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Assessing the impact of institutional quality and environmental depletion on sustainable development practices in Nigeria

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Abstract

The challenge of determining the drivers of sustainable development in Nigeria has emerged as a key research topic. Consequently, there is an urgent need to clarify these ambiguous initial assumptions and examine their impact on the sustainable development trajectory in Nigeria. This study utilized an extensive dataset from 1996 to 2023, extracted from the World Bank database, to explore the complex issues surrounding sustainable development in Nigeria, particularly aiming to provide empirical validation through the institutional quality-environmental degradation framework. This approach provides deeper understanding of the uncertain relationships within the subject. The ARDL cointegration technique was employed to analyze the data. The results indicated that sustainable development in Nigeria is obstructed by poor institutional quality and environmental harm. Moreover, the findings suggest that environmental degradation exerts a crowd-out effect from the first-period to the fourth-period lag, while institutional quality from the first-period to the third-period lags negatively and significantly affects sustainable development at a 5% significance level respectively. In essence, development in Nigeria heavily depends on prior environmental conditions and the influence of institutional quality. As such, short-term policy initiatives should prioritize creating conditions for sustainable development through strong institutional quality and environmental sustainability.

Keywords: *Sustainable development, institutional quality, environmental degradation, ARDL, Nigeria;*

1 Introduction

Many researchers, professionals, and policymakers remain deeply engaged in understanding the economic and developmental differences between economic growth and sustainable development across nations. The concept of "sustainable development" has garnered substantial focus, as it emphasizes not only the form of economic growth but also the importance of sustaining it through effective institutional quality. Recently, the economic landscape and the implementation of sustainable development have been influenced by the distribution of political rights, the strength of the legal framework, and the effectiveness of government agencies in developing nations (Epaphra & Kombe, 2018).

Additionally, it has been noted that the primary obstacle to development in many nations is the lack of sound institutional quality (Gough et al., 2004). Good institutional quality is essential for formulating and executing policies, engaging stakeholders, promoting transparency and accountability, and ensuring long-term planning, all of which are critical for achieving sustainable development goals.

Sustainable development refers to a growth model that satisfies the needs of the present generation without hindering future generations' ability to meet their own needs. It aims to strike a balance between economic growth, social well-being, and environmental protection. Therefore, sustainable development seeks to address pressing challenges such as poverty, inequality, climate change, resource depletion, and biodiversity loss while ensuring lasting prosperity (Brundtland Report, 1987).

Institutional quality, environmental degradation, and sustainable development are closely interrelated and mutually reinforcing. Institutional quality provides the framework, regulations, and mechanisms needed to mitigate environmental damage and support long-term progress. By establishing effective institutional quality systems, societies can protect the environment, conserve resources, and ensure a sustainable future for generations to come. Furthermore, strong institutional quality is essential for achieving sustainable development goals, including effective policy creation and enforcement. Good institutional quality is fundamental to the formulation and execution of policies that foster sustainable development (Thomsen, 2005).

Numerous studies have identified various factors as core determinants of sustainable development, including income, corruption, the contribution of small enterprises to the economy, and employment opportunities (Abdullah, 2012; Adebisi & Gbegi, 2013; Ademola & Michael, 2012; Babandi, 2017; Radelet, Sachs, & Lee, 2001; Shehu et al., 2013). However, the roles of institutional quality and environmental factors as key drivers of sustainable development in Nigeria have been insufficiently explored.

Nigeria faces a range of significant environmental challenges, including habitat destruction, water contamination, and deforestation. These challenges are central to sustainable development, as they prompt actions to reduce environmental harm and foster conservation efforts, such as constructing resilient infrastructure to address climate change caused by greenhouse gas emissions, which leads to severe health consequences like infant and maternal mortality rates, as well as morbidity. Thus, it is critical to prioritize policies that improve environmental sanitation and healthcare, thereby enhancing public health and well-being through reliable institutional quality. This research aims to address the empirical gap in the literature concerning Nigeria's long-term development and environmental health, forming the foundation of the study.

The primary objective of this research is to assess how environmental degradation and institutional quality influence sustainable development in Nigeria. Accordingly, the study aims to answer the following key questions: Does environmental degradation significantly affect Nigeria's sustainable development? Does institutional quality in Nigeria significantly impact sustainable development? Addressing these questions will provide crucial insights for various economic stakeholders such as citizens, policymakers, and both public and private investors and help resolve the policy-related challenges associated with sustainable development. The structure of this research is as follows: Section 2 presents the literature review, Section 3 outlines the methodology, and Section 4 discusses the results, and Sections 5, present discussion, conclusion, policy implications, limitations, and future research directions.

1.1 Environmental Degradation, Institutional quality, and Sustainable Development Nexus

As CO2 emissions become a prominent global issue for national economies and the international community, concerns such as climate change and global warming have attracted substantial attention in the environmental and economic literature (Saud et al., 2019). This issue has gained urgency in recent years, largely due to human activities involving oil, gas, and similar resources, which are pivotal to energy production in industries, transportation, and services sectors intimately connected to economic expansion and progress (Hunjra et al., 2020). The relationship between these elements is heavily influenced by the quality of institutional quality, including the legal framework, social unity, and resource allocation efficiency.

The empirical investigation into the effects of environmental degradation and institutional quality on sustainable development in Nigeria remains insufficient, as the majority of existing research focuses on macroeconomic factors (Alonso et al., 2020; Gough et al., 2004; Salahuddin et al., 2018). This study aims to bridge these empirical and theoretical gaps by exploring the relationship between sustainable development, institutional quality, and environmental degradation in Nigeria. Furthermore, it seeks to validate the environmental Kuznets curve (EKC) hypothesis, which explores the dynamic between development and environmental factors.

Several studies have examined the relationship between foreign direct investment (FDI) and environmental quality, as well as the links between financial development, economic growth, and environmental degradation (Saud et al., 2019; Hunjra et al., 2020; Baloch et al., 2021). However, there is a notable lack of literature concerning Nigeria's specific context, particularly in how environmental degradation and institutional quality shape sustainable development in the country.

In addition, this study's novelty lies in its practical dissection of institutional quality into political stability, rule of law, and corruption control. Political stability influences sustainable development through policy continuity, which fosters social cohesion and international cooperation. The rule of law supports sustainable development by creating a trustworthy legal system that encourages investment, protects the environment, and fosters sustainable growth. Corruption impedes sustainable development by causing inefficiencies in resource distribution and creating inequality. On the other hand, environmental degradation hampers sustainable development through the depletion of resources (Grossman & Krueger, 1995). The analysis of these divides and their policy implications forms a critical part of the inquiry of this study.

2 Literature Review

The Environmental Kuznets Curve (EKC) hypothesis suggests that economic growth, particularly during early stages, is linked to increased pollution and environmental degradation. This assumption stems from the notion that industrialization and economic activities often involve the extraction and consumption of natural resources, energy use, and pollutant emissions. Moreover, the EKC assumes that environmental degradation becomes reversible once a certain level of economic development is reached. As nations achieve higher levels of wealth, they can invest in environmental remedy and conservation efforts, leading to a reduction in pollution levels (see Figure 1). However, this perspective overlooks the irreversible loss of biodiversity, degradation of ecosystems, and long-term environmental impacts.

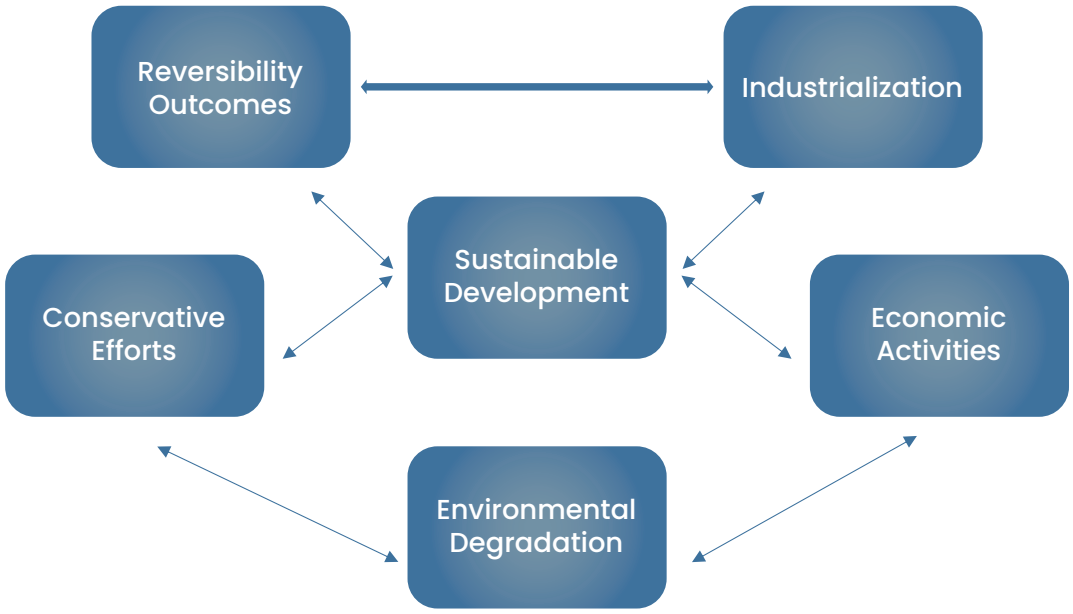

Figure 1: Theoretical Framework.

Source: Conceptualized based on literature review

1.1 Empirical Review

There has been limited research on the intersection of sustainable development, institutional quality, and environmental degradation, especially in Nigeria. The majority of studies on economic growth and development have concentrated on the economies of advanced nations. Much of this empirical work laid the foundation for understanding economic growth sources prior to Solow's (1957) model. Solow's neoclassical growth theory provided the basis for evaluating the contribution of traditional inputs and total factor productivity to GDP (Amin, 2002). Romer (1990) argued that technological progress is driven by skilled workers who create new ideas and products, thus propelling development. He further claimed that countries with large, well-educated workforces tend to experience steady growth as innovations are introduced more rapidly in these nations. Barro (1996) argued that elements such as greater life expectancy, early education, lower fertility rates, reduced government expenditure, stronger

enforcement of the rule of law, lower inflation, and improved trade conditions all contribute to economic progress. However, the potential effects of institutional quality and environmental degradation were overlooked in the growth and development models reviewed by scholars like Barro (1996), Romer (1990), and Solow (1957). This study, therefore, aims to test the null hypothesis based on these theoretical premises in relation to sustainable development in Nigeria.

Recent research has emphasized the significance of institutional quality in the development process and economic progress across various nations. Several economists have established a notable link between institutional quality and per capita gross domestic product (GDP) globally. Countries with strong institutional quality structures tend to attract investments not only in human and physical capital but also in advanced technologies, thereby enhancing both economic outcomes and societal well-being. Alonso et al. (2020) explored the determinants of institutional quality using the generalized method of moments (GMM) technique. Their findings indicated that tax revenues and per capita income growth were consistent indicators of institutional quality, with development facilitating the strengthening of institutions. They also found a positive feedback loop where development enhances institutional quality, and vice versa. Moreover, a well-managed budgetary system further supports the development of strong institutions. The study highlighted that redistribution (instead of mere inequality) plays a key role in shaping institutional quality, as it reflects the proactive role of the state in addressing inequality.

Yang et al. (2014) studied the impact of institutional quality on real savings across 189 countries from 1980 to 2010, utilizing a range of variables such as institutional quality indices, corruption perception indices, and political system databases. Their results revealed that indicators of institutional quality (including institutional quality and corruption perceptions, as well as political system types) have a significant positive effect on actual savings rates. In contrast, constitutional constraints such as proportional representation in parliament and pluralism were found to have no notable influence.

Sarkodie and Strezov (2019) analyzed the influence of foreign direct investment (FDI) inflows, economic growth, and energy consumption on carbon emissions from 1982 to 2016, focusing on China, India, Iran, and Indonesia, and South Africa key carbon emitters in emerging economies. They discovered that energy consumption significantly contributes to the rise in carbon dioxide emissions. The study concluded that FDI can foster the transfer of eco-technological solutions, workforce improvements, and environmentally friendly management practices in developing nations.

Salahuddin et al. (2018) explored the relationships between energy consumption, financial development, and economic growth, FDI, and CO2 emissions in Kuwait from 1980 to 2013. Their study found that CO2 emissions increased due to energy consumption, economic growth, and FDI, both in the long and short terms, as revealed by cointegration, autoregressive distributed lag (ARDL) models, and Granger causality tests.

Acemoglu et al. (2020), Dima et al. (2013), and Bhattacharjee (2017) examined the relationship between environmental degradation and sustainable development in Nigeria using the ARDL approach on data from 1990 to 2020. They discovered that environmental degradation significantly negatively impacts sustainable development in Nigeria. In light of the findings from these studies, it is obvious that the relationship among environmental depletion, institutional quality, and sustainable development is apriori unclear, hence, it is imperative

to explore how institutional quality and environmental degradation influence the sustainable development process in Nigeria a topic that has long been debated and remains an open research question. Based on the theoretical foundations of this study, the following hypotheses are proposed:

H01: Institutional quality does not significantly influence sustainable development in Nigeria.

H02: Environmental degradation does not significantly influence sustainable development in Nigeria.

3 Methodology

This research investigated the influence of institutional quality and environmental deterioration on sustainable development in Nigeria, focusing on the poor performance of its growth indicators, additionally, the factors influencing sustainable development in Nigeria remain uncertain, despite the country's vast resources and repeated institutional quality and sectorial reforms over the years. Referring to prior research, the Autoregressive Distributed Lag (ARDL) model incorporates data on carbon emissions as an indicator of environmental degradation (Hollanders, 2019), political stability, control of corruption, and the rule of law as indicators of institutional quality (Akpo & Hassan, 2015; Ali et al., 2010; Busse & Hefeker, 2007). Human development index are used as a proxy for sustainable development (Dana et al., 2020). A summary of the definitions and measurement sources for the variables is provided in Table 1 (see Appendix-I).

3.1 Data Analysis Technique

This section outlines the description of the study's data, methodologies, data sources, and estimation techniques, which include pre-estimation, estimation, and post-estimation procedures. The data employed in this study were derived using the ARDL model and are secondary in nature. The institutional quality indicators include political stability, control of corruption, and rule of law, while sustainable development is represented by the human development index (HDI), and environmental degradation is measured by carbon emissions per capita (CEPC) for the period 1996 to 2023 (spanning 28 years). The data were gathered from the World Development Indicators (WDI), worldwide governance indicators (WGI), the International Energy Agency (IEA), and the United Nations Development Programme (UNDP). To prevent erroneous regression results and improper conclusions, preliminary analysis was conducted using pre-estimation tests. The stationarity of the data was tested using the Augmented Dickey-Fuller (ADF) unit root test (Dickey & Fuller, 1979) and the Phillips-Perron unit root test (Breitung & Franses, 1998).

Furthermore, the institutional quality dimension, as assessed in this study, includes political stability, rule of law, and control of corruption, all of which are crucial for a state's effective functioning. The data for these indicators were obtained from the World Governance Indicators (WGI), a well-regarded source that compiles global governance assessments from international organizations and expert opinions. While WGI data are considered reliable due to their comprehensive scope and rigorous methodology, they may be subject to bias from expert assessments, which can introduce subjectivity and may not fully capture local perspectives or nuances. Additionally, the accuracy of these measures can vary across regions.

The Carbon Emission per Capita (CEPC) variable measures the amount of carbon emissions produced per person, sourced from the International Energy Agency (IEA), a highly

credible provider of energy and environmental data. The IEA's data is considered reliable due to its extensive global energy monitoring systems. However, variations in reporting practices and methodologies across countries may limit the consistency and comparability of the data.

The Human Development Index (HDI), developed by the UNDP, is a widely recognized composite measure of human development, incorporating key indicators such as life expectancy, education, and income, all of which are crucial for sustainable development. Its comprehensive nature makes it a useful tool for cross-country comparisons. However, while valuable, the HDI may oversimplify sustainable development by focusing on averages and overlooking critical factors like inequalities and environmental sustainability. As such, it may not fully capture the broader, multidimensional aspects of sustainable development.

In summary, the data comes from credible international organizations and research studies, but measuring complex issues like governance, corruption, and sustainable development across various contexts presents challenges that may introduce certain limitations.

Table 1. Variable Descriptions and Sources

Variable	**Descriptions**	**Source(s)**	
Political (POV)	The political dimension of institutional quality represents the foundation for the efficient functioning of any state	WGI	Busse & Hefeker (2007)
Rule of law (RUL)	The extent to which agents have confidence in and abide by the rules of the society	WGI	Akpo & Hassan (2015)
Control of corruption (COC)	The extent to which public power is exercised for private gain, including both petty and grand forms of corruption	WGI	Ali *et al,* (2010)
Carbon emission per capita ()	This represents carbon emission per capita	(IEA)	Hollanders (2019).
Sustainable development	This is the composition of the Human Development Index which is a statistical composite of life expectancy, education, and per capita income	(UNDP)	Dana *et al*. (2020)

Source: Authors' Compilation, 2023

3.2 Model Specification

The model is based on the environmental Kuznets curve (EKC) hypothesis proposed by Grossman and Krueger (1995). Thus, the model is formulated using the autoregressive distributed lag (ARDL) equation, where sustainable development is explained as a function of institutional quality and environmental degradation. The econometric equation is expressed as follows:

$$HDI = B_0 + B_1\, CEPC + B_2\, POLISTA + B_3\, COR + B_4\, RULAW + \varepsilon_t \quad 1$$

In this context, HDI represents the Human Development Index, CEPC stands for Carbon Emissions Per Capita, POLISTA refers to Political Instability, COR denotes Control of Corruption, and RULAW indicates the Rule of Law. The effort to explore the effects of institutional quality and environmental degradation on sustainable development in Nigeria, using the ARDL methodology, is articulated as follows:

$$\Delta HDI_t = B_0 + \sum_{i=1}^{N1} \delta_1\, \Delta HDI_{t-k} + \sum_{j=0}^{N2} \delta_2\, \Delta CEPC_{t-k} + \sum_{j=0}^{N3} \delta_3\, \Delta POLISTA_{t-k} + \sum_{j=0}^{N4} \delta_4\, \Delta COR_{t-k} + \sum_{j=0}^{N5} \delta_5\, \Delta RULAW_{t-k} + U_t \quad 2$$

Equation (2) presents the standard ARDL modeling which consists of the parameters of the regressors. Hence, is the calculated lagged error correction coefficient. $\delta_{t-1} = HDI_{t-1} - \varnothing CEPC_{t-1} - \varphi POLISTA_{t-1} - \omega COR_{t-1} - \theta RULAW_{t-1}$ is expected to be negative and statistically significant for long-run equilibrium to exist.

4. Results

The research applies a three-fold econometric approach to evaluate the impact of institutional quality and environmental degradation on sustainable development in Nigeria. First, the Augmented Dickey-Fuller (ADF) and Phillips-Perron unit root tests were employed to assess the degree of integration of the variables. Secondly, the Auto-Regressive Distributed Lag (ARDL) model, introduced by Pesaran and Shin (2001), was utilized; the ARDL model is particularly advantageous because it does not require all variables to be I (1). Finally, the post-estimation procedure verified the robustness of the model. The ADF test was carried out to examine the stationarity levels of the variables. The ADF procedure involves the following steps:

$$\Delta Y_t = \alpha + \beta_t + \delta Y_{T-1} + \sum^{m}_{i=1} \omega i \Delta\, Y_{t-1} + \in_t \quad 3$$

Where represents the drift, *t* represents the deterministic trend and *m* is an optimal lag length, and $\in_t$ is a white noise error term.

In the unit root examination, the sustainable development variable was found to be stationary at level I (0), while environmental degradation, political stability, control of corruption, and rule of law were stationary at the first difference I(1) in both the ADF and PP unit root tests, with the exception of control of corruption, which showed I(1) in the PP test (see Table 2). Nonetheless, one of the most suitable estimations for analyzing variables with I(1) and I(0) stationarity is the co-integration ARDL model.

Additionally, the bounds testing approach essentially involves the F-test to assess the null hypothesis of no co-integration among the variables against the alternative hypothesis of its existence, as formulated below:

H0: β=1 = β=2 = β=3 = β=4 = β=5 = 0; indicating that no co-integration exists among the variables.

H1: β ≠ 1 ≠ β ≠ 2 ≠ β ≠ 3 ≠ β≠4 ≠ β ≠ 5 ≠ 0; suggesting that co-integration exists among the variables (see Table 3).

4.1 Estimation Findings

The results from the ARDL analysis indicate that both the one-period and two-period lag values of sustainable development are negative and statistically significant. Similarly, from the one-period lag to the fourth-period lag, the values for environmental degradation are also negative and statistically significant. The control for corruption variables from the first lag through the fourth lag are negative and statistically significant. In contrast, the political stability variables for the one-period and two-period lags are positive and statistically significant. Regarding the rule of law, the two-period lag through the fourth-period lags is negative and statistically significant at the 5% level respectively (see Table 4 Appendix II). Moreover, the findings reject both hypotheses one and two, as the target variables, sustainable development and environmental degradation, were found to be statistically significant across their respective lags. Figure 2 illustrates that the cumulative sum (CUSUM) line stays within the critical boundaries of a 5% significance level, suggesting the model's structural stability.

4.2 Discussion

4.2.1 Empirical results of the ARDL estimate

The ARDL results from the Table 4 highlight the impact of institutional quality and environmental depletion on sustainable development in Nigeria from 1996 to 2023, with a focus on key variables such as the Human Development Index (HDI) been a proxy for sustainable development, carbon emissions per capita (CEPC) is a proxy for environmental depletion, while political stability (POLISTA), control for corruption (COR), and rule of law (RULAW) are all components of institutional quality. The coefficients for the lags of sustainable development (D (HDI (-1), D (HDI (-2), and D (HDI (-3) are negative and statistically significant, suggesting that past values of sustainable development have a negative influence on the current sustainable development in Nigeria for the study periods, possibly indicating stagnation or regression in sustainable development over time. The negative relationship is stronger for the 1st and 2nd lags, with significance at 0.0045 and 0.0280, implying that policies aimed at improving sustainable development might have been ineffective over time.

Environmental depletion has negative and statistically significant coefficients across several lags, indicating a strong adverse impact of environmental depletion (carbon emissions) on sustainable development. The results suggest that higher environmental depletion impede sustainable development, which is consistent with the idea that environmental degradation reduces the capacity for sustainable development. The significant negative effect across multiple lags (with the highest significance at 0.0067 for D (CEPC (-2) reinforces the long-term detrimental effects of environmental depletion.

Political stability is positively correlated with HDI (sustainable development). The coefficients for POLISTA and its lags (D (POLISTA), D (POLISTA (-1), D (POLISTA (-2) are positive and statistically significant, indicating that improved political stability contributes to better sustainable development outcomes. The positive and significant effect, particularly for the 2nd lag (D (POLISTA (-2), suggests that long-term political stability is essential for

fostering sustainable development in Nigeria.

The control for corruption (COR) has a significant negative relationship with sustainable development, indicating that higher corruption levels hinder sustainable development. The significant negative coefficients for several lags (D (COR), D (COR (-1), D (COR (-2) suggest that reducing corruption would positively impact sustainable development. The negative correlation implies that institutional improvements in governance, especially reducing corruption, are critical for advancing sustainability.

The rule of law (RULAW) shows a mixed impact. While the 4th lag (D (RULAW (-4) is significant and negative, others (e.g., D (RULAW) and D (RULAW (-1) show weak or no significant effects. This suggests that while rule of law is crucial for institutional quality and sustainable development, its influence is not consistently strong over the studied period.

The R-squared value of 0.867 indicates a strong fit of the model, meaning that a significant proportion of the variability in sustainable development (HDI) is explained by the included variables. The Durbin-Watson statistic of 2.17 suggests that there is no significant autocorrelation, and the regression model is well-specified. The probability value of the F-statistic (0.23345) suggests that, while the model explains a good portion of the variance in HDI, the overall significance of the model might not be as strong as individual predictors.

This aligns with the Environmental Kuznets Curve (EKC) hypothesis by Grossman and Krueger (1995), which suggests that environmental degradation is reversible once a certain level of economic development is attained. It proposes that as countries advance, they should focus on environmental restoration and conservation, which will help reduce environmental damage. Nevertheless, the study's results statistically validate that sustainable development in Nigeria is influenced by both institutional quality and environmental degradation, extending the theoretical framework of this study and reinforcing previous models on growth and development, such as Barro (1996), Romer (1990), and Solow (1957). While the EKC hypothesis is supported, it also highlights a gap in the theory, as it overlooks the role of institutional quality in facilitating the reversibility of environmental degradation.

The analysis shows that institutional quality negatively impacts sustainable development in Nigeria, leading to a "crowd-out" effect. As the quality of institutional quality deteriorates, sustainable development in Nigeria also declines. Consequently, the hypothesis H01, which suggests that institutional quality does not significantly affect sustainable development, is rejected at the 5% level of significance.

Similarly, environmental degradation was found to have a crowd-out effect on sustainable development in Nigeria, leading to the rejection of hypothesis H02, which posited that environmental degradation does not significantly affect sustainable development in Nigeria, at the 5% level of significance. This confirms that ongoing environmental depletion will hinder the attainment of sustainable development in Nigeria.

Thus, the hypotheses were confirmed, with findings showing that Nigeria's slow progress toward sustainable development is partly attributed to challenges in institutional quality and environmental degradation. This outcome aligns with previous studies by Acemoglu et al. (2020), Bhattacharjee (2017), and Dima et al. (2013).

5. Conclusion

The pursuit of sustainable development has been a central objective for many developing nations, including Nigeria. However, much of the focus has traditionally been on macroeconomic variables as primary drivers of sustainable development, with limited attention given to other potentially significant factors, such as environmental, and institutional quality. Previous academic work has primarily concentrated on the relationship between macroeconomic factors and sustainable development (e.g., Alonso et al., 2020; Gough et al., 2004; Salahuddin & Gow, 2018), while the roles of environmental, and institutional quality remain underexplored. This study addresses this gap by investigating the impact of institutional quality and environmental degradation on sustainable development in Nigeria, offering empirical insights into key issues surrounding sustainable development policy and theoretical debates. Using the autoregressive distributed lag (ARDL) model, this research analyzes data spanning from 1996 to 2023.

The findings reveal noteworthy outcomes. Specifically, up to the fourth lag length, the results indicate that, institutional quality and environmental degradation impacts on sustainable development in Nigeria. This suggests that during the study period, both institutional quality issues and environmental degradation have posed significant challenges to achieving sustainable development.

In other word, the results indicate that both institutional quality (especially political stability, control of corruption, and rule of law) and environmental factors (such as carbon emissions per capita) significantly influence sustainable development in Nigeria. Hence, Effective governance, political stability, and anti-corruption measures are essential for promoting sustainable development, while addressing environmental degradation is crucial for achieving long-term sustainability in Nigeria.

5.1 Implications

This study underscores the importance of both institutional quality and environmental factors in shaping sustainable development in Nigeria. The results highlight the need for policy interventions aimed at improving these critical areas. From a theoretical perspective, the study contributes to the understanding that sustainable development is not only supported by good institutional quality but also by a healthy and secure environment. The findings align with the Environmental Kuznets Curve (EKC) hypothesis, with some caveats regarding the role of institutional quality in fostering environmental conservation. The Nigerian government is urged to take immediate and decisive actions to address the factors contributing to environmental degradation, including emissions, pollution, and other negative externalities, as well as institutional quality challenges such as corruption, political instability, and weak rule of law.

Moreover, the theoretical implications of the EKC hypothesis suggest that while early stages of economic development may coincide with increased environmental degradation, it is expected that, over time, investments in environmental conservation will reduce degradation. However, this expectation has not been adequately realized in the Nigerian context, as government efforts to conserve the environment have been insufficient.

5.2 Limitations and Future Directions

This study has some limitations, including the inability to explore all dimensions of institutional quality, such as government effectiveness, ease of doing business, and regulatory

quality. The focus was primarily on key institutional quality challenges relevant to Nigeria, such as political instability, corruption, and the rule of law. The exclusion of certain institutional quality components was also influenced by issues of multicollinearity. Additionally, the study's geographical focus on Nigeria (from 1996 to 2023) limits the ability to generalize the findings to other African nations or globally.

The ARDL (Autoregressive Distributed Lag) model used in this study provides insights into the dynamic relationships between institutional quality, environmental depletion, and sustainable development in Nigeria. However, several challenges could arise in the methodology. First, the accuracy of lag lengths can be influenced by the choice of model specifications, and the results might vary if a different lag structure was used. Second, the study relies on secondary data, which may be subject to reporting inconsistencies or biases in how variables like corruption or environmental degradation are measured over time. Moreover, given the focus on Nigeria, the findings may not be directly applicable to other countries with different political, economic, or environmental contexts, limiting the generalizability of the results.

While the ARDL model provides useful insights, its results should be interpreted with caution, especially when extrapolating to other regions or applying them to long-term policy recommendations. Further research using similar methodologies in different countries or regions could help validate the findings and offer a more comprehensive understanding of the global applicability of institutional quality and environmental depletion on sustainable development practices.

Future research should address these limitations by examining a broader range of institutional quality components, including government regulations and effectiveness, which could offer a more comprehensive view of institutional quality's role in sustainable development. Expanding the scope to include other African countries could provide valuable comparative insights into the region's sustainable development challenges. Such studies may contribute to more nuanced policy recommendations tailored to specific national contexts across the continent.

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APPENDIX

Table 2. Summary statistics; unit root test				
Appendix-1				
ADF test Variables	Critical Value at 5%	Order	Philip Perron test (PP) Critical Value at 5%	Order
HDI	-2.573287	I (0)	2.5763	I (0)
CEPC	-2.611432	I(1)	-2.6239	I(1)
POLISTA	-2.935511	I(1)	-3.6339	I(1)
COR	-2.893452	I(1)	-2.5238	I(0)
RULAW	-2.992654	I(1)	-3.74540	I(1)

Source: Authors compilation 2023

Table 3. Bound Test Result				
Appendix-1I				
F-Bounds Test				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	1.666065	10%	2.2	3.12
K	4	5%	2.55	3.46
		2.5%	2.68	3.55
		1%	3.26	4.34

Source: Authors' compilation 2023

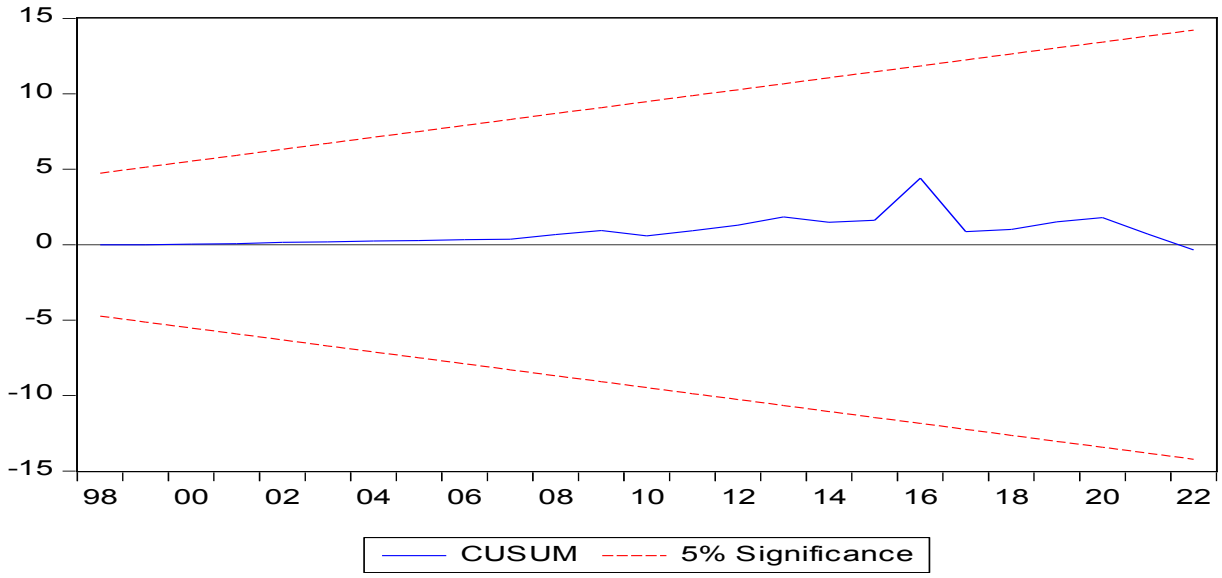
Table 4: Empirical results of the ARDL estimate: 1996-2023

Appendix-III

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
D(HDI(-1))	-1.030426	0.437865	-4.544366	0.0045
D(HDI(-2))	-1.000327	0.354345	-3.976545	0.0280
D(HDI(-3))	-0.56286	0.324446	-2.254646	0.0576
D(HDI(-4))	-0.286342	0.294556	-0.565767	0.5436
D(CEPC)	-1.033654	0.267546	-3.34255y	0.0222
D(CEPC(-1))	-1.050654	0.254654	-2.876565	0.0564
D(CEPC(-2))	-1.895436	0.435435	-5.564777	0.0067
D(CEPC(-3))	-1.753254	0.454446	-3.987666	0.0254
D(CEPC(-4))	-0.438764	0.113245	-3.543644	0.0211
D(POLISTA)	0.164532	0.065454	3.222445	0.0456
D(POLISTA(-1))	0.187643	0.065454	3.056477	0.0234
D(POLISTA(-2))	0.128765	0.034356	3.556433	0.0212
D(POLISTA(-3))	0.056432	0.037657	1.765754	0.1454
D(COR)	-0.167654	0.057655	-3.017654	0.0543
D(COR(-1))	-0.255432	0.057654	-4.276547	0.0122
D(COR(-2))	-0.287324	0.055765	-3.204354	0.0277
D(COR(-3))	-0.223654	0.065433	-3.011324	0.0270
D(COR(-4))	-0.204534	0.078665	-3.434543	0.0321
D(RULAW)	0.654328	0.086043	2.045327	0.1143
D(RULAW(-1))	-0.003276	0.080657	-0.045786	0.7654
D(RULAW(-2))	-0.354676	0.058343	-3.763423	0.0150
D(RULAW(-3))	-0.332535	0.065478	-4.324565	0.0213
D(RULAW(-4))	-0.214353	0.032455	-4.280890	0.0245
C	-0.041232	0.005647	-4.114533	0.0125
R-squared	0.8675478	Mean dependent var		0.000929
Ad R-squared	0.4765458	S.D. dependent var		0.029081
S.E. of regression	0.024325	Akaike info criterion		-5.132456
Sum squared resid	0.001564	Schwarz criterion		-3.567788
Log-likelihood	94.85464	Hannan-Quinn criter.		-4.563422
F\b-statistic	2.123543	Durbin-Watson stat		2.166547
Prob(F-statistic)	0.233456			

Source: Authors' compilation 2023

Appendix-IV



Source: Authors' compilation 2023

Figure: 2**. CUSUM Stability Test: 1996-2**