

Environmental Degradation and Sustainable Development in Nigeria

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Abstract

This study investigates the impact of environmental degradation on Nigeria's sustainable development between 2003 and 2023. By analyzing the Sustainable Development Index (SDI) alongside CO₂ emissions per capita, the study identifies a clear tension between economic activity and environmental health. While Nigeria has experienced a steady rise in its SDI, reflecting improved policy integration, CO₂ emissions remain high due to continued dependence on fossil fuels. A correlation coefficient of $r = -0.41$ indicates that environmental degradation significantly undermines sustainability efforts. The research also highlights governance weaknesses and poor policy enforcement as primary challenges. To address these issues, the study recommends strengthening environmental oversight and incentivizing the transition to renewable energy sources to achieve long-term, carbon-neutral growth.

Introduction

Environmental degradation remains one of the most critical challenges of the 21st century, with profound implications for sustainable development globally. This issue is particularly acute in developing nations such as Nigeria, where rapid urbanization, industrialization, and resource exploitation have significantly strained the country's natural resources. Nigeria's environmental challenges, ranging from deforestation and soil erosion to oil spills and air pollution, not only jeopardize ecological balance but also threaten human well-being, food security, and economic stability. Addressing these challenges is paramount to achieving sustainable development, a concept that emphasizes meeting present needs without compromising the ability of future generations to meet their own (World Commission on Environment and Development (WCED), 1987).

As one of Africa's most resource-rich countries, Nigeria exemplifies the dual-edged nature of resource wealth, offering economic opportunities while presenting significant

environmental trade-offs. The Environmental Kuznets Curve (EKC) hypothesis, a prominent theoretical framework in environmental economics, posits that environmental degradation initially increases with economic growth but declines once a country reaches a certain income level. However, the EKC's applicability to Nigeria remains contested. Studies by Akpan and Chuku (2011) and Ominyi and Abu (2017) reveal deviations from the traditional EKC model, highlighting a complex, non-linear relationship between economic growth and environmental quality. Instead of a predictable decline in degradation at higher income levels, these studies suggest an N-shaped curve, indicating a resurgence of environmental harm as economic activities intensify.

Energy consumption is another critical dimension influencing environmental sustainability in Nigeria. Historically, the nation's heavy reliance on fossil fuels was reinforced by government subsidies, which encouraged excessive consumption and heightened CO₂ emissions. However, with the removal of petrol subsidies in May 2023, the policy landscape has shifted significantly. While the subsidy removal is expected to reduce fossil fuel consumption and stimulate the adoption of cleaner alternatives in the long term, it has also raised short-term concerns over energy affordability and household welfare. Despite global advancements in renewable energy technologies, Nigeria has made limited progress in adopting green alternatives. Osuntuyi and Lean (2022) demonstrate that energy consumption has both direct and indirect effects on environmental outcomes, depending on factors such as education, governance, and income levels. The lack of robust policies to facilitate a transition from fossil fuels to renewable energy underscores the urgent need for targeted interventions that align Nigeria's energy strategies with its environmental and developmental goals.

Compounding these challenges is the degradation of land and natural ecosystems, particularly in rural areas where overcultivation, deforestation, and desertification undermine agricultural productivity and livelihoods. Titilola and Jeje (2008) identify unsustainable land use as a major contributor to rural poverty and food insecurity in Nigeria. Similarly, urbanization pressures have strained Nigeria's ecosystems, with Zipperer et al. (2020) emphasizing the need for urban planning models that integrate natural ecosystems to mitigate biodiversity loss and hydrological disruptions.

The Niger Delta region, a hub of oil production and one of Nigeria's most ecologically sensitive areas, epitomizes the dire consequences of environmental degradation. Widespread pollution from oil spills, gas flaring, and deforestation has not only degraded the environment but also displaced communities and exacerbated socio-economic disparities (Aluko, 2004; Ekpu & Unufe, 2018). Sagay et al. (2012) argue that sustainable development in the Niger Delta requires an integrated approach that addresses ecological restoration while tackling systemic poverty and regional conflicts. However, the lack of adequate environmental governance, compounded by outdated extraction technologies and corporate negligence, has hindered progress in this region.

Globally, the discourse on sustainable development has shifted towards frameworks that balance economic, social, and environmental goals. The United Nations Sustainable Development Goals (SDGs) offer a comprehensive blueprint for achieving

this balance, emphasizing intergenerational equity, poverty eradication, and environmental conservation (UNEP, 2013). Yet, aligning national policies with these global goals remains a formidable challenge for Nigeria. Studies such as Aberu (2023) and Oluwatayo and Ojo (2024) point to governance deficits, policy inconsistencies, and inadequate infrastructure as key barriers to integrating SDGs into Nigeria's development agenda. Furthermore, the global shift towards circular economy models, as advocated by Oluwatayo and Ojo (2024), has yet to gain traction in Nigeria, where waste management systems are plagued by inefficiencies and underinvestment.

Amid these challenges, education emerges as a potential moderating factor in shaping pro-environmental behaviors. Osuntuyi and Lean (2022) emphasize the dual role of education in mitigating or exacerbating environmental degradation, depending on its content and accessibility. Additionally, the role of governance cannot be overstated. Li et al. (2024) highlight how government attention and financial investment in sustainable development initiatives have facilitated the alignment of policies with SDG objectives in other contexts, offering valuable lessons for Nigeria.

Despite the extensive literature on environmental degradation and sustainable development, significant gaps remain. Current studies often focus on specific issues, such as energy consumption, governance, or regional degradation, without integrating these dimensions into a cohesive framework. Furthermore, while the Niger Delta has received considerable attention, less emphasis has been placed on the peculiarity of Nigeria as a country. This study aims to address these gaps by examining the relationship between environmental degradation and sustainable development in Nigeria.

Literature Review

Environmental degradation and sustainable development are interconnected challenges central to contemporary global and national discourse. In Nigeria, the degradation of natural resources driven by industrial activities, urban expansion, and resource exploitation threatens ecological balance and societal well-being. Simultaneously, achieving sustainable development, as envisioned in the Brundtland Report (1987) and the United Nations Sustainable Development Goals (SDGs), necessitates integrating economic, social, and environmental objectives.

This literature review explores the theoretical and empirical perspectives on environmental degradation and sustainable development. It examines the concept of environmental degradation and sustainable development and synthesizes global and regional studies to provide a comprehensive understanding of these critical issues. The review also situates the study within the Sustainable Development Theory, providing a framework for analyzing Nigeria's pathways to growth and sustainability.

Environmental Degradation

Environmental degradation refers to the deterioration of the natural environment caused by human activities, natural processes, or a combination of both, resulting in reduced

environmental quality and ecosystem functions. This concept encompasses a wide range of issues, including deforestation, soil erosion, air and water pollution, biodiversity loss, and climate change. The United Nations Environment Programme (UNEP) defines environmental degradation as the reduction of the environment's capacity to meet social and ecological objectives and needs (UNEP, 2013).

Nwagbara et al. (2012) identify environmental degradation as a paradoxical phenomenon wherein human actions to meet immediate needs often undermine long-term ecological balance. In developing nations like Nigeria, the causes of environmental degradation are multifaceted, ranging from industrial emissions and unsustainable agricultural practices to resource extraction and urban expansion (Inyang, 2019). Studies in Nigeria's Niger Delta region highlight the severe impact of oil exploration, leading to soil contamination, water pollution, and deforestation (Sagay et al., 2012; Ekpu & Unufe, 2018). These findings emphasize the need for multidimensional interventions that address the economic, social, and ecological drivers of degradation.

Globally, environmental degradation has been linked to both poverty and affluence, creating a dual challenge for policymakers. Nwagbara et al. (2012) discuss the "poverty-environment trap," where impoverished communities overexploit natural resources for survival, while affluent societies contribute to degradation through overconsumption and industrialization. This duality is particularly evident in Nigeria, where deforestation for agriculture and fossil fuel reliance for economic growth exacerbate environmental harm (Akpan et al., 2018).

Sustainable Development

Sustainable development is a multidimensional concept that seeks to balance economic growth, social inclusion, and environmental preservation to meet the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987). The 17 Sustainable Development Goals (SDGs) introduced by the United Nations in 2015 provide a global framework for achieving this balance, with goals addressing poverty eradication, climate action, and ecosystem preservation.

The literature on sustainable development highlights its interconnected nature, wherein progress in one dimension often depends on advancements in others. For example, sustainable energy transitions are critical for reducing greenhouse gas emissions, while addressing social inequities ensures the inclusivity of development policies. In Nigeria, sustainable development faces significant barriers, including weak governance, policy inconsistencies, and inadequate infrastructure (Aberu, 2023; Oluwatayo & Ojo, 2024).

Regionally, the Niger Delta serves as a microcosm of Nigeria's sustainability challenges. Despite its economic importance as an oil-producing region, the area has suffered from environmental degradation, socio-economic disparities, and governance failures (Aluko, 2004). The lack of sustainable practices in resource extraction has led to environmental harm and community conflicts, necessitating a change in basic

assumptions towards integrated development strategies that incorporate ecological restoration and community empowerment (Ekpu & Unufe, 2018).

Globally, scholars argue for embedding sustainable development principles into national policies and governance structures. UNEP (2013) emphasizes the importance of integrating environmental considerations into economic and social planning to ensure intergenerational equity. However, aligning these principles with local realities remains a challenge. In Nigeria, studies by Akpan and Chuku (2011) and Ominyi and Abu (2017) reveal that existing economic growth models fail to address the environmental dimension of sustainability, necessitating alternative frameworks that balance resource use with conservation.

Empirical Literature Review

Akpan and Chuku (2011) extended the traditional Environmental Kuznets Curve (EKC) hypothesis to include additional variables such as trade openness and sectoral contributions to GDP. The EKC hypothesis traditionally posits an inverted U-shaped relationship between environmental degradation and economic growth, where environmental damage increases during the initial stages of economic growth but decreases after reaching a certain income level due to structural economic shifts and improved environmental regulations. However, Akpan and Chuku employed an autoregressive distributed lag (ARDL) framework on data spanning five decades (1960–2008) to examine this hypothesis in Nigeria. Their analysis found no evidence supporting the EKC hypothesis in the Nigerian context. Instead, they observed an N-shaped relationship, indicating that after an initial decline in environmental harm as income rises, there is a resurgence of degradation at higher income levels. This finding highlights the limitations of the EKC model in capturing the unique dynamics of environmental degradation in developing economies like Nigeria, where institutional weaknesses, policy inconsistencies, and resource dependency may distort the typical EKC trajectory.

Similarly, Ominyi and Abu (2017) revisited the EKC hypothesis using a vector autoregression (VAR) model and the Granger causality test on data from 1986–2015. Their analysis also contradicted the EKC hypothesis, showing that environmental quality in Nigeria continues to deteriorate as income increases, without the expected decline at higher income levels. The study attributed this trend to factors such as weak governance, ineffective environmental policies, and a lack of investment in cleaner technologies. The authors emphasized the urgent need for policies that harmonize economic growth objectives with environmental sustainability. They advocated for incorporating sustainable practices and green technology adoption into Nigeria's development agenda to mitigate the worsening environmental impact associated with rising incomes.

Energy consumption has been identified as a key determinant of environmental quality, with its effects varying across contexts and income levels. Osuntuyi and Lean (2022) explored this nexus across ninety-two heterogeneous countries using advanced panel regression techniques, including Fully Modified Ordinary Least Squares (FMOLS) and

the Autoregressive Distributed Lag Panel Mean Group (ARDL-PMG) approach. Their findings highlighted that energy consumption contributes significantly to environmental degradation across all income groups. Importantly, the role of education was found to be dual-faceted: in some contexts, education mitigates environmental harm by fostering pro-environmental behavior and awareness; in others, it exacerbates degradation due to increased consumption associated with higher education levels and affluence. This duality underscores the need for targeted educational policies that emphasize sustainability and environmental stewardship.

In Nigeria, environmental degradation, especially through deforestation (forest loss), gas flaring, and oil spillage, has remained a persistent development concern because it can erode the natural-resource base that supports production and livelihoods. Ajudua (2019) investigated this nexus by estimating the effect of environmental degradation on Nigeria's economic growth using annual data for 1986–2016, with real GDP as the growth proxy and forest loss (FOL), quantity of gas flared (QGF), and quantity of oil spilled (QOS) as degradation indicators. Using Johansen cointegration to test long-run relationships and an error-correction model (ECM) to capture short-run dynamics, the study reports evidence of a long-run relationship among the variables and finds that forest loss and oil spillage exert statistically significant negative effects on growth, while gas flaring is negatively signed but not statistically significant in the estimated model. The ECM term indicates that 32% of disequilibrium is corrected annually, implying a gradual adjustment back to long-run equilibrium after short-run shocks, and the stability diagnosis suggests the model parameters are sufficiently stable for policy discussion. Based on these findings, Ajudua emphasizes the need for stronger environmental laws/policies to curb water deterioration linked to oil spillage and tighter controls to reduce land degradation driven by forest loss, framing environmental governance as complementary to Nigeria's long-run growth objectives.

The Niger Delta region exemplifies the intricate and often precarious balance between resource exploitation and environmental sustainability. Rich in crude oil, the region has become a focal point of Nigeria's economic activities, contributing significantly to the nation's GDP and foreign exchange earnings. However, the intense extraction of oil has led to widespread environmental degradation, creating profound ecological and socio-economic challenges. Sagay et al. (2012) detailed the environmental consequences of oil multinational corporations (MNCs) operating in the Niger Delta, including oil spills, gas flaring, and deforestation. These activities have not only polluted soil and water resources but also destroyed biodiversity and disrupted the livelihoods of local communities dependent on farming and fishing. The resultant environmental harm has been a key driver of regional conflicts, with local populations opposing the operations of OMNCs due to inadequate compensation and perceived exploitation. The study underscores that achieving sustainable development in the Niger Delta requires simultaneous efforts to address ecological restoration and mitigate security concerns stemming from environmental grievances.

Broadening the scope, Asongu and Odhiambo (2018) analyzed the relationship between environmental degradation and human development across forty-four sub-Saharan African countries, including Nigeria. Their study identified a U-shaped

relationship between carbon dioxide emissions and human development indices, such as education, health, and income. While economic growth initially supports human development, unchecked environmental degradation eventually undermines these gains by degrading the quality of life and increasing vulnerabilities to health risks. This finding reinforces the need to integrate environmental sustainability into regional development agendas to ensure that economic progress does not come at the cost of social well-being.

In a similar vein, Fernandes et al. (2024) investigated the challenges of sustainable development in Morocco, with a focus on water management as a critical concern. They emphasized that balancing social, economic, and environmental objectives is essential, particularly in rural areas where water scarcity poses significant challenges to livelihoods. Their study aligns with broader global debates, highlighting the trade-offs and synergies required to achieve sustainability. The findings resonate with the Niger Delta's context, where managing natural resource exploitation while ensuring equitable social and economic benefits remains a pressing challenge.

Governance plays a pivotal role in mitigating environmental degradation and fostering sustainable development, as emphasized by Aberu (2023). Using ARDL cointegration analysis, Aberu demonstrated how poor governance exacerbates environmental harm and impedes sustainable development. The study highlighted transparency, accountability, and participatory governance as critical factors for aligning environmental objectives with national development goals. These insights are particularly relevant for the Niger Delta, where governance failures have perpetuated resource mismanagement and hindered meaningful progress toward sustainability.

In rural Nigeria, the impacts of environmental degradation extend beyond resource exploitation to include land degradation caused by overcultivation, deforestation, and desertification. Titilola and Jeje (2008) examined these issues, linking them to declining agricultural productivity and persistent poverty. They advocated for policies promoting sustainable land use and environmentally friendly agricultural practices, which could alleviate poverty and reduce pressure on natural resources. These recommendations align with the broader need for sustainable practices in the Niger Delta, where environmental restoration could support local economies and improve community resilience.

Urbanization adds another layer of complexity to sustainable development in Nigeria. Zipperer et al. (2020) explored the ecological impacts of urban expansion, emphasizing biodiversity loss and hydrological disruptions. They argued for urban planning approaches that integrate natural ecosystems, which could mitigate adverse effects while fostering sustainable growth. Similarly, Oluwatayo and Ojo (2024) introduced the concept of a circular economy as a transformative model for addressing waste management challenges in Nigeria. They identified infrastructure deficits and policy inconsistencies as key barriers to implementation, calling for targeted investments and capacity-building initiatives to enhance resource efficiency and economic resilience. This framework has implications for the Niger Delta, where waste management and resource recovery could complement broader environmental and economic strategies.

Aluko (2004) explored the deep-rooted connection between environmental degradation in Nigeria's Niger Delta and the persistent cycles of poverty and resource mismanagement. The Niger Delta, a region rich in natural resources, particularly oil, has faced extensive environmental challenges due to decades of unsustainable resource exploitation and insufficient governance. Aluko identified that poverty forces many communities to overexploit local resources, such as forests and fisheries, further degrading the environment they depend on for their livelihoods. Concurrently, poor management of the region's vast natural wealth, including the absence of equitable revenue-sharing mechanisms and inadequate reinvestment in local infrastructure, has perpetuated the underdevelopment of affected communities.

To address these issues, Aluko proposed a multidisciplinary approach that combines environmental restoration efforts with socio-economic development. This approach involves ecological rehabilitation, investment in local human capital, and the development of alternative livelihoods that reduce dependency on resource exploitation. By adopting global frameworks like the Brundtland Report (1987), which emphasizes intergenerational equity and sustainable development, Aluko's study underscores the importance of balancing economic growth with conservation to ensure the well-being of current and future generations.

Nwagbara et al. (2012) expanded on this theme by categorizing the link between poverty and environmental degradation into three distinct schools of thought. The first school, poverty-induced degradation, posits that impoverished communities degrade their environments out of necessity, relying heavily on natural resources for immediate survival. The second, affluence-driven degradation, attributes environmental harm to excessive consumption and industrialization in affluent societies. Finally, the hybrid perspective highlights that unsustainable practices are pervasive across both extremes, necessitating global strategies that address the root causes of resource overuse. These findings emphasize the need for integrated solutions that address both poverty and overconsumption to achieve sustainable development.

In developing economies, the pursuit of faster economic growth and greater integration into global capital markets can create a policy tension; growth-enhancing investment and resource extraction may raise output yet can also intensify CO₂ emissions if production remains carbon-intensive. Hunjra et al. (2024) examine this trade-off by assessing how economic growth and foreign direct investment (FDI) affect environmental degradation (CO₂ emissions) using a large panel of 76 developing economies from 1991–2022 and applying multiple estimators (including instrumental-variable 2SLS, cross-sectional time-series FGLS, and fixed-effects models) to strengthen robustness. Their results support the Environmental Kuznets Curve (EKC) logic, suggesting that at higher development stages, economies tend to adopt cleaner technologies and practices that help reduce emissions; however, they also find that FDI is positively associated with carbon emissions, implying that the type of inward investment and the stringency/enforcement of host-country environmental frameworks materially shape outcomes. Importantly, their interaction analysis indicates that environmental degradation rises when high economic growth, abundant natural

resources, and large FDI inflows occur simultaneously, highlighting a “compound risk” scenario for resource-rich developing economies.

The role of governance in sustainable development was examined by Li et al. (2024) in the context of China’s efforts to achieve the United Nations Sustainable Development Goals (SDGs). The study demonstrated that strong government intervention, including robust policies, financial investments, and public participation, significantly enhances the alignment of socio-economic objectives with environmental sustainability. This research provides valuable lessons for Nigeria, where weak governance and poor policy implementation have hindered progress in regions like the Niger Delta.

Lakshmi pathi Raju and Abhishek (2023) underscored the importance of comprehensive policy frameworks in mitigating environmental degradation. Their study highlighted the need for legal mechanisms and public awareness campaigns that balance developmental ambitions with environmental conservation. They cautioned against unchecked resource exploitation, which threatens ecological balance and human well-being. Similarly, Borhan and Ahmed (2019) revisited the Environmental Kuznets Curve (EKC) hypothesis in Malaysia, observing a cubic N-inverted relationship between GDP per capita and pollution levels. Their findings challenge the assumption that economic growth automatically leads to environmental improvements and highlight the necessity of targeted policies to address environmental harm at all stages of development.

In the Nigerian context, Inyang (2019) linked environmental degradation in the South-South region to oil exploration practices, including soil and water contamination. The study attributed these issues to government inaction and corporate irresponsibility, emphasizing the need for comprehensive environmental management strategies. These strategies should involve both private sector accountability and government oversight to address the ecological and socio-economic consequences of resource extraction.

Ekpu and Unufe (2018) further analyzed the Niger Delta’s environmental crises, focusing on the role of oil spills and outdated extraction technologies. They argued that modernizing extraction processes and investing in infrastructure and human capital are essential for restoring ecological balance and fostering sustainable regional development. Their recommendations align with the United Nations Environment Programme (2013), which advocated for integrating socio-economic and environmental goals into SDG-driven policies and using measurable targets to track progress. This framework underscores the importance of ensuring accountability and achieving long-term sustainability. In a broader context, Thakur et al. (2014) explored similar environmental challenges in India, focusing on water contamination and deforestation. Their findings highlighted the need for international collaboration to address global environmental issues while adopting localized solutions tailored to specific challenges. This perspective is particularly relevant to Nigeria, where localized interventions that reflect the unique dynamics of regions like the Niger Delta are critical for achieving sustainable development.

This study addresses key gaps in the empirical literature on the relationship between environmental degradation and sustainable development in Nigeria. While prior studies

like Akpan and Chuku (2011) and Ominyi and Abu (2017) focused on cross-country analyses, they lacked insights into Nigeria's specific trends. By using the Sustainable Development Index (SDI) to analyze progress over 2003–2023, this study provides a long-term perspective on sustainability efforts. Unlike earlier works that examined localized issues like oil spills (e.g., Sagay et al., 2012; Ekpu & Unufe, 2018), it incorporates CO₂ emissions per capita as a broader measure of environmental degradation, linking industrialization and energy policies to sustainability. Additionally, the study addresses policy inefficiencies in decoupling economic growth from environmental degradation, as noted but not empirically analyzed by Akpan et al. (2018). These contributions provide actionable insights for aligning socio-economic progress with environmental sustainability in Nigeria.

Theoretical Framework

This study is anchored in the Sustainable Development Theory, a multidimensional framework that underscores the need to balance economic growth, social inclusion, and environmental preservation. Rooted in the Brundtland Report (1987), the theory defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This conceptualization integrates three critical dimensions:

1. **Economic Growth (E):** This dimension focuses on productive activities that generate wealth, reduce poverty, and improve standards of living. It represents the economic foundation required to fund social programs and environmental conservation efforts.
2. **Social Inclusion (S):** This dimension highlights equitable access to resources, education, health care, and opportunities for all societal groups, ensuring that development is inclusive and addresses the needs of marginalized populations.
3. **Environmental Sustainability (Env):** This dimension emphasizes the responsible use and protection of natural resources to maintain ecological balance. It seeks to mitigate environmental degradation, such as pollution and deforestation, which threatens the planet's capacity to support life.

The theory posits that sustainable development results from an interdependent relationship among these three dimensions. This relationship is mathematically expressed as:

$$SD = f(E, S, Env) \quad [1]$$

Here, SD represents sustainable development, and E, S, and Env denote the economic, social, and environmental dimensions, respectively. The equation reflects the need to optimize these dimensions simultaneously, recognizing that they are mutually reinforcing. For example, Economic growth generates resources that can fund social programs and environmental conservation. Social inclusion enhances human capital, contributing to economic growth and fostering environmental stewardship.

Environmental sustainability ensures the availability of resources necessary for economic and social progress.

The interrelationships inherent in sustainable development can be represented quantitatively to demonstrate both trade-offs and synergies among their various dimensions. A basic additive model is presented as follows:

$$SD = W_1E + W_2S + W_3EnvSD \quad [2]$$

Where W_1 , W_2 , and W_3 represent the relative weights or importance of each dimension, with $W_1 + W_2 + W_3 = 1$.

This additive model is presented as a heuristic simplification to illustrate the trade-offs and synergies among economic growth, social inclusion, and environmental sustainability. It does not imply strict econometric causality but rather highlights the conceptual need to balance these dimensions.

By adopting Sustainable Development Theory as its foundation, this study provides a structured lens to analyze the pathways through which Nigeria can achieve sustainable growth amidst its challenges of environmental degradation and socio-economic inequalities. This framework facilitates the exploration of trade-offs and synergies in Nigeria's pursuit of sustainability, aligning with both national priorities and global developmental goals.

Methodology

Research Design

This study adopts a quantitative research approach to analyze the relationship between environmental degradation and sustainable development in Nigeria. The Sustainable Development Index (SDI) is used as a proxy for sustainable development, while CO₂ emissions per capita serve as a measure of environmental degradation. The study spans 21 years (2003–2023) and utilizes descriptive statistics, correlation analysis, and graphical visualization to explore trends and relationships between the variables.

Data Sources

The data for this study were sourced from two reputable international databases. World Development Indicators (WDI) was the source for CO₂ emissions per capita, representing environmental degradation, while the Sustainable Development Report (SDR) 2023 provided data for the Sustainable Development Index (SDI), capturing progress in sustainability dimensions such as economic growth, social inclusion, and environmental management.

Analytical Techniques

This study combined the analytical tools of descriptive, correlation and graphical analyses. Descriptive statistics were computed to summarize the mean, standard

deviation, minimum, maximum, and range of both SDI and CO₂ emissions per capita. This provides insights into the central tendencies and variability of the variables over the study period. Pearson's correlation coefficient (r) was calculated to measure the strength and direction of the relationship between SDI and CO₂ emissions. A line graph was also used to visualize the trends in SDI and CO₂ emissions over time, allowing for a comparative analysis of their dynamics and identifying key divergences.

Justification of Methodology

The combination of descriptive statistics, correlation analysis, and graphical visualization provides a robust framework for assessing the dynamics between sustainable development and environmental degradation. The reliance on reputable secondary data sources ensures the reliability of findings. Additionally, this methodology aligns with previous studies, such as Akpan et al. (2018) and Aberu (2023), which employed similar approaches to examine sustainability challenges in developing economies.

Limitations

While the methodology provides valuable insights, the study is limited by its reliance on secondary data, which may not capture localized environmental impacts or socio-economic disparities within Nigeria. Future research could incorporate primary data and advanced econometric models to enhance the depth of analysis.

Empirical Findings on the Relationship between Environmental Degradation and Sustainable Development in Nigeria

The analysis of the relationship between environmental degradation and sustainable development in Nigeria, using data sourced from the World Development Indicator (WDI) and Sustainable Development Report (SDR) 2023, with Sustainable Development Index (SDI) as a proxy for sustainability and CO₂ emissions per capita as a measure of environmental degradation, reveals critical insights into the dynamics of these variables.

As reported, (Table 1) the Sustainable Development Index (SDI) has shown a steady increase over the period 2003–2023, with an average value of 0.543 and minimal variation (standard deviation of 0.034). This consistent upward trend reflects Nigeria's gradual progress in implementing sustainable development initiatives, addressing factors such as economic growth, social inclusion, and environmental management. The improvement in SDI suggests ongoing efforts to integrate sustainable practices into national development policies, albeit at a moderate pace.

CO₂ emissions per capita, a measure of environmental degradation, displayed moderate variability during the same period, with an average value of 0.702 and a standard deviation of 0.065. Emissions fluctuated significantly, with a notable reduction in 2009 (0.54) but an upward rebound to 0.81 by 2023. These fluctuations indicate

challenges in stabilizing and reducing emissions, despite apparent progress in sustainable development.

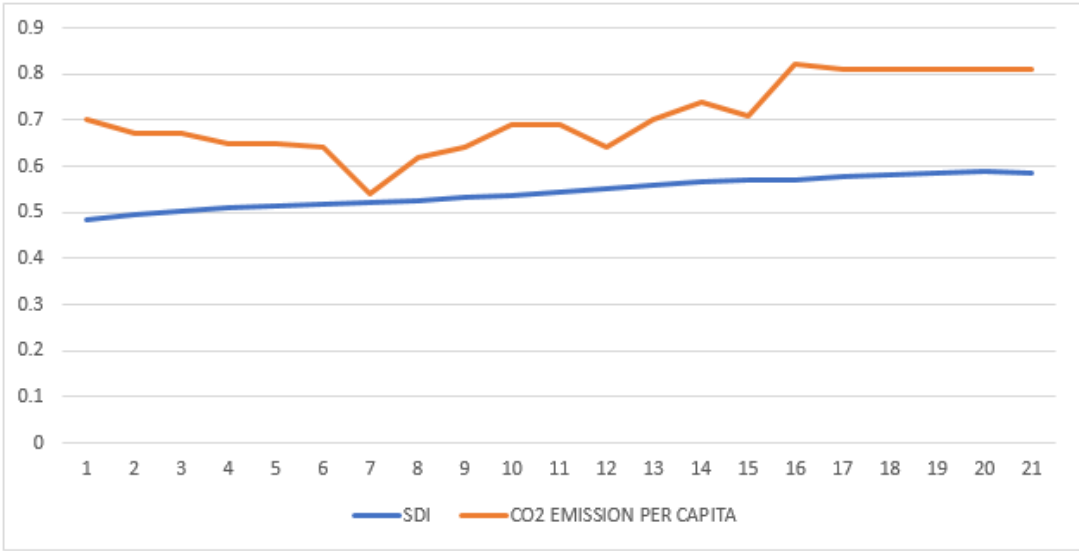
Table1
Descriptive Statistics and Correlation Coefficient of Sustainable Development and CO₂ Emission

Variable	Mean	Std. Dev.	Min	Max	Range
SDI	0.543	0.034	0.484	0.585	0.101
CO ₂ Emission Per Capita	0.702	0.065	0.54	0.82	0.28

Correlation Coefficient (r) = -0.41

The correlation analysis between SDI and CO₂ emissions per capita (Table 1) provides insights into the relationship between environmental degradation and sustainable development in Nigeria. The results show a moderate negative correlation ($r = -0.41$), indicating that higher CO₂ emissions are associated with lower sustainable development. This suggests that reducing environmental degradation may support improvements in sustainable development.

Figure1
Trend of Environmental Degradation and Sustainable Development in Nigeria



The trends in SDI and CO₂ emissions per capita in Nigeria over the period 2003–2023, (Figure 1) offer a nuanced view of the relationship between sustainable development

and environmental degradation. The SDI shows a consistent and gradual increase throughout the period, indicating steady progress in Nigeria's socio-economic and governance dimensions. This upward trend reflects incremental improvements in sustainable practices, governance frameworks, and social inclusion efforts, suggesting that sustainability principles are being integrated into national policies. However, the trend for CO₂ emissions per capita reveals a different story. While emissions showed a temporary decline around 2009, they subsequently rebounded and stabilized at higher levels by 2016, remaining consistently high at approximately 0.81 CO₂ emissions per capita toward the end of the study period. This fluctuation suggests persistent challenges in mitigating environmental degradation, particularly due to Nigeria's continued reliance on carbon-intensive energy sources such as fossil fuels.

The divergence between the SDI and CO₂ emissions trends is particularly striking, as it underscores the difficulty of decoupling socio-economic progress from environmental harm. While sustainable development has advanced, the rising and stabilized levels of emissions indicate that economic growth and energy consumption are still heavily reliant on unsustainable practices. This trend aligns with findings from Akpan et al. (2018), which highlighted Nigeria's reliance on fossil fuel subsidies as a major barrier to transitioning to renewable energy. Furthermore, the graph reflects governance gaps, as identified by studies such as Aberu (2023), suggesting a need for stronger enforcement of environmental regulations and policies. These trends also reinforce the conclusions of Sagay et al. (2012), who highlighted how unchecked resource exploitation in regions like the Niger Delta exacerbates environmental harm.

Policy implications drawn from this analysis emphasize the urgent need for targeted interventions to address the persistent environmental degradation. Accelerating the transition to renewable energy and phasing out fossil fuel subsidies are critical for reducing CO₂ emissions. Integrating environmental objectives into broader development plans can help ensure that economic and social progress is aligned with ecological sustainability. Strengthening governance and improving institutional capacity are equally essential to enforce environmental regulations and promote green technologies. The trends also point to the importance of sector-specific interventions, such as transitioning to energy-efficient technologies in industry and agriculture and encouraging the adoption of low-carbon practices in transportation and urban development. Public awareness campaigns can further complement these efforts by fostering a culture of environmental responsibility and conservation. Overall, while the upward trajectory of SDI reflects progress in sustainable development, the persistent high levels of CO₂ emissions highlight the need for more robust and integrated policies to ensure that environmental degradation does not undermine Nigeria's long-term sustainability goals.

Conclusion

Environmental degradation continues to pose a significant threat to sustainable development in Nigeria. As evidenced by the relationship between CO₂ emissions per capita and the Sustainable Development Index (SDI), environmental harm undermines progress in achieving socio-economic and ecological balance. Despite modest improvements in SDI over the past two decades, persistent and fluctuating CO₂

emissions highlight the challenges of decoupling economic growth from environmental harm. The findings underscore the complex interplay of governance deficiencies, reliance on fossil fuels, and unsustainable resource exploitation, particularly in regions like the Niger Delta. Furthermore, governance gaps and weak policy enforcement exacerbate the negative effects of environmental degradation on human well-being and the broader sustainability agenda. Achieving a balance between economic, social, and environmental dimensions remains critical to ensuring intergenerational equity and sustainable growth. Therefore, the following policy recommendations were made:

I. Accelerate the Transition to Renewable Energy: Given the findings that CO₂ emissions have remained persistently high despite improvements in the Sustainable Development Index (SDI), Nigeria must prioritize renewable energy adoption as a central strategy for reducing emissions. The recent removal of fuel subsidies in May 2023 provides an opportunity to redirect savings toward solar, wind, and hydroelectric power investments. Such measures will not only lower emissions but also create employment opportunities and improve energy access for underserved communities.

II. Strengthen Environmental Governance and Policy Enforcement: The study revealed a moderate negative correlation ($r = -0.41$) between environmental degradation and sustainable development, reflecting the hindering role of weak governance. Thus, enforcement mechanisms must be improved to ensure compliance with environmental regulations, with transparent monitoring of emissions and natural resource exploitation, particularly in the Niger Delta.

III. Promote Sustainable Agricultural Practices: The persistence of land degradation and its impact on livelihoods justifies targeted policies that support agroforestry, soil conservation, and climate-smart agriculture. These practices will directly address the link between land degradation and rural poverty identified in the literature and findings.

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References

- Aberu, F. (2023). Testing the efficacy of sustainable development for the quality of governance and environmental degradation in Nigeria. *International Journal of Management, Economics and Social Sciences*, 12(4), 279–298.
<https://doi.org/10.32327/IJMESS/12.4.2023.11>
- Ajudua, E. I. (2019). Environmental degradation and the Nigerian economic growth. *Dutse Journal of Economics and Development Studies (DUJEDS)*, 8 (December), 114–122.
- Akpan, U. F., & Chuku, A. C. (2011). Economic growth and environmental degradation in Nigeria: Beyond the environmental Kuznets curve. *Munich Personal RePEc Archive*. Retrieved from <https://mpra.ub.uni-muenchen.de/31241/>
- Aluko, M. A. O. (2004). Sustainable development, environmental degradation, and the entrenchment of poverty in the Niger Delta of Nigeria. *Journal of Human Ecology*, 15(1), 63–68.
- Asongu, S. A., & Odhiambo, N. M. (2018). Environmental degradation and inclusive human development in sub-Saharan Africa. *Munich Personal RePEc Archive*. Retrieved from <https://mpra.ub.uni-muenchen.de/88527/>
- Ekpu, C. E., & Unufe, J. (2018). Effects of environmental degradation on rural communities' sustainable development: Niger Delta communities in focus. *Online Journal of Arts, Management and Social Sciences*, 3(2), 34–43.
- Fernandes, C. S. F., Alves, F., & Loureiro, J. (2024). Sustainable futures: From causes of environmental degradation to solutions. *Discover Sustainability*, 5(63).
<https://doi.org/10.1007/s43621-024-00242-1>
- Hunjra, A. I., Bouri, E., Azam, M., Azam, R. I., & Dai, J. (2024). Economic growth and environmental sustainability in developing economies. *Research in International Business and Finance*, 70(Part A), 102341.
<https://doi.org/10.1016/j.ribaf.2024.102341>
- Inyang, B. (2019). Environmental degradation and sustainable development in Nigeria: A study of the South-South region. *International Journal of Humanities, Social Sciences and Education*, 6(8), 33–42.

- Lakshmipathi Raju, M., & Abhishek, D. V. S. (2023). Environmental degradation and sustainable development strategies for intervention and protection. *DSNLU Journal of Social Sciences*, 1(1), 67–69.
- Li, C., Chen, Z., Jiang, Q., Yue, M., Wu, L., Bao, Y., Xu, Z. (2024). Impacts of government attention on achieving Sustainable Development Goals: Evidence from China. *Geography and Sustainability*.
<https://doi.org/10.1016/j.geosus.2024.08.011>
- Nwagbara, E. N., Abia, R. P., Uyang, F. A., & Ejeje, J. A. (2012). Poverty, environmental degradation, and sustainable development: A discourse. *Global Journal of Human Social Science*, 12(11), 23–29.
- Oluwatayo, I. B., & Ojo, A. O. (2024). Circular economy and sustainability in Nigeria: Opportunities and challenges for development. *Electronic Green Journal*, 1(50).<https://doi.org/10.5070/G315060438>
- Ominyi, S. O., & Abu, J. (2017). Sustainable economic development and environmental degradation: Evidence from Nigeria. *IIARD International Journal of Economics and Business Management*, 3(3), 33–35. <http://www.iiardpub.org>
- Osuntuyi, B. V., & Lean, H. H. (2022). Economic growth, energy consumption, and environmental degradation nexus in heterogeneous countries: Does education matter? *Environmental Sciences Europe*, 34(48). <https://doi.org/10.1186/s12302-022-00624-0>
- Sagay, J., Edo, Z. O., & Avweromre, L. (2012). Environmental degradation and the dilemma of sustainable development: Implication for environmental security in the Niger Delta region. *Journal of Environmental Sciences and Resource Management*. <https://www.cenresinjournal.com/wp-content/uploads/2020/02/Page-14-29-679.pdf>
- Thakur, B. K., Rout, H. S., & Chakraborty, T. (2014). Environmental degradation, sustainable development, and human well-being: Evidence from India. *Manthan Journal of Commerce and Management*, 1(1), 102–104.
<https://doi.org/10.17492/manthan.v1i1.2436>
- Titilola, S. T., & Jeje, L. K. (2008). Environmental degradation and its implications for agricultural and rural development: The issue of land erosion. *Journal of Sustainable Development in Africa*, 10(2), 116–122. <https://arcjournals.org>
- United Nations Environment Programme. (2013). Embedding the environment in sustainable development goals. *UNEP Post-2015 Discussion Paper 1*.
<http://www.unep.org/pdf/embedding-environments-in-SDGs-v2.pdf>
- World Commission on Environment and Development. (1987). *Our Common Future*. Oxford University Press.

Zipperer, W. C., Northrop, R., & Andreu, M. (2020). Urban development and environmental degradation. *Oxford Research Encyclopedia of Environmental Science*. <https://doi.org/10.1093/acrefore/9780199389414.013.97>

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