computation, 2025

4.7 Presentation of ARDL Model Results

Since no long-run relationship was found, the ARDL method was applied to estimate the short-run parameters. The short-run results, based on the ARDL approach, were derived using lag lengths selected with the Hannan-Quinn Criterion (HQC) in Figure 1.

4.7.1 Presentation of Short-run ARDL Model Results

The result of the estimated short-run dynamics between the dependent and independent variables is presented in Table 7.

Table 7: Results of Short-run ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LGINI(-1)	-0.313839	1.157482	-0.271139	0.7881
MPR	0.022785	0.018951	2.202319	0.0083
CLIM	-0.006861	0.006495	-1.056349	0.2990
GDPGR	0.842946	0.474885	1.775052	0.0857
LMP*CLIM	0.059147	0.201087	0.294135	0.7707
R-squared	0.745270	Mean dependent var		12.55594
Adjusted R-squared	0.657257	S.D. dependent var		0.490978
S.E. of regression	0.361708	Akaike info criterion		0.968866
Sum squared resid	4.055823	Schwarz criterion		1.270526
Log likelihood	-11.40845	Hannan-Quinn criter.		1.076194
F-statistic	6.195376	Durbin-Watson stat		2.108611
Prob(F-statistic)	0.000235			
*Note: p-values and any subsequent tests do not account for model				
selection.				

Source: Authors' computation, 2025

Table 4.7 presents the short-run ARDL results, examining the immediate effects of monetary policy, climate change, and macroeconomic factors on income inequality in Nigeria. The lagged income inequality term is insignificant, indicating that past inequality levels do not strongly influence short-term changes. The monetary policy rate (MPR) has a positive and significant effect (coef. 0.0228, p = 0.0083), implying that short-term interest rate hikes widen income inequality, likely due to restricted credit access for lower-income groups and higher returns for the wealthy. Climate change (CLIM) shows an insignificant effect, suggesting no immediate link to inequality. The model explains about 74.5% of the variation in income inequality (Adj. R^2 =

65.7%), is statistically significant overall (F-statistic p = 0.0002), and shows no autocorrelation (Durbin-Watson = 2.11). Information criteria suggest good efficiency. The short-run findings highlight that monetary policy, particularly interest rates, significantly influences income inequality, while climate change has negligible immediate effects. GDP growth appears to slightly exacerbate inequality in the short term.

Post Estimation Test (Summary Table)

Table 8: Summary of Post-Estimation Test

F-statistic	2.0123	Prob. F(6,31)	0.0940	Heteroskedasticity Test
F-statistic	4.6807	Prob. F(2,29)	0.7173	Serial Correlation LM Test
Jarque-Bera	0.7999	Probability	0.67032	Normality Test

Source: Authors' computation, 2025

The Breusch-Pagan-Godfrey test indicates no evidence of heteroskedasticity at the 5% level, suggesting the model largely satisfies the homoskedasticity assumption. The Breusch-Godfrey Serial Correlation LM Test confirms no autocorrelation, as high p-values support the null hypothesis of independently distributed residuals, validating the short-run ARDL specification. The normality test further shows that residuals are normally distributed, with a probability value above 0.05, confirming the acceptance of the null hypothesis. The regression model is statistically reliable and well-specified.

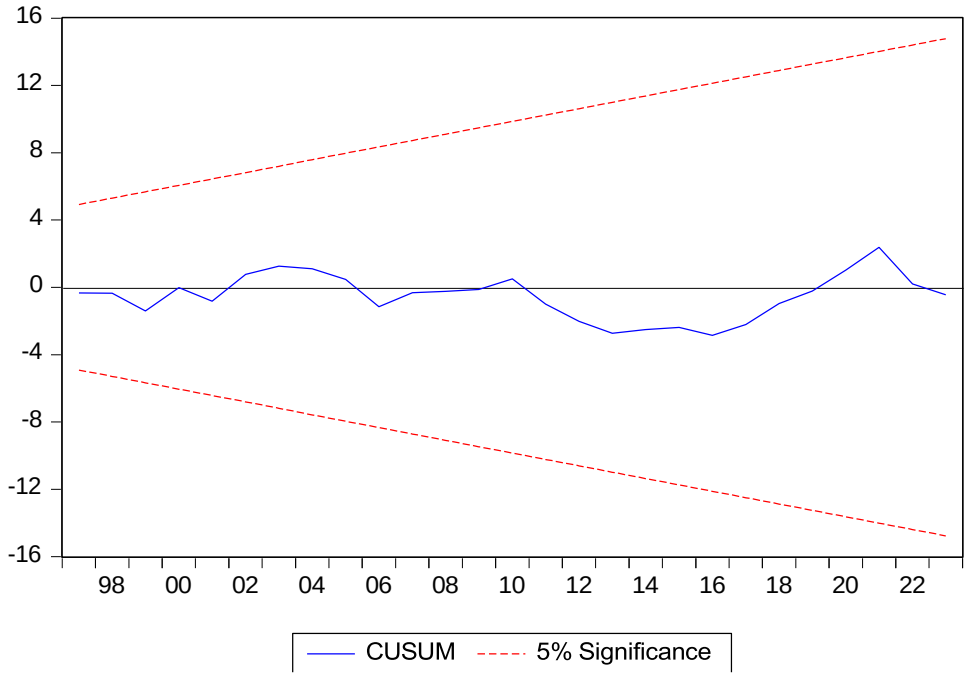


Figure 2: Stability Test Result (CUSUM)

Source: Authors' computation, 2025

The stability test results show that the residual is stable, as the blue line remains within the upper and lower red boundaries. The points fluctuate randomly around zero, indicating stability. However, a consistent upward or downward trend would suggest a shift in the process mean, while points outside the control limits would signal that the process is out of control.

4.11 Discussion of Results and Implications of Findings

The study reveals that the monetary policy rate (MPR) significantly increases income inequality in Nigeria in the short run. A one-percentage-point rise in MPR raises the Gini index by about 2.3%, reflecting how monetary tightening disproportionately affects the poor. This effect operates through several channels: restricted credit access for smallholders and microenterprises (Akinbobola & Saibu, 2023), reduced employment opportunities due to weaker investment demand (Romer & Romer, 1999), and increased returns to wealthier households with financial assets (Coibion et al., 2022). In addition, climate shocks amplify credit risks in agriculture, further excluding vulnerable groups from finance (Kifle et al., 2024). Together, these mechanisms highlight how monetary tightening redistributes opportunities away from the poor.

By contrast, climate change indicators were insignificant in the pooled ARDL model. This does not imply irrelevance but rather reflects the limitations of short-run estimations in capturing cumulative or episodic impacts. Evidence from related studies shows that climate shocks disproportionately harm rural households (Kifle et al., 2024; Letta et al., 2024) and worsen intergenerational poverty through recurrent floods (Onuoha & Egwuonwu, 2023). Supporting this, rolling-window and structural break analyses reveal that climate shocks became significant after the early 2000s, coinciding with intensifying floods and droughts (Olaniyi & Bamidele, 2023). These findings suggest that climate impacts are increasingly important and must be incorporated into forward-looking policies.

The positive effect of GDP growth on inequality supports the narrative of ―growth without inclusion.‖ Between 2000 and 2015, growth exceeded 5% annually, but was concentrated in oil, gas, and urban services (World Bank, 2024; Nadabo et al., 2024). Agriculture, which employs over one-third of the population, lagged due to climate disruptions and weak productivity (Adeleke & Mohammed, 2024). Poverty data confirm a persistent rural–urban divide, with rural poverty above 50% compared to less than 30% in urban centres (UNDP, 2023). Thus, Nigeria's growth trajectory has disproportionately favoured urban elites and capital owners while excluding rural households.

Overall, the findings show that monetary policy has significant distributional consequences, climate shocks are becoming more relevant for inequality, and GDP growth has not translated into broad-based welfare improvements. These results underscore the urgent need for policies that embed inclusivity into monetary design, strengthen resilience against climate shocks, and restructure growth to benefit vulnerable groups. Without such interventions, macroeconomic stability risks being achieved at the cost of widening disparities.

Implications of Findings

The findings show that monetary policy in Nigeria has clear distributional consequences. Since the MPR significantly increases inequality in the short run, the Central Bank should design policies that incorporate equity concerns. This could include concessional credit for SMEs and smallholder farmers, credit guarantees for rural borrowers, and liquidity lines that prioritise labour-intensive sectors, helping to offset the redistributive effects of higher interest rates. The positive link between GDP growth and inequality confirms that Nigeria's recent growth has been largely non-inclusive. To address this, fiscal policy should make growth more pro-poor by

expanding social transfers, investing in rural infrastructure, and supporting agricultural value chains. Such measures would ensure that growth benefits are more evenly distributed across households and regions.

The results also highlight the role of credit markets in transmitting monetary policy effects. Strengthening collateral registries, expanding microfinance and mobile banking, and incentivising banks to lend to rural and informal sectors would ease credit access for vulnerable groups and reduce the inequality impact of MPR hikes. Finally, while climate variables were not significant in the pooled model, this does not mean they are irrelevant. Instead, the study recommends further analyses—such as rolling-window and structural-break tests—to capture their time-varying effects. Until then, climate-related prescriptions should be framed as important for broader policy goals, but not presented as direct implications of the current findings.

5.0 Conclusion and Recommendations

This study examined the impact of climate change and monetary policy on income inequality in Nigeria using annual data from 1986 to 2024. The technique of analysis used was the ARDL, and the findings reveal that monetary policy significantly influences inequality in the short run, as increases in money supply and adjustments to the policy rate tend to widen income gaps, benefiting wealthier individuals and large firms more than low-income groups with limited access to credit. The results also show that Nigeria's economic growth has been uneven, with real GDP expansion coinciding with rising inequality. While climate change showed no significant short-term effect, existing evidence highlights its long-term threat to inclusive development, particularly in climate-sensitive sectors like agriculture. The study emphasises the need to strengthen financial inclusion, address structural barriers, and adopt climate-resilient strategies to prevent monetary policy from disproportionately benefiting higher-income groups and worsening inequality.

Recommendations

Based on the study's findings, the following recommendations are offered:

1. The Central Bank of Nigeria should complement monetary tightening with equity-focused measures such as concessional credit for SMEs and smallholder farmers to reduce the inequality impact of higher MPR.
2. Fiscal authorities should reorient growth policies toward inclusivity by expanding social transfers, investing in rural infrastructure, and supporting agricultural value chains so that growth benefits reach vulnerable groups.
3. Credit market reforms are needed to ease access for low-income households through stronger collateral registries, mobile banking expansion, and incentives for banks to lend to rural and informal sectors.
4. While climate indicators were not significant in this study, further time-varying analyses are recommended to better understand their evolving role in shaping inequality.

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