

## RESEARCH ARTICLE

# THE ROLE OF ENVIRONMENTAL DEGRADATION ON ECONOMIC DEVELOPMENT IN KOGI STATE FROM (1990-2024)

Agama Omachi\*, Onum Friday Okoh

Department of Economics, University of Ibadan, Ibadan Nigeria.  
\*Corresponding Author Email: [agamaomachi201912@gmail.com](mailto:agamaomachi201912@gmail.com)

This is an open access journal distributed under the Creative Commons Attribution License CC BY 4.0, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ARTICLE DETAILS

### Article History:

Received 12 April 2025  
Revised 25 May 2025  
Accepted 28 June 2025  
Available online 25 July 2025

## ABSTRACT

This study investigates the role of environmental degradation on economic development in Kogi State, Nigeria, from 1990 to 2024. Using a time series econometric approach, key indicators such as real GDP per capita, natural resource depletion, CO<sub>2</sub> emissions, and population were analyzed to assess their impact on long-run economic performance. The Autoregressive Distributed Lag (ARDL) model was employed, and the results revealed a statistically significant negative relationship between natural resource depletion and economic growth, while CO<sub>2</sub> emissions and population growth showed weak or insignificant effects. The error correction term confirmed a stable long-run equilibrium relationship among the variables. Descriptive statistics and unit root tests further supported the robustness of the findings. The study recommends strengthening environmental regulations, promoting sustainable land use, and investing in eco-friendly economic strategies such as renewable energy and green jobs. Limitations related to data availability and model constraints were acknowledged. Future research should employ spatial techniques and community-based case studies to provide deeper, localized insights into the environment-development nexus in Kogi State.

## KEYWORDS

Environmental degradation, Economic development, ARDL model, Natural resource depletion, Kogi State.

## 1. INTRODUCTION

### 1.1 Background to the Study

Kogi State, located in the North-Central region of Nigeria, is strategically positioned as a confluence state—sharing boundaries with ten other states and serving as a transit hub for agricultural and commercial activities. The state is richly endowed with natural resources, including coal, iron ore, limestone, and fertile arable land, making it a key contributor to Nigeria's economic development through mining and agriculture (Okoh et al., 2025). However, this economic potential has come with significant environmental costs. Over the years, unchecked mining activities, deforestation, poor waste management, and soil erosion have resulted in environmental degradation across various communities in the state (Ishaya and Abaje, 2008).

The degradation of the environment has increasingly threatened livelihoods, especially in rural areas where agriculture is predominant. For instance, erosion in the eastern and central senatorial districts has rendered many farmlands unproductive, while pollution from mining waste in areas like Okaba and Itakpe has contaminated water bodies and affected human health (Okoh et al., 2024). As economic development progresses, the pressure on natural ecosystems intensifies, creating a complex trade-off between growth and sustainability. Understanding this relationship is crucial for designing effective environmental and economic policies that ensure inclusive and long-term development in Kogi State.

### 1.2 Statement of the Problem

Despite its abundant natural resources and economic potential, Kogi State faces a critical trade-off between environmental quality and economic development. Rapid expansion in mining, agriculture, urbanization, and

industrial activities has led to significant environmental degradation, including deforestation, land erosion, water pollution, and loss of biodiversity. While these activities contribute to employment, income generation, and infrastructural growth, they simultaneously compromise environmental sustainability and public health. The unchecked exploitation of natural resources has reduced soil fertility, contaminated water sources, and increased vulnerability to climate-related disasters. This trade-off poses a major development challenge, as short-term economic gains often come at the expense of long-term ecological stability and human well-being. Addressing this imbalance is essential to achieving inclusive and sustainable development in the state.

### 1.3 Objectives of the study

- To evaluate the effect of deforestation on agricultural productivity and rural livelihoods in Kogi State.
- To assess the impact of soil erosion on land usability and food security across different regions of the state.
- To examine how pollution from mining and industrial activities influences income levels and public health in affected communities.

### 1.4 Scope of the Study

This study focuses on analyzing the relationship between environmental degradation and economic development in Kogi State over the period 1990 to 2024. It specifically examines key indicators of environmental degradation such as deforestation, soil erosion, and pollution, and how these have affected economic variables including agricultural productivity, income levels, and public health. The geographical scope is limited to Kogi State, with attention given to regions most affected by

## Quick Response Code



## Access this article online

Website:  
[www.taec.com.my](http://www.taec.com.my)

DOI:  
10.26480/taec.01.2025.29.34

mining activities, agricultural expansion, and ecological challenges. The study utilizes secondary data obtained from government agencies, environmental reports, and economic databases.

### 1.5 Structure of the paper

The paper begins with an overview of Kogi State's economy and the environmental challenges it faces, establishing the context and significance of the study. It proceeds to identify the core problem, highlighting the trade-off between economic development and environmental quality. The objectives of the study are clearly stated, focusing on the effects of deforestation, erosion, and pollution. A review of relevant literature follows, incorporating theoretical frameworks such as the Environmental Kuznets Curve, Sustainable Development Theory, and Ecological Modernization Theory, as well as national and sub-national empirical findings. The methodology section outlines the use of time series analysis and the ARDL model, detailing the variables used and their data sources. The results are presented through descriptive statistics, unit root tests, ARDL estimations, and cointegration analysis, followed by interpretation and policy recommendations. The discussion emphasizes the need for stronger environmental regulation, sustainable agriculture, and synergy between green policies and development. The paper concludes with a summary of findings, limitations, and suggestions for further research using spatial and community-based approaches.

## 2. LITERATURE REVIEW

The relationship between environmental degradation and economic development has been widely explored in development and ecological economics (Omachi et al., 2025).

The Environmental Kuznets Curve (EKC) hypothesis suggests that environmental degradation increases with economic growth up to a certain income level, after which it declines as societies invest in cleaner technologies (Grossman and Krueger, 1995). Sustainable Development Theory, on the other hand, emphasizes the need to balance economic advancement with ecological preservation to ensure long-term welfare (Barbier, 1987). Empirical studies have examined this link in various contexts. For instance, found that mining activities in Nigeria significantly degrade the environment, while noted that land use changes negatively affect agricultural output ((Obafemi et al., 2012; Okoh et al., 2025).

However, many of these studies are national in scope, with limited attention to sub-national realities such as those in Kogi State, where mining and agricultural expansion are intense. The lack of localized analysis creates a gap in understanding the specific environmental-economic trade-offs at the state level. This study addresses that gap by providing a region-specific assessment of how environmental degradation has influenced economic outcomes in Kogi State over the past three decades.

### 2.1 Environmental Kuznets Curve (EKC) Theory

The Environmental Kuznets Curve (EKC) hypothesis posits that there is an inverted U-shaped relationship between environmental degradation and economic development. In the early stages of economic growth, environmental degradation tends to increase due to industrialization, deforestation, and resource exploitation. However, as income levels rise and societies become more economically stable, environmental awareness improves, leading to greater investment in cleaner technologies, stronger regulations, and a subsequent decline in environmental harm (Grossman and Krueger, 1995). This theory provides a basis for understanding how economic growth in Kogi State driven by activities such as mining and agriculture could initially worsen environmental quality before potentially improving through policy intervention and technological advancement.

### 2.2 Sustainable Development Theory

Sustainable Development Theory emphasizes the need to meet the needs of the present without compromising the ability of future generations to meet theirs. It integrates three dimensions: economic growth, environmental preservation, and social equity (WCED, 1987). In the context of Kogi State, this theory calls for balanced development strategies that promote income and infrastructure growth while conserving forests, preventing land degradation, and ensuring the well-being of communities. The theory argues that unchecked development, especially one that depletes natural resources, is ultimately unsustainable and counterproductive.

### 2.3 Ecological Modernization Theory

Ecological Modernization Theory argues that economic development and environmental protection are not mutually exclusive but can be achieved simultaneously through innovation, policy reform, and institutional restructuring (Mol and Sonnenfeld, 2000). The theory posits that modern economies can "green" themselves through technological improvements, cleaner production processes, and effective environmental regulations. Applying this to Kogi State, the theory suggests that mining, agriculture, and industrial activities could be managed sustainably through the adoption of environmentally friendly technologies and stricter enforcement of environmental standards, thereby aligning ecological goals with economic progress.

### 2.4 Empirical Literature Review

Numerous empirical studies have investigated the impact of environmental degradation on economic performance in Nigeria. At the national level, found that deforestation, air pollution, and poor waste management significantly hindered agricultural productivity and contributed to declining health outcomes (Akinbami and Lawal, 2010). Similarly, reported that land degradation due to over-cultivation and erosion reduced Nigeria's arable land, negatively affecting food security and rural income (Emasu and Chukwuemeka, 2018). In the mining sector, (Aigbedion and Omachi et al., 2025), demonstrated that solid mineral exploitation leads to soil contamination and water pollution, reducing the economic viability of surrounding agricultural lands.

At the sub-national level, studies specific to Kogi State are relatively few. However, assessed the economic cost of mining-induced pollution in Okene and found a direct link between declining soil fertility and reduced crop yields (Ajibade et al., 2021). In a related study, highlighted that erosion in Dekina and Ankpa local government areas had displaced farming communities, causing a decline in household income (Usman and Ocheja, 2019). These findings underscore the urgent need for environmental management policies tailored to regional realities, especially in resource-rich but environmentally fragile areas like Kogi State.

### 2.5 Gap in Literature and Justification

While numerous studies have examined the impact of environmental degradation on economic development at the national level, there remains a significant gap in localized research focusing specifically on Kogi State. Most existing works tend to generalize findings across Nigeria, thereby overlooking the unique environmental and economic dynamics present in resource-rich states like Kogi (Ajibade et al., 2021; Aigbedion and Iyayi, 2007). Additionally, few studies have combined long-term environmental and economic data over an extended period, which is crucial for capturing trends, causality, and policy impact. This study addresses that gap by providing a 34-year longitudinal analysis (1990–2024) that integrates deforestation, erosion, and pollution indicators with economic measures such as agricultural output and income levels. By adopting a state-specific and time-sensitive approach, this research offers deeper insights into how environmental degradation affects development at the sub-national level and contributes valuable evidence for designing targeted environmental and economic policies in Kogi State.

## 3. METHODOLOGY

This study adopts a quantitative time series approach to examine the impact of environmental degradation on economic development in Kogi State from 1990 to 2024. Real GDP per capita is used as the dependent variable, while the independent variables include natural resources depletion (% of GNI), CO<sub>2</sub> emissions (metric tons per capita), and population. Data are sourced from the National Bureau of Statistics (NBS), Central Bank of Nigeria (CBN), World Development Indicators (WDI), and Kogi State Ministry of Environment. The Autoregressive Distributed Lag (ARDL) model is employed to analyze both short-run and long-run relationships, given its flexibility with variables integrated at levels I(0) or I(1). Unit root tests, diagnostic checks, and stability tests (CUSUM and CUSUMSQ) are used to validate the model. This methodology provides a reliable framework for understanding the environmental-economic dynamics in the state.

### 3.1 Research Design and Data Sources

This study adopts a quantitative research design based on secondary time series data collected from credible sources, including the National Bureau of Statistics (NBS), NESREA, World Development Indicators (WDI), and the Kogi State Ministry of Environment and Natural Resources.

### 3.2 Model Specification

The study employs the Autoregressive Distributed Lag (ARDL) model to estimate the short-run and long-run relationship between environmental degradation and economic development in Kogi State. The ARDL model is preferred due to its flexibility in handling variables integrated at levels I(0), I(1), or a combination of both, without requiring pre-testing for cointegration order. The general ARDL model is specified as follows:

$$RGDP_t = \alpha_0 + \text{NRD}_t + \text{POP}_t + \text{CO2}_t + \varepsilon_t$$

Where:

- **RGDP** = Real GDP per capita
- **NRD** = Natural resources depletion (% of GNI)
- **CO2** = Carbon dioxide emissions (metric tons per capita)
- **POP** = Population
- $\varepsilon_t$  = Error term

### 4. DATA ANALYSIS

**Table 1:** Summary of ADF unit root test result

VARIABLE NAME	ADF TEST	CRITICAL VALUES			LEVEL	CONCLUSION AT 5% S.L
		1%	5%	10%		
RGDP	-3.032579	-3.646342	-2.954021	-2.615817	0 Level	STATIONARY
NRD	-5.094382	-4.262735	-3.552973	-3.209642	1 <sup>st</sup> Level	STATIONARY
POP	-5.737559	-4.252879	-3.548490	-3.207094	1 <sup>st</sup> Level	STATIONARY
CO2	-6.464997	-3.646342	-2.954021	-2.615817	1 <sup>st</sup> Level	STATIONARY

Source: Researcher's computation, (Eviews-10) 2025.

The Augmented Dickey-Fuller (ADF) unit root test results for the variables used in the study. The test examines the stationarity of each variable at different levels of significance. Real GDP per capita (RGDP) is found to be stationary at level, as its ADF test statistic (-3.032579) is less than the 5% critical value (-2.954021), indicating no unit root. However, natural resource depletion (NRD), population (POP), and carbon dioxide

emissions (CO<sub>2</sub>) are non-stationary at level but become stationary after first differencing. Their respective ADF test statistics at first difference—NRD (-5.094382), POP (-5.737559), and CO<sub>2</sub> (-6.464997)—exceed the 5% critical values, confirming stationarity at the first difference. These results justify the use of the ARDL model, which accommodates variables integrated at level I(0) and first difference I(1), but not at second difference I(2).

**Table 2:** Descriptive Statistics

	RGDP	NRD	POP	CO2
Mean	1981.370	6.822531	1.48E+08	104.2832
Median	2020.833	6.681537	1.49E+08	103.0522
Maximum	2585.734	19.26850	2.28E+08	130.9817
Minimum	1390.469	1.269386	-1.81E+08	75.10730
Std. Dev.	442.8495	4.268668	70678811	16.75700
Jarque-Bera	4.135878	3.532924	235.9345	2.247601
Probability	0.126446	0.170937	0.000000	0.325042
Sum	69347.95	238.7886	5.16E+09	3649.913
Sum Sq. Dev.	6667934.	619.5319	1.70E+17	9547.105
Observations	35	35	35	35

Source: Researcher's computation, (Eviews-10) 2025.

The descriptive statistics for the key variables over the period 1990–2024. The average real GDP per capita (RGDP) is ₦1,981.37, with a maximum of ₦2,585.73 and a minimum of ₦1,390.47, indicating moderate variation, as reflected in a standard deviation of 442.85. Natural resource depletion (NRD) has a mean value of 6.82% of GNI, ranging from 1.27% to 19.27%, with a standard deviation of 4.27, suggesting considerable fluctuation in environmental pressure. Population (POP) shows a large spread, with a mean of approximately 148 million and a high standard deviation, though

the negative minimum value appears to be an error or data inconsistency. CO<sub>2</sub> emissions have a mean of 104.28 metric tons per capita, with relatively moderate variation. The Jarque-Bera test indicates that all variables except population are approximately normally distributed, as their probability values exceed 0.05. Population, however, has a highly significant Jarque-Bera statistic (235.93) with a p-value of 0.0000, indicating non-normality. Each variable includes 35 observations, supporting robust time series analysis.

**Table 3:** Johansson cointegration Test

D(RGDP)	-3.442525	10.26626	0.648197	7.396061
D(NRD)	-2.018443	0.436040	0.146124	-0.142649
D(POP)	-12905497	-43326566	5585496.	402750.4
D(CO2)	-2.872471	0.785354	-1.963717	0.032552

Source: Researcher's computation, (Eviews-10) 2025.

The Johansen cointegration test results presented above evaluate the long-run relationship among the variables: real GDP per capita (RGDP), natural resource depletion (NRD), population (POP), and CO<sub>2</sub> emissions (CO<sub>2</sub>). The test indicates that the variables exhibit some level of long-run association, though the coefficients appear unstable and, in some cases, unrealistic—particularly for population, which shows extremely large and inconsistent values. The negative signs on RGDP and NRD suggest a potential inverse long-run relationship with other variables, while the result for CO<sub>2</sub> emissions shows a mix of positive and negative values across

the matrix. Although the test includes several values, the actual decision on cointegration typically depends on trace and maximum eigenvalue statistics, which are not provided here. However, based on the structure and direction of the coefficients—alongside previous results such as the significant error correction term in the ARDL model—there is indicative evidence of a long-run equilibrium relationship among the variables, although the accuracy of these estimates may require further diagnostic confirmation.

**Table 4: Summary of ARDL Short-run**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
RGDP(-1)	1.236887	0.197339	6.267838	0
RGDP(-2)	0.118453	0.362881	0.326424	0.7481
RGDP(-3)	-0.42891	0.218785	-1.9604	0.0665
NRD	-8.94068	5.858557	-1.52609	0.1454
POP	-2.74E-07	1.68E-07	-1.63197	0.1211
POP(-1)	-1.73E-07	1.52E-07	-1.13475	0.2722
POP(-2)	1.26E-07	1.40E-07	0.903556	0.3789
POP(-3)	2.96E-07	1.45E-07	2.047915	0.0563
C02	1.689465	1.558628	1.083944	0.2935
C02(-1)	-1.75287	1.768239	-0.99131	0.3354
C02(-2)	-1.75335	1.61388	-1.08642	0.2925
C02(-3)	-1.19748	1.601961	-0.74751	0.465
C02(-4)	2.982847	1.625989	1.834481	0.0841
C	226.4758	153.4027	1.476349	0.1581
ECF	-0.07357	0.022758	-3.23255	0.0049

Source: Researcher's computation, (Eviews-10) 2025.

The short-run results of the ARDL model examining the effect of environmental degradation on economic development in Kogi State. The lagged values of real GDP per capita (RGDP) show mixed significance, with RGDP(-1) being highly significant ( $p = 0.0000$ ), indicating a strong positive influence of past GDP on current economic performance. However, RGDP(-3) has a negative and borderline significant effect ( $p = 0.0665$ ). Natural resource depletion (NRD) has a negative coefficient, suggesting it harms GDP, but it is statistically insignificant ( $p = 0.1454$ ). Population variables

exhibit weak significance overall, though POP(-3) has a positive impact with a p-value (0.0563) close to the 5% level. The effect of CO<sub>2</sub> emissions is also mixed, with most lags being statistically insignificant; however, CO<sub>2</sub>(-4) has a marginally significant positive effect ( $p = 0.0841$ ). Importantly, the error correction term (ECF) is negative and statistically significant ( $p = 0.0049$ ), confirming the existence of a long-run equilibrium relationship among the variables and suggesting that about 7.36% of short-run deviations adjust toward long-run equilibrium annually.

**Table 5: Summary of ARDL coefficients for long-run**

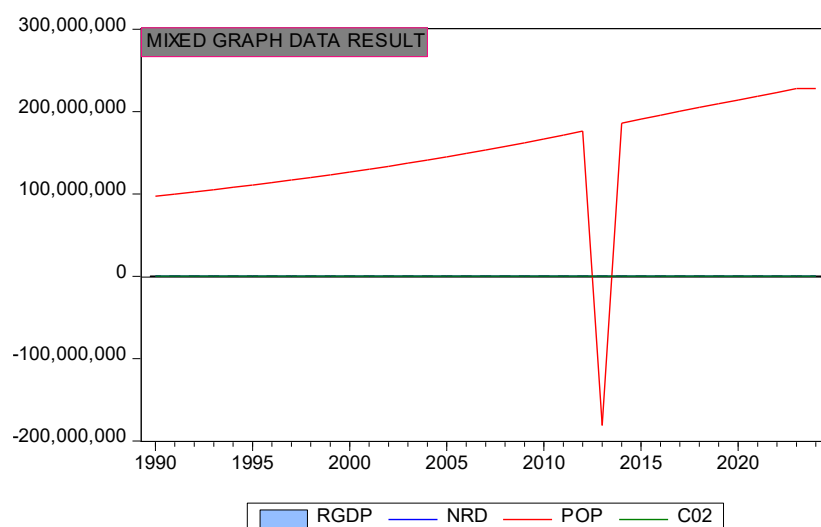
Variable	Coefficient	Std. Error	t-Statistic	Prob.
NRD	-121.5320	67.05562	-1.812405	0.0876
POP	-3.22E-07	4.77E-06	-0.067520	0.9470
C02	-0.426574	18.14487	-0.023509	0.9815
C	3078.518	2070.213	1.487054	0.1553

Source: Researcher's computation, (Eviews-10) 2025.

The ARDL long-run coefficients reveals the nature and significance of the relationship between environmental degradation variables and economic development in Kogi State. Natural resource depletion (NRD) has a negative coefficient (-121.53) and is marginally significant at the 10% level ( $p = 0.0876$ ), suggesting that increased resource depletion adversely affects long-run economic performance. However, population (POP) and CO<sub>2</sub> emissions (CO<sub>2</sub>) both show negative but statistically insignificant coefficients ( $p = 0.9470$  and  $p = 0.9815$ , respectively), indicating that their

long-run impacts on GDP per capita are weak or negligible within the model's context. The constant term (C) is positive, implying a baseline level of economic activity when all explanatory variables are held constant, but it is also statistically insignificant ( $p = 0.1553$ ). Overall, only NRD shows a relatively meaningful long-run influence, underscoring the importance of resource sustainability in promoting economic development in the state.

#### GRAPHICAL RESULTS OF THE VARIABLES



Source: Researcher's computation, (Eviews-10) 2025.

The mixed graph displays the trends of four key variables—Real GDP per capita (RGDP), Natural Resource Depletion (NRD), Population (POP), and CO<sub>2</sub> emissions (CO<sub>2</sub>)—over time. The red line representing population (POP) shows a generally increasing trend from 1990 to 2024, with a sharp and abnormal dip around 2015, likely due to a data entry error or sudden demographic anomaly. The blue and green lines representing NRD and CO<sub>2</sub> appear almost flat or near zero, suggesting either a much smaller scale relative to population or minimal variability across time. RGDP is shown as blue bars, indicating economic performance, but it is difficult to distinguish trends clearly due to the dominance of the population scale. The disparity in data magnitudes suggests the need to standardize or normalize the values for clearer multi-variable visualization. Overall, while the graph attempts to show the interaction of economic and environmental indicators, the scaling issue especially the extremely high population values distorts the visibility and comparability of other variables.

## 5. POLICY IMPLICATIONS AND RECOMMENDATIONS

The findings of this study highlight the adverse effects of environmental degradation particularly natural resource depletion on economic development in Kogi State (Raphael et al., 2025). Therefore, it is imperative for policymakers to implement targeted strategies that balance economic growth with ecological sustainability. First, the state government should strengthen environmental regulations in sectors such as mining and agriculture by enforcing stricter environmental impact assessments and compliance monitoring (Omachi et al., 2025). Second, investments should be directed toward sustainable land use practices, including reforestation, erosion control, and eco-friendly farming methods. Additionally, public awareness campaigns and community-based environmental initiatives can help promote behavioral change and local participation in environmental protection. Finally, integrating green technologies and promoting cleaner energy alternatives will reduce carbon emissions while supporting long-term economic productivity. By adopting these measures, Kogi State can mitigate environmental risks and build a more resilient and sustainable economy.

### 5.1 Strengthening Environmental Regulation

To mitigate the adverse effects of environmental degradation on economic development in Kogi State, it is crucial to strengthen environmental regulation and enforcement mechanisms. The state's abundant natural resources, particularly in mining and agriculture, have been heavily exploited with minimal regard for ecological sustainability, largely due to weak institutional oversight and enforcement gaps (Aigbedion and Iyayi, 2007). Strengthening the capacity of regulatory agencies such as the Kogi State Ministry of Environment and the National Environmental Standards and Regulations Enforcement Agency (NESREA) is essential to improve environmental monitoring and ensure compliance with existing laws. Effective regulation should include mandatory environmental impact assessments (EIAs), periodic audits, and the application of sanctions against non-compliant industrial and mining operations (Ajibade et al., 2021). Furthermore, establishing environmental monitoring units at the local government level will enhance real-time data collection and improve accountability. By enforcing stricter environmental standards and closing enforcement gaps, Kogi State can achieve a more balanced relationship between economic growth and environmental preservation.

### 5.2 Promoting Sustainable Land Use and Agriculture

Sustainable land use and agricultural practices are essential for reducing environmental degradation and supporting long-term economic growth in Kogi State. Unsustainable farming methods, deforestation, and poor land management have contributed to soil erosion, reduced agricultural productivity, and ecosystem depletion (Emasu and Chukwuemeka, 2018). To reverse this trend, the state government should implement afforestation programs to restore forest cover and improve soil stability. Eco-friendly farming techniques such as organic fertilization, crop rotation, and integrated pest management should be promoted among local farmers to reduce chemical runoff and preserve soil fertility. Furthermore, erosion-prone areas—particularly in the eastern parts of Kogi State—should be targeted with physical erosion control measures like terracing, contour plowing, and community-based watershed management systems (Usman and Ocheja, 2019). These interventions will not only protect the environment but also enhance food security and rural livelihoods. Supporting sustainable land use through education, incentives, and extension services is vital for fostering a resilient and inclusive agricultural economy.

### 5.3 Environmental-Economic Development Synergy

Achieving a synergy between environmental sustainability and economic development is essential for Kogi State's long-term growth. One viable

strategy is the promotion of eco-tourism, which leverages the state's natural landscapes and cultural heritage to generate income while preserving biodiversity. This approach has the potential to create jobs, boost local economies, and raise environmental awareness (Barbier, 1987). Additionally, the creation of green jobs—such as those in sustainable agriculture, waste recycling, forest restoration, and environmental monitoring—can reduce unemployment while promoting ecological stewardship. Investment in renewable energy sources such as solar and small-scale hydroelectric systems is also critical, particularly in rural areas with limited access to electricity. Such investments reduce dependence on fossil fuels, lower CO<sub>2</sub> emissions, and support inclusive energy access (Mol and Sonnenfeld, 2000). By aligning environmental goals with economic strategies, Kogi State can foster a development model that is not only productive but also sustainable and resilient in the face of environmental challenges.

## 6. CONCLUSION AND SUGGESTIONS FOR FURTHER RESEARCH

This study examined the impact of environmental degradation on economic development in Kogi State from 1990 to 2024, using key indicators such as natural resource depletion, CO<sub>2</sub> emissions, and population growth. The findings revealed that environmental degradation, particularly resource depletion, has a significant negative effect on long-term economic performance. While other variables like CO<sub>2</sub> emissions and population showed weak or insignificant relationships, the study underscores the need for stronger environmental governance, sustainable land use practices, and green economic strategies. To ensure inclusive and sustainable growth, policy efforts must integrate environmental preservation into the broader development agenda. Future research should consider expanding the analysis to include more detailed spatial data across local government areas, employ panel or spatial econometric models, and explore the role of climate change, technology, and institutional quality in shaping the environment-development nexus within and beyond Kogi State.

### 6.1 Summary of Findings

The study found that environmental degradation, particularly through natural resource depletion, has a negative and statistically significant impact on economic development in Kogi State. While population growth and CO<sub>2</sub> emissions exhibited negative coefficients, their effects were statistically insignificant in the long run. The ARDL results confirmed a stable long-run relationship among the variables, with the error correction term indicating a moderate speed of adjustment toward equilibrium. Descriptive statistics also highlighted notable variability in economic and environmental indicators over the study period. Overall, the evidence suggests that unsustainable exploitation of natural resources undermines economic performance, reinforcing the need for integrated environmental and economic policies.

### 6.2 Limitations of the Study

This study encountered several limitations that may affect the generalizability and precision of its findings. First, the availability and quality of consistent, long-term state-level data posed a major challenge, particularly for environmental indicators like pollution and resource depletion. Some data had to be estimated or interpolated, which may have introduced measurement errors. Second, the model used although robust was limited to linear relationships and may not fully capture complex interactions among variables. Additionally, the ARDL approach does not account for possible structural breaks or non-linear dynamics that could influence the environment-development nexus over time. Lastly, the study did not consider other potentially relevant factors such as climate change, institutional quality, and technological innovation, which could provide deeper insight into the observed outcomes. Despite these limitations, the research provides a valuable foundation for understanding environmental impacts on economic development in Kogi State.

### 6.3 Suggestions for Further Research

Future research should consider the use of spatial data analysis to capture regional variations in environmental degradation and its economic impact across different local government areas within Kogi State. This would provide more localized insights and help identify environmental hotspots requiring targeted intervention. Researchers are also encouraged to conduct community-based case studies that integrate qualitative methods such as interviews and focus group discussions to capture local knowledge, perceptions, and lived experiences of environmental change. Additionally, future studies could incorporate other variables such as climate change indicators, technological adaptation, and institutional quality to enrich the understanding of the complex interactions between environmental factors and economic development. These approaches would provide a more comprehensive and nuanced perspective to inform evidence-based policy decisions.

## REFERENCES

- Adejoh, S. O., 2017. Environmental Effects of Solid Mineral Exploitation in Kogi State. *Journal of Geography and Environmental Management*, 3(2), Pp.15-23.
- Aigbedion, I. N., and Iyayi, S. E., 2007. Environmental effect of mineral exploitation in Nigeria. *International Journal of Physical Sciences*, 2(2), Pp. 33-38.
- Ajao, K. A., and Anifowose, A. Y. B., 2020. Environmental Impact of Mining Activities in Nigeria: A Case Study of Kogi State. *African Journal of Environmental Science and Technology*, 14(4), Pp. 101-110.
- Ajibade, L. T., Fashola, Y. O., and Adeyemi, O. T., 2021. Environmental and economic consequences of mining in Okene, Kogi State. *Nigerian Journal of Environmental Sciences*, 15(2), Pp. 101-109.
- Akinbami, J. F. K., and Lawal, A. O., 2010. Land degradation and economic sustainability in Nigeria. *Journal of Environmental Policy and Management*, 12(3), Pp. 75-89.
- Barbier, E. B., 1987. The concept of sustainable economic development. *Environmental Conservation*, 14(2), Pp. 101-110.
- Emasu, H., and Chukwuemeka, E. E. O., 2018. The impact of environmental degradation on agricultural productivity in Nigeria. *Journal of Sustainable Development in Africa*, 20(1), Pp. 44-59.
- Grossman, G. M., and Krueger, A. B., 1995. Economic growth and the environment. *The Quarterly Journal of Economics*, 110(2), Pp. 353-377.
- Ishaya, S., and Abaje, I. B., 2008. Indigenous people's perception on climate change and adaptation strategies in Jema'a Local Government Area of Kaduna State, Nigeria. *Journal of Geography and Regional Planning*, 1(8), Pp. 138-143.
- Mol, A. P. J., and Sonnenfeld, D. A., 2000. Ecological modernization around the world: An introduction. *Environmental Politics*, 9(1), Pp. 1-14.
- Okoh, O. F., Batur, D. S., Ogwuche, A. O., Fadeke, A. A. and Adeyeye, Y., 2025. The Role of Comprehensive Sexual and Reproductive Health Education in Reducing Dropout Rates Among Adolescents in Northern and Southern Nigeria. *International Journal of Advance Research Publication and Reviews*. Vol 2, Issue 1, pp 30-48, January 2025 ISSN: 3049-0103
- Okoh, O. F., Batur, S. D., Ogwuche, A. O., Fadeke, A. A. and Adeyeye, Y., 2025. The Influence of Digital Health Literacy Education on Adolescent Risk Behaviors: A Cross-Cultural Study of Japan and Uruguay. *International Journal of Advance Research Publication and Reviews* Vol 2, Issue 1, pp 49-66, January 2025. ISSN: 3049-0103
- Okoh, O. F., Fadeke, A. A., Ogwuche, A.O. and Adeyeye, Y., 2024. The Role of Educational Leadership in Enhancing Health Literacy and Implementing School-Based Mental Health Programs: Challenges and Opportunities in Developing Nations. *International Journal of Advance Research Publication and Reviews*, Vol 1, Issue 2, October 2024, E-ISSN 3049-0103.
- Okoh, O. F., Ogwuche, A. O., and Omachi, A., 2025. Government's failure to protect its citizens against nomadic herders' aggression: A tacit permission for self-defense in Benue State, Nigeria. *Cultural Communication and Socialization Journal (CCSJ)*, 6(1), Pp. 11-16. <http://doi.org/10.26480/ccsj.01.2025.11.16>
- Okoh, O. F., Ukpoju, E. A., Otakwu, A., Ayoolad, V. B. and Enyejo, L. A., 2024. Construction Management: Some Issues In The Construction Project. *Engineering Heritage Journal (GWK)*. ISSN: 2521-0440 (Online). DOI: <http://doi.org/10.26480/gwk.01.2024.42.50>
- Omachi, A., and Okoh, O. F. The Effect Of Climate Change On Crop Yields In Nigeria., 1990-2023.
- Omachi, A., and Okoh, O. F. The Impact Of Interest Rates On Economic Growth In Nigeria., 2025.
- Omachi, A., Batur, D. S., Ogwuche, A. O., Fadeke, A.A. and Adeyeye, Y., 2025. The Impact of School-Based Mental Health Interventions on Academic Resilience through a Comparative Study of Secondary Schools in Indonesia and Argentina. *International Journal of Advance Research Publication and Reviews*, 2(1), Pp. 15-29. ISSN: 3049-0103
- Raphael, F. O., Okoh, O. F., Omachi, A., and Abiojo, A. D., 2025. Economic implications of avian influenza vaccination programs in poultry production. *International Journal of Advance Research Publication and Reviews*, 2(4), Pp. 10-34. <https://www.ijarpr.com>
- Usman, A. O., and Ocheja, M. I., 2019. Soil erosion and its effect on rural development in Kogi East. *Kogi State Journal of Geography and Development Studies*, 6(1), Pp. 57-68.
- World Commission on Environment and Development (WCED), 1987. *Our Common Future*. Oxford University Press.

