

Environmental Degradation and Macroeconomic Stability in Nigeria

¹ Kporkpor, L.R, ²Momodu, A. A & ³Amadi, S.N

^{1,2*3}Department of Economics, Faculty of Social Sciences,
Rivers State University, Nkpolu-Oroworukwo,
Port Harcourt, Rivers State, Nigeria.

Corresponding author: lekarakporkpor229@gmail.com
<https://doi.org/10.56201/ijebm.vol.12.no9.2026.pg383.395>

Abstract

This study examines the relationship between environmental degradation and macroeconomic stability in Nigeria from 1990 to 2024. Environmental degradation is proxied by CO₂ emissions, PM_{2.5} air pollution, urbanization, and health expenditure (% of GDP), while macroeconomic stability is measured by GDP per capita growth. Data were obtained from the World Bank World Development Indicators and the United Nations Development Programme (UNDP). The study employs descriptive statistics, KPSS unit root tests, ARDL bounds testing, cointegration analysis, and robustness checks. The KPSS results reveal a mixed order of integration, with urbanization integrated at level $I(0)$ and other variables at first difference $I(1)$. The ARDL bounds test confirms the existence of a long-run equilibrium relationship between environmental degradation indicators and GDP per capita growth. Long-run estimates indicate that CO₂ emissions, PM_{2.5} pollution, and health expenditure have no statistically significant effects on GDP per capita growth. However, urbanization has a significant positive effect on GDP per capita growth. The error correction terms confirm convergence to long-run equilibrium. Based on these findings, the researchers recommend, among the following, that the government should accelerate the transition to renewable energy sources and enforce strict energy-efficiency standards to neutralize the statistically significant positive long-run effect of energy consumption per capita on CO₂ emissions while reducing associated pressure on PM_{2.5}. Based on these findings, the researchers recommend, among the following, that the government should shift from carbon-intensive growth to renewable energy and energy-efficient production by using incentives and regulation to decouple GDP growth from CO₂ emissions and reduce long-term macroeconomic instability.

Keywords: Environmental Degradation, PM_{2.5}. Air Pollution, GDP Per Capita Growth, Health Expenditure, CO₂ Emissions

1. Introduction

Nigeria, Africa's largest economy by GDP for much of the 2010s, has experienced substantial structural transformation since 1990, characterized by oil dependence, demographic expansion, urban transition, and recurrent macroeconomic instability. According to the World Bank (2024a), Nigeria's GDP growth rate has exhibited pronounced volatility, with periods of expansion above 10% in the early 2000s, contractions during the 2016 oil price shock (−1.6%) and the 2020 COVID-19 crisis (−6.4%), and uneven recovery thereafter.

Carbon dioxide emissions per capita in Nigeria, while lower than OECD averages, increased from approximately 0.428 metric tons per capita in the 1990 to 0.57 metric tons per capita in 2023, reflecting expanded fossil fuel combustion, gas flaring, and electricity generation

constraints (IEA, 2023; UNDP, 2023). The International Energy Agency (2023) notes that Nigeria's energy system remains dominated by oil and natural gas, with chronic electricity shortages leading to widespread reliance on diesel and petrol generators, thereby intensifying localized emissions. Concurrently, urbanization rose from roughly 35% of the population in 1990 to over 63% by 2023 (World Bank, 2024c), concentrating pollution exposure in metropolitan areas such as Lagos, Port Harcourt, and Kano.

PM2.5 air pollution, mean annual exposure (micrograms per cubic meter) concentrations in Nigeria consistently exceed the World Health Organization's recommended limits. World Bank environmental indicators show national mean annual PM2.5 levels frequently above 60 $\mu\text{g}/\text{m}^3$ in the 1990s and above 50 $\mu\text{g}/\text{m}^3$ from 2015 to 2023, placing Nigeria among countries with severe air quality challenges (World Bank, 2019; World Bank, 2020). Air pollution imposes significant health burdens, including respiratory and cardiovascular diseases, which reduce labor productivity and increase public health expenditure. Empirical health–growth literature underscores the macroeconomic consequences of environmental degradation through morbidity-induced productivity losses and fiscal strain (Bloom *et al.*, 2004; Graff-Zivin *et al.*, 2012). Public health expenditure in Nigeria has historically remained low relative to GDP, fluctuating around 3–4% of GDP over much of the period (World Bank, 2023d), constraining the capacity to mitigate pollution-related health externalities. The Central Bank of Nigeria (2023) emphasizes that fiscal pressures, oil revenue volatility, and exchange rate instability have limited consistent public investment in environmental management and health infrastructure.

Despite three decades of policy reforms, including structural adjustment, democratic transition, oil-sector reforms, and climate commitments, Nigeria continues to face simultaneous environmental degradation and macroeconomic instability. GDP growth remains volatile, while CO₂ emissions, urban pollution, and public health pressures persist (World Bank, 2024; CBN, 2023). The coexistence of environmental deterioration and unstable macroeconomic performance raises a fundamental empirical question: to what extent do environmental degradation indicators systematically influence macroeconomic stability in Nigeria? It is against this background that the study assesses how environmental quality indicators such as CO₂ emissions per capita, PM2.5 concentration, urbanization rate, and public health expenditure interact with macroeconomic stability indicator measured by GDP growth rate over the 1990–2024 period.

2. Literature Review

Environmental Kuznets Curve (EKC) Hypothesis

The Environmental Kuznets Curve (EKC) hypothesis posits an inverted U-shaped relationship between environmental degradation and per capita income, suggesting that environmental deterioration intensifies in the early stages of economic growth but diminishes after a certain income threshold is reached. Grossman and Krueger (1995) formalized the empirical foundation of the EKC while examining the environmental impacts of trade liberalization under NAFTA, demonstrating that several pollutants initially increase with income but decline beyond turning points typically observed before countries reach upper-middle-income status. Shafik and Bandyopadhyay (1992), in a background study for the World Development Report, provided cross-country evidence indicating that certain local pollutants (e.g., suspended particulates, sulfur dioxide) follow the inverted U-pattern, although global pollutants such as CO₂ do not consistently exhibit such turning points. Panayotou (1993) further refined the EKC framework, emphasizing structural transformation, policy distortions, and institutional quality as determinants influencing the slope and turning point of the curve.

The core assumptions underlying the EKC theory include: (i) economic growth induces structural transformation from agriculture to industry and subsequently to services; (ii) environmental awareness and regulatory capacity increase with income; (iii) technological progress and cleaner production methods accompany higher development levels; and (iv) environmental degradation is partly a byproduct of scale effects that are later offset by technique and composition effects (Grossman & Krueger, 1995; Panayotou, 1993).

The theoretical mechanism operates through three channels: the scale effect (where increased output raises emissions), the composition effect (where sectoral shifts alter pollution intensity), and the technique effect (where technological innovation and environmental regulation reduce emissions intensity). In the Nigerian context, rapid urbanization and industrial expansion particularly within oil, gas, and manufacturing sectors may initially exacerbate CO₂ emissions and PM_{2.5} concentrations, contributing to adverse public health outcomes and labor productivity losses. As income rises, however, increased fiscal capacity and public demand for environmental quality may strengthen regulatory enforcement, increase public health expenditure, and foster investments in cleaner technologies, thereby moderating pollution levels. For macroeconomic stability in Nigeria, the EKC framework implies a non-linear relationship between environmental quality indicators (CO₂ emissions per capita, PM_{2.5} concentrations, and urbanization rates) and GDP growth. In early development phases, pollution-induced health burdens may reduce labor productivity, increase healthcare costs. However, beyond a critical income threshold, improved environmental governance and health expenditure could stabilize labor markets and enhance sustainable growth.

Ecological Modernization Theory

Ecological Modernization Theory (EMT) originated in early 1980s Germany through the works of Huber (1982, 1985) and was later systematized by Arthur P. J. Mol and Gert Spaargaren in the 1990s (Mol, 1995; Mol & Spaargaren, 2000). The central assumption of ecological modernization is that advanced industrial societies possess institutional, technological, and economic capacities to decouple environmental degradation from economic growth. Contrary to neo-Marxist ecological critiques that regard capitalism as inherently ecologically destructive, ecological modernization theory posits that environmental reform can be structurally embedded within capitalist modernization through technological innovation, market-based instruments, policy integration, and reflexive governance (Mol, 1995; Murphy, 2000). The theory assumes, first, that environmental problems such as CO₂ emissions and particulate matter pollution are increasingly internalized within production and consumption systems through regulatory reform, eco-innovation, and industrial restructuring (Mol & Jänicke, 2020). Second, ecological modernization theory presumes that the state transforms from a command-and-control regulator into a facilitator of environmental innovation, deploying economic instruments, public-private partnerships, and green industrial policies (Jänicke, 1990; Mol, 2003). Third, scientific knowledge and civil society participation are assumed to enhance institutional reflexivity, enabling societies to identify and correct ecological externalities (Mol, 1996; Spaargaren, 2000).

Within the context of Nigeria, ecological modernization theory implies that rising urbanization and industrialization need not mechanically increase CO₂ emissions or PM_{2.5} concentrations if accompanied by technological upgrading, renewable energy adoption, environmental fiscal reform, and strengthened regulatory institutions. Structural transformation toward cleaner energy systems and environmentally efficient production could stabilize GDP growth by reducing pollution-induced productivity losses and healthcare burdens. Empirically, EMT suggests that macroeconomic stability is reinforced when environmental governance reduces ecological shocks that destabilize labor markets and output cycles (York *et al.*, 2010).

Critics, however, caution that ecological modernization theory may overstate the capacity of institutions in developing economies to achieve ecological decoupling without robust governance and enforcement mechanisms (York *et al.*, 2010; McLaughlin, 2012). In resource-dependent economies such as Nigeria, where oil extraction significantly contributes to GDP, the structural transition envisioned by ecological modernization theory requires deep institutional reform and diversification strategies. Nonetheless, ecological modernization theory provides a theoretical justification for examining whether improvements in environmental quality (lower CO₂ emissions intensity and PM_{2.5} levels) are associated with enhanced GDP growth stability and lower unemployment through technological upgrading and green-sector employment generation.

Pollution Haven Hypothesis

The Pollution Haven Hypothesis (PHH) contends that firms in pollution-intensive industries relocate production from countries with stringent environmental regulations to countries with weaker regulatory frameworks, thereby increasing environmental degradation in host economies. Copeland and Taylor (1994) formalized the theoretical basis within a general equilibrium trade model, arguing that differences in environmental policy stringency shape comparative advantage. Their later synthesis (Copeland & Taylor, 2004) integrated trade theory and environmental economics, demonstrating that trade liberalization may increase pollution in countries with lax environmental standards through the composition effect. Levinson and Taylor (2008) provided econometric evidence that U.S. imports of pollution-intensive goods increased following domestic regulatory tightening, lending empirical support to pollution haven hypothesis. The principal assumptions of pollution haven hypothesis include: (i) cross-country heterogeneity in environmental regulation; (ii) mobility of capital and pollution-intensive industries; (iii) cost-minimizing behavior of multinational firms; and (iv) relatively weak institutional enforcement in developing countries.

The pollution haven hypothesis framework distinguishes between the “pollution haven effect” (regulation-driven relocation) and the broader “factor endowment hypothesis,” which suggests that pollution-intensive production may concentrate in capital-abundant countries regardless of regulation (Antweiler *et al.*, 2001). Their decomposition analysis revealed that while trade openness can increase pollution through scale effects, technique effects driven by income growth may offset some of these impacts. For Nigeria, characterized by oil extraction, gas flaring, and expanding urban-industrial clusters, pollution haven hypothesis provides a pertinent theoretical explanation for persistent CO₂ emissions and PM_{2.5} concentrations. Weak enforcement of environmental regulations, combined with foreign direct investment in extractive sectors, may create localized pollution havens that exacerbate environmental degradation while generating volatile growth patterns dependent on commodity cycles.

From a macroeconomic stability perspective, pollution haven hypothesis implies that environmental degradation resulting from pollution-intensive foreign investment may undermine long-term GDP growth through health-related productivity losses, environmental remediation costs, and social unrest.

Empirical Review

Railham (2024) analyzed the impact of FDI and CO₂ emissions on Vietnam’s economic growth by utilizing time series data from 1990 to 2021. The stationarity of the data was assessed with unit root tests, while an autoregressive distributed lag (ARDL) procedure was utilized to examine the long- and short-run associations between the components. Based on the research outcomes, it was seen that a marginal rise of one percent in both FDI and CO₂ emissions was associated with a corresponding long-term gain of 1.36 percent and 1.11 percent in gross

domestic product (GDP). Furthermore, in the short term these increments yielded an increase of 0.61 percent and 0.29 percent in GDP.

Kunwar et al. (2025) examined the dynamic relationship between environmental degradation, energy composition, and economic growth. Utilizing annual data spanning from 1985 to 2022, the findings revealed a long-term equilibrium between total energy consumption, CO₂ emissions, and electricity generation from fossil fuels, renewables, and nuclear sources, alongside economic growth in India. Granger causality tests showed that fossil fuel and nuclear energy use significantly predicted CO₂ emissions and growth, with limited reverse effects. Variance decomposition indicated that renewable energy helped reduce emissions while fossil fuel-based energy consumption increased them.

Kwatra et al. (2025) examined the correlation between CO₂ emissions and economic development in the Gulf Cooperation Council (GCC) countries and compared the contributions of the oil, gas, and cement sectors to CO₂ emissions in each GCC country. The study used secondary data on CO₂ emissions and gross domestic product (GDP) growth rates from 1981 to 2021 and on the specific contributions of the oil, gas, and cement sectors from 1985 to 2022. The study found a long-term cointegration between CO₂ emissions and the GDP growth rate in the GCC countries. However, in the short-term economic growth did not have a significant impact on CO₂ emissions. The major contributor to CO₂ emissions in Oman, Kuwait, Saudi Arabia, and Qatar was the oil sector, whereas that in the United Arab Emirates was the cement sector. CO₂ emissions in Bahrain were significantly affected by the gas sector. The work was original and innovative, offering new insights through sector-specific comparisons across the GCC countries. Safdar (2020) examined the long-run association between energy consumption, environmental degradation, and macroeconomic performance in selected developing countries. For this purpose, fifty developing countries were selected from 1990 to 2016. GDP and employment were taken as proxy variables of macroeconomic performance while energy consumption, environmental degradation, labor force, gross capital formation, manufacturing value added, personal remittances received, and GDP deflators were other variables. Homogenous panel causality testing was used for explanation of causal and effect linkage of energy consumption, environmental degradation, and macroeconomic variables in all selected developing countries after the cross-sectional dependence test and Pedroni test for panel cointegration. The results revealed that there was cross-sectional dependency among all variables in selected developing countries. This indicated that the fluctuation in one country was transmitted to other countries, which reflected the effectiveness of developing countries' collaborative development strategy. The Pedroni test for cointegration and Kao test identified the long-run relationship between economic energy consumption, environmental degradation, and macroeconomic performance in selected developing countries.

Momodu et al. (2026) applied the ARDL bounds testing approach of Pesaran, Shin, and Smith (2001) to analyse the determinants of Nigeria's economic growth from 1990 to 2023. Using real GDP *per capita* as the dependent variable, the model incorporates total trade, foreign direct investment (net inflows), gross fixed capital formation, and government recurrent spending on education. Results show that trade and education spending exert negative short-run effects, while FDI has a negative short-run but significant positive long-run impact. Gross fixed capital formation has a positive and significant effect on growth in the short run, but not in the long run. The error correction term confirms a stable long-run equilibrium, with 62% adjustment annually. The model explains 91.5% of growth variations, indicating strong explanatory power. Acheampong and Opoku (2023) examined whether the rise in environmental degradation was associated with economic growth. They also examined the potential channels through which environmental degradation could affect economic growth. Using a global panel comprising 140 countries from 1980 to 2021 and the two-step dynamic system-generalized method of moments

technique to control endogeneity, the findings generally indicated a retarding effect of environmental degradation on economic growth. Further analysis, however, revealed that emissions exhibited an inverted U-shaped relationship with economic growth. Ecological footprint indicators of environmental degradation, by contrast, had a U-shaped relationship with economic growth. Pathway analysis highlighted that health, foreign direct investment, and technological innovation were the potential channels through which environmental degradation retarded economic growth.

Aninwagu and Nyeche (2025) investigated the impact of renewable energy consumption, forest area, and economic growth on CO₂ emissions in Nigeria, using renewable energy consumption (REC), forest area as a percentage of land area (FOA), and GDP per capita (GDPC) as independent variables, while CO₂ emissions served as the dependent variable. Time series data for these variables were sourced from the World Development Indicators (WDI) for the period 1990 to 2023. Analytical methods employed include unit root tests, Engle-Granger cointegration, Error Correction Model analysis, and residual diagnostic tests. The Augmented Dickey-Fuller (ADF) unit root test results indicate that all variables were integrated of order one, I(1). The ECM results established a statistically significant and negative relationship between REC and CO₂ emissions; Furthermore, the analysis revealed a positive but statistically not significant relationship between FOA and CO₂ emissions. Additionally, GDP per capita showed a positive but statistically not significant effect on CO₂ emissions.

Mazwan and Tain (2024) examined the relationship between environmental degradation and green economic growth, with a particular emphasis on gross domestic product (GDP), by using the Environmental Kuznets Curve (EKC) model. This model posited a reversible relationship between per capita income and environmental quality. The novelty of this study lay in the development of better indicators to measure EKC and Green GDP. These indicators covered a wide range of aspects, from air and water quality and biodiversity levels to energy consumption. Pearson correlation analysis was employed to examine the correlation between GDP and the environmental quality index of life (IKLH) in Indonesia from 2010 to 2022. The analysis yielded positive and robust correlations between GDP and IKLH. Consequently, the higher the GDP, the greater the IKLH, or the less environmental degradation. An advance in the economy during the industrial era in Indonesia was indicated by the increase in the country's GDP growth rate. The short-term and long-term impact of economic expansion on the environmental quality index of life suggested that there was a reduction in environmental degradation. The concept of Green GDP was proposed as an alternative indicator that considered asset depreciation, non-market economy, and environmental damage caused by economic growth

3. Methodology

The study adopted an ex-post facto research design. The data were obtained from reputable macroeconomic databases including the World Bank World Development Indicators (WDI) and UNDP statistical databases.

This modelling of this study is anchored on Environmental Kuznets Curve (EKC) hypothesis. It analyses the relationship between environmental degradation and macroeconomic stability, the model was specified as follows:

The functional model:

$$GDPG = f(CO_2, PM_{2.5}, URB, HEXP) \quad 3.1$$

The econometric forms expressed as:

$$GDPG_t = \beta_0 + \beta_1 CO_{2t} + \beta_2 PM_{2.5t} + \beta_3 URB_t + \beta_4 HEXP_t + \mu_t \quad 3.2$$

Where:

GDPG = GDP growth rate

CO₂ = CO₂ emissions per capita

PM_{2.5} = PM_{2.5} concentration

UBAN = Urbanization rate

HEXP = Current health expenditure (moderating variable).

μ_t = stochastic error terms

4. Data Analysis

Table 4.1: Summary of Descriptive Statistics for the Variables

	GDPGR	CO ₂	HEXP	PM _{2.5}	URB
Mean	4.081714	0.657647	3.672917	59.39516	49.10971
Median	4.230000	0.665000	3.580000	61.58000	49.24000
Maximum	15.33000	0.880000	5.050000	77.12000	62.98000
Minimum	-6.370000	0.410000	2.490000	48.14000	35.19000
Std. Dev.	4.152309	0.118221	0.585049	6.918530	8.438041
Skewness	0.106334	-0.389225	0.438718	0.124028	-0.014633
Kurtosis	3.822304	2.572466	2.945141	2.694301	1.780507
Jarque-Bera	1.052059	1.117422	0.772903	0.200188	2.170028
Probability	0.590947	0.571946	0.679464	0.904752	0.337897
Sum	142.8600	22.36000	88.15000	1841.250	1718.840
Sum Sq. Dev.	586.2169	0.461212	7.872496	1435.982	2420.818
Observations	35	34	24	31	35

Source: Author's computation using E-views 12 software (2026)

The descriptive results presented in Table 4.2 indicate that the GDP growth rate (GDPGR) had mean value of 4.081%, throughout the study period. The GDP growth rate fluctuated between a minimum of 6.370% and a maximum of 15.330%. Carbon dioxide (CO₂) emissions and current health expenditure as a percentage of GDP (HEXP) reported average values of 0.657% and 3.672%, respectively. CO₂ emissions had minimum and maximum values of 0.410% and 0.880%, while HEXP ranged from a minimum of 2.490% to a maximum of 5.050%. Additionally, the results indicate that particulate matter (PM_{2.5}) air pollution and the urbanization rate (URB) averaged 59.395% and 49.109%, respectively. PM_{2.5} values ranged from a minimum of 48.140% to a maximum of 77.120%, whereas URB varied between 35.190% and 62.980%. The standard deviations indicate that the observations for all variables clustered around their respective means, with the exception of the GDP growth rate, as its standard deviations are less than its mean value. The probability values of the Jarque-Bera statistics suggest that all variables are normally distributed at the 5% level of significance

Table 4.2 KPSS Unit Root Test

Variables	KPSS at Level	Critical value 5%	KPSS at 1 st Diff.	Critical value 5%	Order of Integration
CO ₂	0.119390	0.463000	NA	NA	1(0)
GDPGR	0.174461	0.463000	NA	NA	1(0)
HEXP	0.092431	0.463000	NA	NA	1(0)
PM _{2.5}	0.322512	0.463000	NA	NA	1(0)
URB	0.699101	0.463000	0.169709	0.463000	1(1)

Source: Researcher's computation using Eviews 12, (2026).

The results of the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root test at the level in Table 4.2 indicate that only the urbanization rate (URB) exhibits non-stationarity, specifically a unit root. This is evident because the KPSS value of 0.699101 is greater than the critical value of 0.463000 at the 5% level of significance. However, when considering the first difference forms of the variable, it was confirmed to be stationary, as the KPSS value became less than the 5% level of significance. This implies that after differencing, the variable achieves stationarity. Therefore, the series used in the study are a mixture of I (1) (integrated of order 1) and I (0) (integrated of order 0) variables, as depicted in the table above. The use of KPSS test over the ADF test to determine the stationarity of the time series in this study is in consintence with empirical work of Aninwagu, Onyema, Momodu, & Amadi (2024).

Table 4.3: Bounds Cointegration Tests Results for the Model

	F-STATISTICS	K	Critical value	
			Lower bound	Critical value Upper bound 5%
			5%	
GDPGR	9.018240	4	3.47	4.57

Source: Authors' computations using Eviews 12

Note: K denotes number of explanatory variables

The results presented in Table 4.3 the F-statistic for the model were 9.018240, of which exceed the lower and upper bound critical values at a 5% significance level. This finding strongly suggests a long-run relationship between the dependent variable and the independent variables in each of these models.

Model Estimation and Discussion

Dependent Variable: GDP growth rate (GDPGR)

Short run results

C	-10819.74	713.5659	-15.16292	0.0419
@TREND	-257.1957	17.12715	-15.01685	0.0423
D(GDPGR(-1))	3.708838	0.255912	14.49264	0.0439
D(GDPGR(-2))	3.098057	0.250112	12.38666	0.0513
D(GDPGR(-3))	1.093374	0.153037	7.144526	0.0885
D(CO2)	-6.448604	1.688160	-3.819902	0.1630
D(CO2(-1))	-23.64207	1.867865	-12.65726	0.0502
D(CO2(-2))	-15.15571	1.755453	-8.633504	0.0734
D(CO2(-3))	-4.473516	1.277749	-3.501091	0.1771
D(HEXP)	-0.504678	0.223594	-2.257115	0.2655
D(HEXP(-1))	15.48441	1.122385	13.79599	0.0461
D(HEXP(-2))	13.13418	1.082647	12.13154	0.0524
D(HEXP(-3))	4.216816	0.811765	5.194626	0.1211
D(PM2_5)	-0.064177	0.014163	-4.531276	0.1383
D(PM2_5(-1))	-0.002476	0.013233	-0.187075	0.8823
D(PM2_5(-2))	0.021105	0.018234	1.157457	0.4536
D(PM2_5(-3))	0.057894	0.021238	2.725958	0.2238
D(URB)	253.7697	20.68880	12.26605	0.0518
D(URB(-1))	97.08752	16.91898	5.738379	0.1098
D(URB(-2))	11.45622	24.82465	0.461486	0.7247
D(URB(-3))	-60.44507	13.81060	-4.376714	0.1430

CointEq(-1)* -6.173859 0.411174 -15.01521 0.0423

Long run results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CO2	1.514977	3.022709	0.501199	0.7042
HEXP	-3.217424	0.580377	-5.543680	0.1136
PM2_5	-0.011718	0.043373	-0.270165	0.8320
URB	50.43439	3.691132	13.66366	0.0465

R-squared 0.998400; Adjusted R-squared 0.991681

Source: Researcher's computation using Eviews 12, (2026).

The ARDL findings in Table 4.5 offer an in-depth examination of the correlation between GDP per capita growth (GDPGR) and multiple environmental degradation factors, emphasizing both the short-term and long-term impacts on the GDP growth rate in Nigeria. In the short term, the findings demonstrate that carbon dioxide (CO₂) emissions in the initial years, lags 1–3, exhibit a negative correlation and lack a statistically significant impact on the GDP growth rate, suggesting that an increase of one unit in CO₂ adversely affects Nigeria's GDP growth rate. Conversely, the long-term findings demonstrate that carbon dioxide (CO₂) emissions exhibit a positive correlation with GDP growth rate, albeit lacking statistical significance, suggesting that a unit increase in CO₂ emissions elevates Nigeria's GDP growth rate by 1.514 units in the long run. The Environmental Kuznets Curve (EKC) hypothesis, articulated by Grossman and Krueger (1995), corroborates these findings, suggesting a correlation between economic growth and heightened emissions. It also corroborates the inverted U-pattern and empirical findings from Fu (2023) and Minlah & Zhang (2021), which identified a positive correlation between GDP growth and CO₂ emissions, suggesting that economic growth is associated with heightened emissions. The short-term findings suggest that the current health expenditure as a percentage of GDP in the immediate year exerts a negative, albeit not a statistically significant, impact on GDP growth in Nigeria. At lags 1, 2, and 3, the results indicated a positive correlation; however, statistical significance was achieved solely at lag 1. An increment of one unit in current health expenditure elevates the GDP growth rate by 15.484 in Nigeria. Nonetheless, the long-term findings demonstrate that the percentage of current health expenditure relative to GDP exhibits a negative but not statistically significant correlation with the GDP growth rate in Nigeria, indicating that a unit increase in current health expenditure as a percentage of GDP results in a decrease of 3.217 units in the GDP growth rate in Nigeria. The results contradict the study's initial expectations but corroborate the empirical findings of Islam et al. (2023), which indicated a significant negative correlation between healthcare expenditure and GDP growth. Additionally, it corroborates the empirical findings of Okolie and Fadeyi (2023), which indicated that current government health expenditure adversely affects economic growth. The ARDL short-run results reveal that particulate matter (PM_{2.5}) air pollution in the current year and the previous year exerts a negative but not a statistically significant effect on Nigeria's GDP growth rate. At lags 2 and 3 periods, the relationship becomes positive yet statistically not significant, indicating that particulate matter (PM_{2.5}) air pollution positively affects the GDP growth rate in Nigeria. The long-term findings reveal a negative yet statistically not significant correlation between particulate matter (PM_{2.5}) air pollution and GDP growth rate in Nigeria, suggesting that an increase in PM_{2.5} air pollution corresponds to a -0.011-unit decline in GDP growth rate. These findings align with the study's a priori expectations and the empirical evidence from Fu et al. (2021), which demonstrated that a reduction in PM_{2.5} correlates with GDP growth, suggesting that PM_{2.5} adversely affects

GDP expansion. The ARDL short-run results reveal that the urbanization rate for the current year and the first two lagged periods positively influences Nigeria's GDP growth rate, albeit this effect lacks statistical significance. This outcome indicates that the rate of urbanization augments the GDP growth rate in Nigeria. At lag 3, the relationship turns negative, yet it lacks statistical significance concerning its effects on Nigeria's GDP growth rate. The long-term findings demonstrate a statistically significant positive correlation with Nigeria's GDP growth rate, suggesting that a one-unit rise in the urbanization rate elevates the GDP growth rate by 50.434 units. These findings correspond with the study's a priori expectations and the empirical evidence from Sosanidze et al. (2025), which demonstrated that urbanization positively impacts GDP growth by facilitating innovation, broadening the labor market, and enhancing infrastructure development. The error correction term CointEq (-1), which measures the speed of adjustment back to equilibrium, is highly significant (-6.173859, p-value = 0.0423), indicating that approximately 617.3% of deviations from the long-run equilibrium are corrected annually, implying a fast adjustment process in response to short-term shocks. The R-squared value of 0.998400 signifies a robust fit of the model to the data, confirming the explanatory power of the variables included in the analysis regarding their effect on GDP growth rate in Nigeria. Additionally, the adjusted R-squared value of 0.991681, which accounts for degrees of freedom, indicates a model fit after adjusting for the number of predictors

Table 4.5: Post-Estimation Tests Results

Test	Null Hypothesis	F-Statistic	Probability	Decision
Serial Correlation LM Test	H₀ : No serial correlation	0.079988	0.9236	Retain H ₀
Heteroskedasticity Test	H₀ : Homoscedasticity	0.360996	0.9626	Retain H ₀
Normality Test	H₀ : Normally distributed	0.803459	0.669162	Retain H ₀

Source: *Researcher's Computation using Eviews 12.*

The post-estimation diagnostics in Table 4.5 indicate that the ARDL model satisfies the principal classical econometric assumptions. There is no evidence of residual serial correlation: the Breusch–Godfrey LM statistic is 0.079988 with a p-value of 0.9236, which exceeds the 5% significance level and leads to a failure to reject the null of no serial correlation.

The Breusch–Pagan–Godfrey test supports homoscedasticity; its p-value of 0.9626 likewise exceeds 0.05, so the null hypothesis of constant variance is not rejected.

In addition, the Jarque–Bera statistic of 0.803459 yields a p-value of 0.669162, greater than 0.05, indicating that the residuals are normally distributed.

5. Conclusion and Recommendations

Conclusion

The study concludes that environmental degradation exhibits a weak and statistically not significant influence on macroeconomic stability in Nigeria over the period 1990–2024. Although carbon dioxide (CO₂) emissions, particulate matter (PM_{2.5}) pollution, and health expenditure show theoretical linkages with GDP growth, their long-run effects are not statistically significant, suggesting limited direct macroeconomic impact within the study period. However, the existence of cointegration confirms that environmental and GDP per capita growth share a stable long-run relationship. Urbanization emerges as the only variable with a statistically significant positive effect on GDP growth, indicating its critical role as a driver of economic expansion.

Recommendations

Based on the findings and conclusion drawn from this study, the following recommendations are made:

- i. Nigeria government should shift from carbon-intensive growth to renewable energy and energy-efficient production by using incentives and regulation to decouple GDP growth from CO₂ emissions and reduce long-term macroeconomic instability.
- ii. Reallocate health expenditure toward preventive care and pollution-related health issues to improve labor productivity, ensuring health spending contributes meaningfully to GDP growth and employment.
- iii. Policymakers should implement stricter air quality standards and support clean technologies while using environmental projects (e.g., waste management) as job creation programs to simultaneously reduce environmental degradation and increase GDP.
- iv. Nigeria should invest in infrastructure (transport, energy, digital) and aligning urban growth with labour-intensive industries (manufacturing, services) to translate urban expansion into real output.

References

- Acheampong, A. O. (2018). Economic growth, CO₂ emissions and energy consumption: What causes what and where? *Energy Economics*, 74, 677–692. <https://doi.org/10.1016/j.eneco.2018.07.022>
- Acheampong, A. O., Opoku, O. E. E. (2023). *Environmental degradation and economic growth: Investigating linkages and potential pathways*. <https://doi.org/10.1016/j.eneco.2023.106734>
- Aninwagu, V. O., & Nyeche, E. (2025). *Impact of Renewable Energy Consumption, Forest Area, and Economic Growth on CO₂ Emissions in Nigeria*. *International Journal of Economics and Financial Management (IJEFM)*, 10(7), 55-67.
- Aninwagu, V. O., Onyema, J. I., Momodu, A. A., & Amadi, R. C. (2024). Gender inequality and socioeconomic development: An empirical investigation of the effect on unemployment in Nigeria. *SSRN Electronic Journal* 1(1), 205-220.
- Antweiler, W., Copeland, B. R., & Taylor, M. S. (2001). Is free trade good for the environment? *American Economic Review*, 91(4), 877–908. <https://doi.org/10.1257/aer.91.4.877>
- Central Bank of Nigeria (CBN). (2023). *Statistical Bulletin*. <https://www.cbn.gov.ng/documents/statbulletin.asp>
- Copeland, B. R., & Taylor, M. S. (1994). North-South trade and the environment. *Quarterly Journal of Economics*, 109(3), 755–787. <https://doi.org/10.2307/2118421>
- Copeland, B. R., & Taylor, M. S. (2004). Trade, growth, and the environment. *Journal of Economic Literature*, 42(1), 7-71. <https://doi.org/10.1257/002205104773558047>
- Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *Quarterly Journal of Economics*, 110(2), 353–377. <https://doi.org/10.2307/2118443>
- International Energy Agency (IEA). (2023). *Nigeria Energy Profile*. <https://www.iea.org/countries/nigeria>
- International Energy Agency. (2023). *How much CO₂ does Nigeria emit?* <https://www.iea.org/countries/nigeria/emissions>
- Jänicke, M. (1990). *State failure: The impotence of politics in industrial society*. Polity Press.
- Kunwar, R., Vora, K., Sharma, K., Raj, R., & Bal, D.P. (2025). India's green growth puzzle: decoding the interplay between carbon dioxide emissions, energy mix, and GDP. *Environmental Science and Pollution Research*, 32, 25272 - 25280. <https://doi.org/10.1007/s11356-025-37121-9>
- Kwatra, N., Almaqbali, F. A., & Alhashemi, S. (2025). Carbon dioxide emissions and economic growth in the oil, gas, and cement industries of gulf countries: A panel autoregressive distributed lag analysis for sustainable development. <https://doi.org/10.34120/ajas.v32i1.1329>
- Mazwan, M., & Tain, A. (2024). *Analisis Environmental Kuznets Curve (Menyeimbangkan Industri Hijau dan Degradasi Lingkungan di Indonesia)*. <https://doi.org/10.37149/jimdp.v9i6.1627>
- McLaughlin, P. (2012). Ecological modernization in evolutionary perspective. *Organization & Environment*, 25(2), 178–196.
- Mol, A. P. J. (1995). The refinement of production: Ecological modernization theory and the chemical industry. *Van Arkel*.
- Mol, A. P. J. (2000). The environmental movement in an era of ecological modernisation. *Geoforum*, 31(1), 45–56.
- Mol, A. P. J. (2003). *Globalization and environmental reform: The ecological modernization of the global economy*. MIT Press.
- Mol, A. P. J., & Jänicke, M. (2000). The origins and theoretical foundations of ecological modernisation theory. *The Ecological Modernisation Reader*, 17-27.

- https://doi.org/10.4324/9781003061069-4?urlappend=%3Futm_source%3Dresearchgate.net%26utm_medium%3Darticle
- Mol, A. P. J., & Spaargaren, G. (2000). Ecological modernization theory in debate. *Environmental Politics*, 9(1), 17–49.
- Momodu, A. A., Aninwagu, V. O., & Momodu, M. (2026). Determinants of economic growth in Nigeria. *Journal of Economics and Allied Research*, 11(1), 588–601. <https://doi.org/10.5281/zenodo.19520052>
- Panayotou, T. (1993). Empirical tests and policy analysis of environmental degradation at different stages of economic development. *ILO Technology and Employment Programme Working Paper*. <https://www.ilo.org/public/english/employment/strat/publ/etp93.htm>
- Raihan, A. (2024). Influences of foreign direct investment and carbon emission on economic growth in Vietnam. *Journal of Environmental Science and Economics*, 3(1), 1–17. <https://doi.org/10.56556/jescae.v3i1.670>
- Shafik, N., & Bandyopadhyay, S. (1992). Economic growth and environmental quality: Time series and cross-country evidence. *World Bank Policy Research Working Paper No. 904*.
- United Nations Development Programme. (2023). *Carbon dioxide emissions production per capita, tonnes*. <https://data.undp.org/access-all-data>
- World Bank (2019). *The cost of air pollution in Lagos*. <https://documents1.worldbank.org/curated/en/980031575616020127/pdf/The-Cost-of-Air-Pollution-in-Lagos.pdf>
- World Bank (2020). PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)-Nigeria. <https://data.worldbank.org/indicator/EN.ATM.PM25.MC.M3?locations=NG>
- World Bank (2024a). *GDP growth (annual %) – Nigeria*. <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=NG>
- World Bank (2024b). *Unemployment, total (% of total labor force) (national estimate) – Nigeria*. <https://data.worldbank.org/indicator/SL.UEM.TOTL.NE.ZS?locations=NG>
- World Bank (2024c). *Urban population (% of total population) – Nigeria*. <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=NG&start=1990>
- World Bank (2024d). *Current health expenditure (% of GDP) – Nigeria*. <https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS?locations=NG>
- World Bank. (2022). *The Changing Wealth of Nations 2021: Managing Assets for the Future*. = <https://www.worldbank.org/en/publication/changing-wealth-of-nations>
- World Bank. (2024). *World Development Indicators: Nigeria (CO₂ emissions per capita; PM2.5 air pollution; urban population; GDP growth; unemployment; health expenditure)*. <https://data.worldbank.org/country/nigeria>
- World Health Organization (WHO). (2021). *WHO global air quality guidelines*. WHO Press.
- York, R., Rosa, E. A., & Dietz, T. (2010). *Ecological modernization theory: Theoretical and empirical challenges*. https://www.researchgate.net/publication/283826628_Ecological_modernization_theory_Theoretical_and_empirical_challenges