**Rethinking Development Finance: Do External Debt and Governance Promote Sustainable Human Development in Nigeria?**

**ABSTRACT**

Existing literature on development outcomes often examines health, education, or environmental quality in isolation, with few studies offering a holistic assessment of sustainable human development. Moreover, the moderating role of governance quality in the relationship between external debt and sustainable human development remains underexplored. Additionally, most prior research relies on linear modelling approaches, which may not adequately capture the dynamic and asymmetric nature of this relationship. This study addresses these gaps by investigating the impact of external debt on sustainable human development in Nigeria, while incorporating governance quality as a moderating variable. Using quarterly data from 1996 to 2022 and applying the Nonlinear Autoregressive Distributed Lag (NARDL) model, the results reveal that both positive and negative shocks to external debt have a significant positive effect on sustainable human development, indicating that external borrowing, when effectively managed, can support long-term development goals. Furthermore, governance quality independently improves sustainable human development, and its interaction with external debt amplifies these gains. These findings highlight the critical role of strong institutional frameworks in enhancing the developmental returns of external debt. **This evidence can inform policy decisions on debt management and institutional reform to maximize development outcomes.**

**Keywords:** External debt;NARDL, Nigeria;Sustainable human development; SDGs

**1. Introduction**

Sustainable human development offers a more comprehensive and future-oriented framework than traditional human development by not only focusing on improving people’s well-being today but also ensuring that progress is inclusive, equitable, and environmentally sustainable for future generations (Verma et al., 2023). While human development emphasizes health, education, and income, sustainable human development integrates environmental stewardship, social equity, and economic resilience, aligning more closely with long-term development goals such as the United Nations Sustainable Development Goals (SDGs) and the African Union’s Agenda 2063 (Noor et al. 2023; Ekesiobi et al. 2025). For Nigeria, advancing sustainable human development is a critical national priority. However, the country continues to perform poorly across key indicators. Life expectancy remains low at 54 years, falling short of the Sub-Saharan African average of 61 years and the global average of 72 years (World Bank, 2023). Infant mortality is high at 69 per 1,000 live births, and maternal mortality is alarmingly elevated at 1,047 deaths per 100,000 live births, over four times the global average. Out-of-pocket health expenditure is the highest globally at 76%, compared to the world average of 17%, indicating inadequate access to affordable healthcare (World Bank, 2023). Economic growth is sluggish, with GDP per capita rising by just 0.4%, far below the global average of 1.8% (World Bank, 2023). Meanwhile, environmental degradation has intensified, with CO₂ emissions steadily increasing over the past three decades. The steady rise in CO₂ emissions over the past three decades signals worsening environmental degradation in Nigeria. This trend undermines efforts to achieve environmental sustainability, a key pillar of sustainable human development. Increased emissions contribute to climate change, which poses severe risks to agriculture, water resources, and public health (Dimnwobi et al. 2021; Okere et al. 2024a; Okere et al., 2025a). It also places additional stress on already fragile ecosystems, threatening biodiversity and livelihoods (Dimnwobi et al. 2022a; Dimnwobi et al. 2022b; Hammami et al. 2025). Without urgent and coordinated action, these environmental pressures could reverse development gains and hinder the achievement of national and global sustainability targets (Omoju et al. 2024; Aladejare & Dimnwobi; 2025). Nonetheless, progress toward this multidimensional development agenda is often slowed by financial shortfalls and institutional weaknesses, which are especially pronounced in many developing nations (Samour et al., 2024; Nwani et al. 2025; Okere et al., 2025b; Okere et al., 2025c).

External debt remains an essential tool for addressing these development shortfalls (Nwokoye et al., 2024; Dimnwobi et al., 2025). When properly managed, external borrowing can serve as a vital source of funding for national development (Dimnwobi et al. 2023a). It enables governments to invest in essential sectors such as infrastructure, healthcare, education, and environmental protection (Okere et al., 2023a; Ezenekwe et al., 2023). These sectors form the foundation of sustainable human development, contributing to long-term economic growth and improved human well-being (Onuoha et al., 2023a; Onuoha et al., 2023b). Nigeria’s total public debt stood at N87.91 trillion as of 2023, with external debt accounting for 36.38% of the total (DMO, 2023). However, the developmental outcomes of debt depend significantly on the quality of governance. Strong governance systems enhance debt effectiveness by ensuring that borrowed funds are allocated efficiently and transparently (Metu et al. 2020). In contrast, weak institutional frameworks often result in misappropriation, corruption, and the failure of debt-financed projects, undermining progress and deepening inequality (Dimnwobi et al. 2023b). Governance quality can therefore play a decisive moderating role in shaping the relationship between external debt and sustainable human development. Good governance strengthens institutions, promotes fiscal accountability, and fosters citizen trust, factors that collectively improve the developmental return on debt-financed investments (Okere et al., 2023b). By contrast, governance failures increase the risk of debt distress, policy inefficiency, and long-term developmental stagnation. It is within this context that this study examines the impact of external debt on sustainable human development in Nigeria, incorporating governance quality as a moderating variable.

The primary objective is to empirically investigate how both the magnitude and direction of external debt influence sustainable human development, while accounting for the conditional effects of governance quality. Using quarterly data from 1996 to 2022 and applying the Nonlinear Autoregressive Distributed Lag (NARDL) model, the study captures both asymmetries in debt behavior and non-linear relationships often overlooked in previous literature. This approach also accommodates structural shifts including those caused by the COVID-19 pandemic, thus providing a more robust framework for policy recommendations. Despite growing interest in debt and development studies, several gaps remain. First, no study has holistically assessed sustainable human development, as most focus on singular components such as health, education, or environmental quality. Second, the moderating role of governance quality in the external debt-development nexus remains underexplored, particularly within the Nigerian context. Third, existing studies largely adopt linear models that may fail to capture dynamic and asymmetric interactions between debt and sustainable human development. Lastly, few studies incorporate both pre- and post-COVID-19 data, limiting the relevance of their findings in the face of shifting global economic realities. This study addresses these gaps by offering a more integrated, nuanced, and policy-relevant analysis.

The rest of the study is organized as follows: Section 2 provides a review of the relevant literature, while Section 3 details the data sources and methodological approach. Section 4 presents the empirical findings and offers a discussion of the results. Section 5 concludes the study by summarizing key insights and offering policy recommendations.

**2. Literature review**

Akpan (2009) examined the influence of foreign loans on poverty reduction in Nigeria using the OLS technique. The findings suggest that external debt significantly contributes to poverty alleviation. In contrast, Oyedele et al. (2013) analyzed the effects of external debt and debt servicing on poverty between 1980 and 2010 and found that both variables were associated with increased poverty in Nigeria. In a Turkish context, Katircioglu and Celebi (2018) assessed the impact of external debt on ecological degradation from 1960 to 2013, using carbon emissions as the dependent variable and controlling for economic growth and energy consumption. The results indicated no significant relationship between external debt and ecological degradation. Egungwu (2018) studied the effects of rising external debt stock and its servicing on human capital development in Nigeria between 1986 and 2015. The study found a significant negative impact, suggesting that both rising debt stock and servicing obligations undermine human capital development. Similarly, Karimanzira et al. (2020), using OLS, found that external debt contributed to poverty in Zimbabwe.

Bahuli and Inuwa (2020) investigated the impact of external debt servicing on health outcomes in Nigeria and suggest that debt servicing had a positive effect on health outcomes. Conversely, Ojukwu (2021) found no significant relationship between external debt and sustainable development in Nigeria. In another Nigerian study, Igudia (2021) employed OLS to assess the impact of external debt and debt servicing on human capital development between 1960 and 2019. Results showed that while external debt positively influenced human capital development, debt servicing had a negative effect. Akam et al. (2021a) analyzed the relationship between external debt and environmental pollution in four African countries from 1970 to 2018, using ecological footprint and carbon emissions as proxies. The Augmented Mean Group (AMG) results showed that external debt did not significantly affect environmental quality. In a broader study, Akam et al. (2021b) found a statistically insignificant positive relationship between external debt and environmental degradation across 33 heavily indebted poor countries from 1990 to 2015.

Bese et al. (2021a) examined the impact of external debt on carbon emissions in China (1978–2014) and found a significant positive relationship, indicating that external debt exacerbates ecological degradation. Bese et al. (2021b) found similar results in India (1971–2012), while Bese and Friday (2022) found no significant effect of external debt on emissions from coal consumption in Turkey (1970–2020). Sadiq et al. (2022) studied BRICS countries (1990–2019) and found that external debt hinders human development while simultaneously promoting environmental sustainability. Jabari et al. (2022) reported a negative relationship between external debt and renewable energy consumption in Turkey (1980–2016), indicating that higher debt levels discourage renewable energy adoption. In a study covering 23 Asian economies from 1980 to 2020, Arshed et al. (2022) revealed that low debt levels reduce poverty and improve quality of life, whereas high debt levels worsen poverty. Alhassan and Kwakwa (2023) found that external debt servicing in Ghana is associated with improved environmental quality.

Mumuni and Abille (2023) investigated the effect of external debt on income inequality in 30 African countries from 2000 to 2018. They found that external debt exacerbates inequality. Similarly, Aladejare (2023) found that external debt reduces longevity in West Africa between 1981 and 2020. In Brazil, Saleem et al. (2024) used the augmented ARDL method to show that rising external debt between 1970 and 2021 had a detrimental effect on ecological sustainability. Likewise, Samour and Adebayo (2024) found that in BRICS nations (1990–2018), external debt, non-renewable energy use, and economic growth negatively impacted ecological sustainability, while renewable energy consumption had a positive effect.

Governance has also been studied in relation to development outcomes. Saba and Pretorius (2024), Rahman et al. (2025), and Nam and Ryu (2023) found that governance enhances human development in various regions. Additionally, Hasan et al. (2024), Khan and Khan (2024), and Solaymani and Montes (2024) observed that governance quality contributes to environmental sustainability and reduces ecological decay.

Despite the breadth of empirical studies on external debt, several gaps remain. First, no study has holistically assessed sustainable human development; rather, most studies focus on individual indicators such as poverty, health, education, or environmental quality. Second, the moderating role of governance quality in the relationship between external debt and sustainable human development remains underexplored. Third, most existing studies rely on linear models, which may not adequately capture complex interactions. Lastly, few studies incorporate both pre- and post-COVID-19 periods, limiting the relevance of findings in the current global economic context.

**3. Data and Methodology**

**3.1. Data**

This study examines the impact of **external debt on sustainable human development** and assess the **moderating role of governance quality** in this relationship. To achieve this objective, we utilize **quarterly time series data spanning from 1996 to 2022.** This period is strategically selected for two main reasons: first, it reflects a phase of substantial external borrowing in Nigeria, often justified by the government’s intent to strengthen human capital and promote environmental sustainability; second, it ensures data availability and satisfies statistical requirements for a sufficient degree of freedom, thereby minimizing the risks associated with the **curse of dimensionality** in econometric estimations. The data employed in this analysis are **secondary time series data** obtained from reputable sources, including the **Central Bank of Nigeria (CBN) Statistical Bulletin**, the **Global Footprint Network (GFN),** and the **World Development Indicators (WDI).**

**3.2. Empirical Model**

One of the most critical aspects of public debt is external debts. As opined by Turunen and Hiilamo (2014), studying the impact of external debt on sustainable human development is vital for assessing how external borrowings affect investments in key sectors like education and healthcare, and income disparities. Our empirical model in line with extant literature (Ezenekwe et al. 2023; Nwokoye et al. 2024) is specified below

 1

As argued earlier, governance quality is critical for the administration of public funds. Thus, it will enter the model. Again, governance quality influences how effectively external debt is managed and allocated towards development projects. Strong governance can ensure that debt is used efficiently, transparently, and accountably, leading to positive development outcomes. This makes interacting indicators of governance quality with external debt very crucial. Also, Verma et al., (2023) and Noor et al (2023) observe that ECG is crucial for sustainable human development as it enables increased resources for addressing social needs and environmental sustainability.

Thus, in NARDL context, Equation 1 becomes:

 2

*Where = parameter estimate*

*Where SHD is sustainable human development, EXD is external debt, PGR is population growth rate, KPW is Capital per worker, DSC is debt service cost, SPW is savings per worker, OPW is* output per worker, *QOG is governance quality, ECG is economic growth, EXD\*QOG is the interaction between external debt and governance quality*

The outcome variable, **Sustainable Human Development,** was constructed using a **two-stage Principal Component Analysis (PCA)** approach to generate a composite index that captures multiple dimensions of well-being. SHD integrates three broad dimensions: (i) the **Human Development Dimension,** comprising life expectancy, education levels, and per capita income; (ii) the **Environmental Sustainability Dimension,** measured through ecological footprint, CO₂ emissions, and renewable energy consumption; and (iii) the **Economic Equity Dimension** proxied by consumption per capita, access to clean water, and access to electricity. Each indicator within these dimensions was standardized and aggregated using PCA to derive a comprehensive SHD index. Additionally, **governance quality** was also indexed through PCA, incorporating multiple indicators that reflect the strength of institutions and policy effectiveness

**3.3. Econometric methodology**

This study employs the Nonlinear Autoregressive Distributed Lag (NARDL) model as the primary estimation technique to explore the asymmetric effects of external debt and governance on sustainable human development. The NARDL approach is particularly suitable for capturing nonlinear and directional relationships, which traditional linear models may overlook. To ensure the robustness and validity of the empirical analysis, a series of preliminary diagnostic procedures were conducted. First, descriptive statistics were employed to examine the central tendencies, dispersion, and distributional properties of the dataset. Second, the stationarity properties of the time series variables were assessed using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. Establishing stationarity is essential to avoid spurious regression results and to confirm the appropriateness of time series modeling (Ekesiobi et al., 2016; Obi et al., 2016; Nwokoye et al., 2019a). Third, the Bounds Testing approach to cointegration was applied to determine the existence of a long-run equilibrium relationship among the variables, which is critical when dealing with integrated series (Dimnwobi et al., 2017; Okere et al., 2024b). Finally, Principal Component Analysis (PCA) was employed to construct composite indices for sustainable human development and governance quality. This dimensionality reduction technique condenses multiple related indicators into a single index, enhancing the precision and parsimony of the regression analysis (Ekesiobi et al. 2025)

**4. Results and Discussion**

**(a) Descriptive Statistics**

Table 1 provides a summary of key descriptive statistics, offering important insights into the characteristics and relationships within the dataset. This foundational understanding supports the subsequent econometric analysis. The Sustainable Human Development (SHD) index has a mean value of 0.52, indicating that Nigeria’s SHD remains in the lower range, given the index is normalized between 0 (lowest) and 1 (highest). The maximum and minimum SHD values are 0.57 and 0.46, respectively, reflecting challenges such as inadequate healthcare, limited educational access, and persistent economic inequality. Similarly, external debt (EXD) as a percentage of GDP averaged 12.61% over the study period. The median EXD was 6.56%, with values ranging from a minimum of 1.20% to a peak of 45.66%, highlighting substantial variation in Nigeria’s debt burden. Population growth rate averaged 2.64%, with a narrow range between 2.42% and 2.80% and a low standard deviation of 0.12%, indicating relative stability. Nigeria’s high population growth is driven by high fertility rates (averaging five births per woman), a predominantly youthful population, limited access to family planning, and low contraceptive use (Ekesiobi & Dimnwobi, 2020). Although fertility rates have declined slightly, population momentum and improved healthcare (leading to lower mortality) continue to drive growth. Projections estimate Nigeria’s population will reach 239 million by 2025 and 440 million by 2050 (Nwokoye et al., 2020; Dimnwobi et al., 2023c). Addressing these issues requires targeted interventions in education, healthcare, and family planning.

Economic growth (ECG) in Nigeria has been marked by volatility. The average growth rate was 5.06%, with a peak of 14.6% in 2002 and a low of -1.79% in 2020. Early 2000s growth was driven by reforms under President Obasanjo, including telecommunications sector liberalization, which spurred investment and improved services (Dimnwobi et al., 2017; Nwokoye et al., 2019b; Nwokoye et al., 2022). Between 2000 and 2010, GDP growth averaged 8.6%, but slowed to an average of 2.7% between 2011 and 2022. The 2020 recession, the worst since the 1990s, was largely due to the COVID-19 pandemic and a collapse in oil prices, severely impacting the services and industry sectors (Ezenwaka et al. 2025). Additionally, Table 1 shows that average output per worker was N352,200 annually, ranging from N33,880 to N933,650. Saving per worker (SPW) averaged N112,540 per year, while capital per worker (KPW) stood at N77,670 per year. These figures provide further context for analyzing Nigeria’s economic structure and productivity.

**Table 1: Descriptive statistics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Mean | Median | Min | Max | Std |
| Sustainable human development, SHD | 0.52 | 0.53 | 0.46 | 0.57 | 0.03 |
| Population growth, PGR(%) | 2.64 | 2.66 | 2.42 | 2.80 | 0.12 |
| Debt service cost, DSC(%) | 1.56 | 1.40 | 0.55 | 5.79 | 1.00 |
| External debt, EXD(%) | 12.61 | 6.56 | 1.20 | 45.66 | 13.79 |
| Economic growth, ECG(%) | 5.06 | 4.89 | -1.79 | 14.60 | 3.76 |
| Output per worker, OPW(N'000) | 352.20 | 281.62 | 33.88 | 933.65 | 269.15 |
| Saving per worker, SPW(N'000) | 112.54 | 106.03 | 15.90 | 333.51 | 86.38 |
| Capital per worker, KPW(N'000) | 77.67 | 57.94 | 13.29 | 300.94 | 74.70 |
| Quality of governance, QOG | -0.49 | 0.63 | -4.18 | 2.01 | 2.01 |

Source: Researchers’ estimation

**(b) Stationarity Tests**

In regression analysis, conducting a unit root test is essential to determine whether a time series variable is stationary or exhibits a unit root (Okafor et al., 2022; Azolibe et al., 2025). The presence of a unit root suggests that the variable follows a stochastic trend and does not revert to a constant mean over time (Dimnwobi et al., 2023d). Table 2 displays the results of the ADF and PP tests, with the null hypothesis of a unit root assessed at the 5% significance level. The results reveal that the variables are integrated at different orders.

**Table 2: Unit Root Test Results**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ADF Test | | Philip-Perron (PP)Test | | Assumptions |
| Variable | ADF statistics | Order of  Integration | PP statistics | Order of  Integration |  |
| Sustainable human development (SHD) | -5.463\*\*\* | I(0) | -9.619\*\*\* | I(0) | Intercept |
| Debt service cost (DSC) | -4.599 | I(1) | -5.139\*\*\* | I(1) | Intercept & trend |
| External debt (EXD) | -5.863\*\* | I(1) | -5.693\*\* | I(1) | Intercept & trend |
| Savings per worker (SPW) | -26.355\*\*\* | I(1) | -25.872\*\*\* | I(1) | Intercept & trend |
| Capital per worker (KPW) | -4.278\*\*\* | I(1) | -16.479\*\*\* | I(1) | Intercept & trend |
| Population growth rate (PGR) | -7.428\*\*\* | I(1) | -7.403\*\*\* | I(1) | Intercept & trend |
| Output per worker (OPW) | -3.976\*\* | I(0) | -3.633\*\* | I(0) | Intercept |
| Quality of governance (QoG) | -4.189\*\*\* | I(0) | -4.104\*\*\* | I(0) | Intercept |
| Economic growth (ECG) | -6.837\*\*\* | I(0) | -3.425\*\* | I(0) | Intercept |
| Critical Values (Both ADF and PP) | Constant |  | Constant & Trend |  |  |
|  | I(0) | I(1) | I(0) | I(1) |  |
| 1% | -3.788 | -3.809 | -4.468 | -4.498 |  |
| 5% | -3.012 | -3.021 | -3.645 | -3.658 |  |
| 10% | -2.646 | -2.650 | -3.261 | -3.269 |  |

Source: Researchers’ estimation

The bounds testing approach is particularly beneficial as it accommodates variables with different orders of integration, making it a flexible tool for assessing cointegration even when variables are not uniformly integrated. It is also well-suited for small sample sizes, which is especially important in time series analysis. The test was conducted using regression models aligned with the study’s objectives, and the outcomes are presented in Table 3. According to the bounds test procedure, if the computed F-statistic exceeds the upper bound critical value at the 5% significance level, the null hypothesis of no cointegration is rejected. If the F-statistic falls below the lower bound, the null cannot be rejected. When the F-statistic lies between the bounds, the result is inconclusive. In this study, the F-statistic exceeded the upper bound, leading to the rejection of the null hypothesis of no cointegration.

**Table 3: Summary of Bound Test Results**

|  |  |  |
| --- | --- | --- |
| Null Hypothesis: | No level relationship |  |
|  | 11 |  |
|  | 7.39 |  |
|  | Critical Values |  |
|  | Upper bound I(1) | Lower bound I(0) |
| 10% | 2.77 | 1.76 |
| 5% | 3.04 | 1.98 |
| 2.5% | 3.28 | 2.18 |
| 1% | 3.61 | 2.41 |

Source: Researchers’ estimation

**4.2. Main Results**

The estimates of the impact of external debt on sustainable human development are summarized on Table 4. The result shows that there is asymmetry in the impact of external debt on SHD. This conclusion is based on the test of symmetry. The test shows that F stat of symmetry test is 8.7009 while the p value is 0.0319. Thus, the null hypothesis that the coefficients are symmetric is rejected at 5% significance level. However, this asymmetry happens in the following year (that is with lag one). In the current period, the coefficient of external debt (EXD) is 0.067 with standard error of 0.025.

However, the impact of EXD a year after is asymmetric. The result shows that coefficient of positive shock to external debt (EXD\_POS (-1)) is 0.078 with a standard error of 0.019. Also, the coefficient of negative shock to external debt (EXD\_NEG (-1)) is 0.016 with a standard error of 0.023. Both coefficients are statistically significant at 5% significance level. This suggests that one unit of positive shock to external debt will increase SHD by 0.078 unit while one unit of negative shock to external debt will increase SHD only by 0.016. This further indicates that the impact of positive change surpasses that of negative change. The positive impact of external debt on sustainable human development can be attributed to the nature of such loans. According to Chilombo and Li (2020), external debt often comes with lower interest rates and longer repayment periods, making it easier for governments to invest in long-term development projects. These funds are typically channelled into infrastructure development, education, healthcare, and social services, all of which directly enhance human development indicators. Also, Mumba and Li (2020) observe that external lenders, such as international financial institutions and foreign governments, often provide technical assistance and oversight, ensuring that the borrowed funds are used effectively and transparently. This external scrutiny can lead to better project outcomes and more sustainable development gains. This result also aligns with Gaiya et al. (2024).

As opine by Gaiya et al. (2024), when external debt increases, it often leads to an influx of funds that governments can use for significant investments in infrastructure, healthcare, education, and other critical sectors. These investments can drive immediate improvements in human development indicators, such as health outcomes, educational attainment, and overall living standards. The positive effects are amplified because the funding supports large-scale development projects that have a visible and substantial impact on people's lives. On the other hand, a reduction in external debt typically necessitates austerity measures, such as cuts in public spending and social services, which can negatively impact human development but to a lesser extent. Additionally, the benefits of reducing external debt, such as improved fiscal stability and reduced interest obligations, are often less immediately tangible and take longer to translate into direct human development gains.

**Table 4: Summary estimates for impact of external debt on sustainable human development**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Column 1  Level/differenced xxx/D(xxx) | | Column 2  First lag of the differenced  D(xxx(-1)) | | Column 3  Second lag of the differenced  D(xxx(-2)) | |
| Variable | Coef | Std | Coef | Std | Coef | Std |
| SHD (-1) |  |  | 0.040\*\*\* | 0.006 |  |  |
| D(PGR) | -0.092\*\*\* | 0.035 | 0.033\*\*\* | 0.002 |  |  |
| KPW | 0.070\*\*\* | 0.010 |  |  |  |  |
| D(SPW) | -0.037\*\*\* | 0.015 | 0.073\*\*\* | 0.016 |  |  |
| D(OPW) | 0.031\*\*\* | 0.001 | 0.023\*\*\* | 0.009 |  |  |
| QOG | 0.700\*\*\* | 0.134 |  |  |  |  |
| D(ECG) | -0.019\* | 0.011 | 0.201\*\*\* | 0.012 | 0.192\*\* | 0.095 |
| EXD\*QOG | 0.048\*\*\* | 0.011 |  |  |  |  |
| D(DSC) | 0.042 | 0.005 | -0.048\*\*\* | 0.010 |  |  |
| D(EXD) | 0.067\*\*\* | 0.025 | 0.178\*\*\* | 0.074 |  |  |
| DSC\_POS (-1) |  |  | -0.246\*\*\* | 0.083 |  |  |
| DSC\_NEG (-1) |  |  | 0.017\*\* | 0.008 |  |  |
| EXD\_POS (-1) |  |  | 0.078\*\*\* | 0.019 |  |  |
| EXD\_NEG (-1) |  |  | 0.016\*\*\* | 0.023 |  |  |
| R-squared | 0.8615  0.7027  1.2908  -38.9827  9.2382  0.0000 | | |  |  |  |
| Adjusted R-squared |  |  |  |
| S.E. of regression |  |  |  |
| Log likelihood |  |  |  |
| F-statistic |  |  |  |
| Prob(F-statistic) |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Coefficient symmetry test - H0: Coefficient is symmetric | | | | | | |
|  | F-statistic | Prob | Remark |  |  |  |
| DSC | 15.0504 | 0.0012 |  |  |  |  |
| EXD | 8.7009 | 0.0319 |  |  |  |  |

*Source: Researchers’ estimation Note: \*,\*\*,\*\*\* indicates statistical significance at 10%, 5% and 1% respectively.* xxx *stand for relevant variable.*

The result obtained also show that governance quality, on its own, also enhances sustainable human development, and its interaction with external debt further strengthens this positive impact, underscoring the importance of institutional quality in maximizing the developmental benefits of debt.

The coefficient of capital per work (KPW) is 0.070 with a standard error of 0.010, indicating that the coefficient is statistically significant at 5% significant level. This result suggests that one unit increase in KPW will lead to 0.07 increase in SHD. According to Halliki and Aigner (2022), more capital per worker typically means better tools, machinery, and infrastructure, leading to higher productivity and efficiency. As workers become more productive, overall economic output increases, which can translate into higher wages and improved living standards. Carmen et al. (2022) also noted that higher capital intensity also facilitates innovation and technological advancement. When workers have access to modern technology and equipment, they can perform tasks more efficiently, reduce waste, and produce higher quality goods and services. This contributes to economic growth, which in turn generates more resources for investment in education, healthcare, and social services - all critical components of sustainable human development. Moreover, Halliki and Aigner (2022) argued that increased capital per worker can lead to more equitable growth. With better tools and technology, even workers in less developed areas can enhance their productivity and contribute to economic growth, reducing regional disparities. This promotes inclusive development, ensuring that the benefits of economic progress reach all sections of society.

The result also shows that savings per worker (SPW) entered the model with lag 1. The current values are 0.037 (with standard error of 0.015) while the value at lag 1 (the values a year after) is 0.073 (with standard error of 0.16). This suggests that that savings reduces SHD in the current period but exerts positive on SHD in the subsequent period. As noted by Ahmed et al. (2023), savings play a pivotal role in enhancing sustainable human development. When individuals save, they build a financial cushion that can be invested in education, healthcare, and other essential services, leading to improved living standards. Lusardi and Messy (2023) also argue that for families, savings mean the ability to afford better schooling for children or access to quality healthcare services, which directly impacts human development indicators. On a broader scale, savings contribute to economic stability and growth. They provide the capital needed for investment in infrastructure, businesses, and social programs, all of which are crucial for long-term development. Moreover, Ibe (2024) emphasize that a culture of savings fosters resilience, enabling individuals and communities to weather economic downturns and unexpected financial shocks. This financial stability promotes a more sustainable and equitable society, where everyone has the opportunity to thrive.

* 1. **Robustness Check**

We used the bootstrapping technique as a robustness check to confirm the reliability of our estimated coefficients. This approach involves repeatedly resampling the dataset to generate multiple simulated samples, enabling us to evaluate the stability of our results. By minimizing the impact of outliers and sample-specific biases, bootstrapping strengthens confidence in the consistency of our findings.

**Table 5: Bootstrap estimates of the impact of external debt on sustainable human development)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model 2 | Average of the resampled coefficient | Bias | Bootstrapped Std. Error | bias  (p-value) | Remarks |
| Null Hypothesis (H0): Bootstrap bias is not statistically significant | | | | | |
| SHD (-1) | 0.0394 | 0.0008 | 0.0055 | 0.1861 | Do not reject H0 |
| D(PGR) | -0.0906 | -0.0014 | 0.0341 | 0.3069 | Do not reject H0 |
| D(PGR(-1) | 0.0332 | 0.0002 | 0.0036 | 0.0445 | Do not reject H0 |
| KPW | 0.0674 | 0.0022 | 0.0100 | 0.4895 | Do not reject H0 |
| D(SPW) | -0.0413 | 0.0046 | 0.0165 | 0.0382 | Do not reject H0 |
| D(SPW(-1) | 0.0746 | -0.0013 | 0.0167 | 0.2848 | Do not reject H0 |
| D(OPW) | 0.0302 | 0.0005 | 0.0013 | 0.1238 | Do not reject H0 |
| D(OPW(-1) | 0.0217 | 0.0013 | 0.0084 | 0.2925 | Do not reject H0 |
| QOG | 0.6969 | 0.0027 | 0.1332 | 0.6159 | Do not reject H0 |
| D(ECG) | 0.0187 | 0.0003 | 0.0111 | 0.0683 | Do not reject H0 |
| D(ECG(-1) | 0.2044 | -0.0034 | 0.0224 | 0.7737 | Do not reject H0 |
| D(ECG(-2) | 0.1869 | 0.0052 | 0.0926 | 0.1810 | Do not reject H0 |
| EXD\*QOG | 0.0467 | 0.0016 | 0.0107 | 0.3664 | Do not reject H0 |
| D(DSC) | -0.0459 | 0.0040 | 0.0056 | 0.9126 | Do not reject H0 |
| D(DSC(-1) | -0.0514 | 0.0032 | 0.0106 | 0.7295 | Do not reject H0 |
| D(EXD) | 0.0661 | 0.0012 | 0.0246 | 0.2819 | Do not reject H0 |
| D(EXD(-1)) | 0.1716 | 0.0066 | 0.0713 | 0.4909 | Do not reject H0 |
| CUMDP(DSC(-1)) | -0.2437 | -0.0026 | 0.0818 | 0.5987 | Do not reject H0 |
| CUMDN(DSC(-1)) | 0.0088 | 0.0081 | 0.0043 | 1.8368 | Do not reject H0 |
| CUMDP(EXD(-1)) | 0.0761 | 0.0023 | 0.0188 | 0.5319 | Do not reject H0 |
| CUMDN(EXD(-1)) | 0.0198 | -0.0041 | 0.0292 | 0.9196 | Do not reject H0 |

Source: Researchers’ estimation

The bootstrap estimates which examined the impact of external debts on SHD are shown on Table 5. The results show that the null hypothesis that the bootstrap bias is not statistically significant cannot be rejected for all the estimates. This suggests that the model is robust.

**5. Conclusion and Policy Implications**

This study investigated the impact of external debt on sustainable human development in Nigeria, incorporating governance quality as a moderating variable. By applying the Nonlinear Autoregressive Distributed Lag (NARDL) model to quarterly data spanning from 1996 to 2022, the findings reveal that both current and lagged external debt have significant positive effects on sustainable human development. Moreover, the results indicate that both positive and negative shocks to external debt contribute positively to development outcomes, suggesting that external borrowing, when managed effectively, can be beneficial regardless of its direction. Governance quality, on its own, also enhances sustainable human development, and its interaction with external debt further strengthens this positive impact, underscoring the importance of institutional quality in maximizing the developmental benefits of debt.

Based on these findings, policy efforts should focus on ensuring that external debt is used prudently and channelled into productive sectors such as education, healthcare, and infrastructure that directly influence human development indicators. Equally important is the need to strengthen governance institutions, as effective governance characterized by transparency, accountability, and institutional capacity amplifies the positive impact of external debt on human development. Aligning debt management strategies with governance reforms would help institutionalize a synergistic relationship that sustains development gains. Long-term debt sustainability measures should also be implemented to ensure that the benefits of borrowing are not undermined by fiscal vulnerability or debt distress, especially since both immediate and delayed effects of debt are found to be significant.

For future research, it would be valuable to explore the specific dimensions of governance such as regulatory quality, rule of law, government effectiveness, corruption control among others to identify which aspects most significantly enhance the development impact of external debt. Additionally, sector-specific analyses could provide insights into how external borrowing affects human development through particular channels like health, education, and housing. Comparative studies across countries or regions would also help generalize the findings and offer broader policy relevance. Finally, investigating potential threshold effects of debt and governance could further clarify whether there are critical levels beyond which the impacts on sustainable human development become more pronounced or begin to taper off.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1. Option 1

2.

3.

**References**

Ahmed, R., Emam, H. A., & Samak, N. A. (2023). Financial inclusion and human development: Is there a nexus? *Journal of Humanities and Applied Social Sciences*, 5(1), 17-29. https://doi.org/10.1108/JHASS-11-2021-0178

Aladejare, S., & Dimnwobi, S.K. (2025). Can natural resource endowment and human capital development drive clean cooking transition in Sub-saharan African countries? Available at <https://ssrn.com/abstract=5235884> or [http://dx.doi.org/10.2139/ssrn.5235884](https://dx.doi.org/10.2139/ssrn.5235884)

Akam, D., Nathaniel, S.P., Muili, H.A, & Eze, S.N. (2021a). The relationship between external debt and ecological footprint in SANE countries: Insights from Kónya panel causality approach. *Environmental Science and Pollution Research*, 29, 19496‑19507. <https://doi.org/10.1007/s11356-021-17194-y>

Akam, D., Owolabi, O., & Nathaniel, S. P. (2021b). Linking external debt and renewable energy to environmental sustainability in heavily indebted poor countries: New insights from advanced panel estimators. *Environmental Science and Pollution Research*, 28, 65300–65312. https://doi.org/10.1007/s11356-021-15191-9

Akpan, P.L. (2009). External debt and human development in Sub-Saharan Africa: The Nigerian case. <https://ssrn.com/abstract=1445298> or [http://dx.doi.org/10.2139/ssrn.1445298](https://dx.doi.org/10.2139/ssrn.1445298)

Aladejare, S.A. (2023). Does External Debt Promote Human Longevity in Developing Countries? Evidence from West African Countries. *Fudan Journal of Humanities and Social Sciences*, 16, 213–237. <https://doi.org/10.1007/s40647-023-00365-1>

Alhassan, H., & Kwakwa, P.A. (2023). The effect of natural resources extraction and public debt on environmental sustainability. *Management of Environmental Quality*, 34(3), 605-623. <https://doi.org/10.1108/MEQ-07-2022-0192>

Arshed, N., Nasir, S. & Saeed, M.I. (2022). Impact of the external debt on standard of living: A Case of Asian countries. *Social Indicators Research*, 163, 321‑340. <https://doi.org/10.1007/s11205-022-02906-9>

Azolibe, C.B., Dimnwobi, S.K., & Uzochukwu-Obi, C.P. (2025). The determinants of unemployment rate in developing economies: does banking system credit matter? Journal of Economic and Administrative Sciences, 41(1), 300-319. <https://doi.org/10.1108/JEAS-01-2022-0021>

Bahuli, A.S., & Inuwa, M.B. (2020). Impact of external debt servicing on health outcomes in Nigeria 1995– 2017. *IDOSR Journal of Arts and Humanities*, 5(1), 1-20

Bese, E., Friday, S.H., & Ozden, C. (2021a). The effect of external debt on emissions: Evidence from China. *International Journal of Energy Economics and Policy*, 11(1), 440-447

Bese, E., Friday, H.S., & Ozden, C. (2021b). Is India financing its emissions through external debt? *International Journal of Energy Economics and Policy*, 11(6), 170-179.

Bese, E., & Friday, H. S. (2022). The effect of external debt on emissions from coal consumption: evidence from Turkey. *International Journal of Energy Economics and Policy*, 12(5), 515 - 518.

Carmen, E., Fazey, I., Ross, H., Bedinger, M., Smith, F. M., Prager, K., McClymont, K., & Morrison, D. (2022). Building community resilience in a context of climate change: The role of social capital. *Ambio*, 51, 1371-1387. https://doi.org/10.1007/s13280-021-01678-9

Chilombo, S.M., & Li, J. H. (2020). The impact of external debt on economic growth: Evidence from Southern Africa. *Journal of Finance and Economics*, 8(3), 135‑141. https://doi.org/10.12691/jfe-8-3-6

Debt management Office (2023). Nigeria’s total public debt portfolio as at September 30, 2023. https://www.dmo.gov.ng/debt-profile/total-public-debt/4499-nigeria-s-total-public-debt-as-at-september-30-2023/file

Dimnwobi, S. K., Ekesiobi, C., Madichie, C.V., & Asongu, S.A. (2021). Population dynamics and environmental quality in Africa. *Science of The Total Environment*, 797, 149172. https://doi.org/10.1016/j.scitotenv.2021.149172

Dimnwobi, S.K., Madichie, C.V., Ekesiobi, C., & Asongu, S.A. (2022a). Financial development and renewable energy consumption in Nigeria. *Renewable Energy*, 192, 668-677. <https://doi.org/10.1016/j.renene.2022.04.150>

Dimnwobi, S.K., Okere, K.I., Onuoha, F.C., Ekesiobi, C. (2022b). Energy poverty, environmental degradation and agricultural productivity in Sub‑Saharan Africa. *International Journal of Sustainable Development & World Ecology*. <https://doi.org/10.1080/13504509.2022.2158957>

Dimnwobi, S.K., Okere, I.K., Azolibe, C.B., & Onyenwife, K.C. (2023a). Towards a green future for Sub-Saharan Africa: do electricity access and public debt drive environmental progress?. *Environmental Science and Pollution Research*, 30, 94960‑94975. <https://doi.org/10.1007/s11356-023-29058-8>

Dimnwobi, S.K., Okere, K.I., Onuoha, F.C., Uzoechina, B.I., Ekesiobi, C., & Nwokoye, E.S. (2023b). Energizing environmental sustainability in Sub-Saharan Africa: The role of governance quality in mitigating the environmental impact of energy poverty. *Environmental Science and Pollution Research*, 30, 101761–101781. <https://doi.org/10.1007/s11356-023-29541-2>

Ezenwaka, U.S., Oguanobi, C.R., Dimnwobi, S.K., & Oguanobi, C.A. (2025). Exchange rate dynamics and manufacturing sector performance in Nigeria. *ANSU Journal of Arts and Social Sciences,* 12(1), 110-146

Ezenekwe, U.R., Okere, K.I., Dimnwobi, S.K. & Ekesiobi, C. (2023a). Balancing the scales: Does public debt and energy poverty mitigate or exacerbate ecological distortions in Nigeria? *International Social Science Journal*. <https://doi.org/10.1111/issj.12465>

Dimnwobi, S.K., Nwokoye, E.S., Igbanugo, C.I., Ekesiobi, C.S. & Asongu, S.A. (2023c). Assessment of energy efficiency investment in Onitsha business cluster, Nigeria. *International Journal of Energy Sector Management*, 17(6), 1232-1251. <https://doi.org/10.1108/IJESM-11-2021-0012>

Dimnwobi, S.K., Onuoha, F.C., Uzoechina, B.I., Ekesiobi, C.S., & Nwokoye, E.S. (2023d). Does public capital expenditure reduce energy poverty? Evidence from Nigeria. [International Journal of Energy Sector Management](https://www.emerald.com/insight/publication/issn/1750-6220), 17(4), 717-738. <https://doi.org/10.1108/IJESM-03-2022-0008>

Dimnwobi, S.K., Okere, K.I., Ozoh, J.N. & Ebenebe, O.E. (2025). Advancing clean cooking transition in Nigeria through public debt and governance infrastructure. https://doi.org/10.21203/rs.3.rs-6222857/v1

Egungwu, I.C. (2018). Impact of external debt on human capital development in Nigeria. *IDOSR Journal of Current Issues in Social Sciences*, 4(1), 1-33

Ekesiobi, C.S, Dimnwobi, S.K,Ifebi, O.E andIbekilo, B.N. (2016). Public sector education investment and manufacturing output in Nigeria: Empirics and policy options. *Public Policy and Administration Research*, 6 (7), 95 -106

Ekesiobi, C., & Dimnwobi, S.K. (2020). Economic assessment of the Igbo entrepreneurship model for entrepreneurial development in Nigeria: evidence from clusters in Anambra state. *International Journal of Entrepreneurial Behavior & Research*, 27(2), 416-433. <https://doi.org/10.1108/IJEBR-11-2019-0640>

Ekesiobi, C., Madichie, C. V., Dimnwobi, S. K., & Asongu, S.A. (2025). Mitigating the next pandemic: An assessment of macroeconomic resilience and social vulnerability in Sub-Saharan Africa. *International Social Science Journal*. https://doi.org/10.1111/issj.12582

Gaiya, B. A., Akintola, U., Akpan, U., Abel, I. M., & Etudaiye, M. (2024). External debt, institutions, and economic growth: New evidence from emerging markets and low-income countries. *Journal of Social and Economic Development*. https://doi.org/10.1007/s40847-024-00363-3

Halliki, K., & Aigner, E. (2022). From “Decent work and economic growth” to “Sustainable work and economic degrowth”: A new framework for SDG 8. *Empirica*, 49, 281-311. https://doi.org/10.1007/s10663-021-09526-5

Hammami, S., Bachegour, H., Samour, A., Dimnwobi, S.K., & Mati, S. (2025)*.* Technological innovation, industrialization, natural resources and ecological quality: evidence from the load capacity factor. *Discover Sustainability*. <https://doi.org/10.1007/s43621-025-01074-3>

Hasan, M. A., Voumik, L. C., Mozumder, A. I., Esquivias, M. A., Verteramo-Chiu, L., & Das, M. K. (2024). Role of governance index, democracy, industrialization, and urbanization on environmental sustainability of BRICS countries: A novel PMG-ARDL approach. *Social Sciences & Humanities Open*, 11, 101242. <https://doi.org/10.1016/j.ssaho.2024.101242>

Ibe, N. (2024). The impact of national savings on economic development: A focused study on the ten poorest countries in Sub‑Saharan Africa. *Scientific Reports*, 14, 67‑85. https://doi.org/10.1038/s41598-024-67228-x

Igudia, P.O. (2021). Impact of external debt servicing on human capital development in Nigeria: 1960-2019. *International Journal of Business & Law Research*, 9(3), 38-55

Jabari, M.S., Aga, M., & Samour, A. (2022). Financial sector development, external debt, and Turkey’s renewable energy consumption. *PLoS ONE*, 17(5), 26‑45. <https://doi.org/10.1371/journal.pone.0265684>

Karimanzira, T., Maradze, T.C., Nyoni, T., & Nyoni, S.P. (2020). The impact of external debt on poverty in Zimbabwe. *IJARIIE*, 6(6), 1177- 1189

Katircioglu, S., & Celebi, A. (2018). Testing the role of external debt in environmental degradation: empirical evidence from Turkey. *Environmental Science and Pollution Research*, 25(9), 8843-8852. <https://doi.org/10.1007/s11356-018-1194-0>

Khan, M., & Khan, I. (2024). Achieving environmental sustainability through technological innovation, good governance and financial development: Perspectives from low income countries. *Sustainable Futures*, 8, 100392. <https://doi.org/10.1016/j.sftr.2024.100392>

Lusardi, A., & Messy, F.A. (2023). The importance of financial literacy and its impact on financial wellbeing. *Journal of Financial Literacy and Wellbeing*, 1(1), 1‑15. https://doi.org/10.1017/jflw.2023.1

Metu, A. G., Ajudua, E., Eboh, I., Ukeje, C., & Madichie, C. (2020). Ending youth unemployment in sub-saharan Africa: Does ICT development have any role? *African Development Review*, *32*, S20-S31. https://doi.org/10.1111/1467-8268.12479

Mumba, S. C., & Li, J. H. (2020). External debt and economic growth in Sub-Saharan Africa: Does governance matter? *PLOS ONE*, 17(3), 1-10. https://doi.org/10.1371/journal.pone.0264082

Mumuni, S., & Abille, A.B. (2023). Do trade liberalization and external debt offset income inequality? New evidence from selected African countries. *Cogent Economics & Finance*, 11(2), 1-15. https://10.1080/23322039.2023.2241228

Noor, M., Khan, D., Khan, A., & Rasheed, N. (2023). The impact of renewable and non-renewable energy on sustainable development in South Asia. *Environment, Development and Sustainability*. <https://doi.org/10.1007/s10668-023-03210-3>

Nwani, C., Okere, K.I., Dimnwobi, S. K., Uche, E., & Iorember, P.T. (2025). From non-renewables to renewables and high-tech production: The impact of natural wealth and technology on ecological load capacity in sub‑Saharan Africa. *Review of Development Economics*, 29(2), 1170-1194. https://doi.org/10.1111/rode.13161

Nwokoye, E.S., Igbanugo, I.C., Mgbemena, E.M., & Dimnwobi, S.K (2019a). Joblessness in the midst of riches: What factors reinforce the resource-curse syndrome in Nigeria? *International Journal of Social Science & Economic Research*, 4(3), 1787-1805

Nwokoye, E.S., Oyim, A., Dimnwobi, S.K & Ekesiobi, C.S. (2019b). Socioeconomic determinants of information and communication technology adoption among rice farmers in Ebonyi state, Nigeria. *Nigerian Journal of Economic and Social Studies*, 61(3), 1-20

Nwokoye, E. S., Igbanugo, C. I., & Dimnwobi, S. K. (2020). International migrant remittances and labour force participation in Nigeria. *African Development Review*, 32(2), 125-137. <https://doi.org/10.1111/1467-8268.12421>

Nwokoye, E. S., Igbanugo, C. I., Ekesiobi, C., & Dimnwobi, S. K. (2022). Fiscal incentives and tax compliance behaviour in industrial clusters: A survey of clusters in South-east Nigeria. *Journal of African Business*, 24(1), 147-166. https://doi.org/10.1080/15228916.2022.2031827

Nwokoye, E. S., Dimnwobi, S. K., Onuoha, F. C., & Madichie, C. V. (2024). Does public debt matter for human capital development? Evidence from Nigeria. *Journal of Public Affairs*, *24*(2), 29-35. <https://doi.org/10.1002/pa.2912>

Obi, C.U, Ekesiobi, C.S, Dimnwobi, S.K., & Mgbemena, E.M. (2016). Government education spending and outcome in Nigeria. *International Journal of Economics, Finance and Management Sciences*, 4 (4), 223-234

Ojukwu, C.O. (2021). External Debt and Sustainable Development: Empirical Evidence from Nigeria. *Gusau International Journal of Management and Social Sciences, Federal University, Gusau*, 4(2), 114-129

Okafor, S. N., Ekesiobi, C., Ifebi, O., Dimnwobi, S. K., & Asongu, S. A. (2022). Testing the triple deficit hypothesis for sub-Saharan Africa: Implications for the African continental free trade area. *African Development Review*, *34*(1), 142-153. https://doi.org/10.1111/1467-8268.12616

Okere, K. I., Dimnwobi, S. K., Ekesiobi, C., & Onuoha, F. C. (2023a). Turning the tide on energy poverty in sub‑Saharan Africa: Does public debt matter? *Energy*, *282*, 128365. https://doi.org/10.1016/j.energy.2023.128365

Okere, K. I., Dimnwobi, S. K., Ekesiobi, C., & Onuoha, F. C. (2023b). Pollution, governance, and women's work: Examining African female labour force participation in the face of environmental pollution and governance quality puzzles. *Women's Studies International Forum*, *102*, 102851. <https://doi.org/10.1016/j.wsif.2023.102851>

Okere, K. I., Dimnwobi, S. K., & Fasanya, I. O. (2024a). Striding towards a greener future: Unlocking the potential of natural resources and employment dynamics in green energy transition in sub‑Saharan Africa. *Managerial and Decision Economics*, 46(1), 329‑346. <https://doi.org/10.1002/mde.4377>

Okere, K.I., Dimnwobi, S.K., & Fasanya, I.O. (2024b). Do fintech, natural resources and globalization matter during ecological crises? A step towards ecological sustainability. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(3), 100371. https://doi.org/10.1016/j.joitmc.2024.100371

Okere, K. I., Dimnwobi, S. K., Onuoha, F. C., & Ekesiobi, C. (2025a). Policy measures for advancing environmental sustainability: Assessing the impact of governance efficiency and fiscal approach in Sub‑Saharan Africa. *Environmental Quality Management*, 34(4), e70090. <https://doi.org/10.1002/tqem.70090>

Okere, K. I., Dimnwobi, S. K., & Fasanya, I. O. (2025b). Navigating the green frontier: The role of employment dynamics and natural capital in renewable energy consumption in Africa. *Renewable Energy*, 247, 122963. <https://doi.org/10.1016/j.renene.2025.122963>

Okere, K. I., Dimnwobi, S. K., & Fasanya, I. O. (2025c). Pathways to environmental sustainability: exploring the role of FinTech, natural resources and globalization in North Africa. *International Journal of Sustainable Development & World Ecology*, 1‑19. https://doi.org/10.1080/13504509.2025.2481222

Oyedele, S.O., Emerah, A.A., & Ogege, S. (2013). External debt, debt servicing and poverty reduction in Nigeria: An empirical analysis. *Journal of Economics and Sustainable Development,* 4(19), 174-179

Omoju, O. E., Beyene, L. M., Ikhide, E. E., Dimnwobi, S. K., & Ehimare, O. A. (2024). Being green and prudent: Economy-wide and environmental impacts of renewable energy production subsidy in Nigeria. *The Journal of Developing Areas*, 58(3), 47‑66. <https://doi.org/10.1353/jda.2024.a929940>

Onuoha, F. C., Dimnwobi, S. K., Okere, K. I., & Ekesiobi, C. (2023a). Funding the green transition: Governance quality, public debt, and renewable energy consumption in Sub-Saharan Africa. *Utilities Policy*, 82, 1-15. <https://doi.org/10.1016/j.jup.2023.101574>

Onuoha, F.C., Dimnwobi, S. K., Okere, K. I., & Ekesiobi, C. (2023b). Sustainability burden or boost? examining the effect of public debt on renewable energy consumption in Sub-Saharan Africa. *Energy Sources, Part B: Economics, Planning, and Policy*, 18(1), 1‑15. <https://doi.org/10.1080/15567249.2023.2214917>

Sadiq, M., Shinwari, R., Usman, M., Ozturk, I., & Maghyereh, A. I. (2022). Linking nuclear energy, human development and carbon emission in BRICS region: Do external debt and financial globalization protect the environment? *Nuclear Engineering and Technology*, 54(9), 3299-3309. <https://doi.org/10.1016/j.net.2022.03.024>

Samour, A, Radmehr, R, Ali, E.B., Shayanmehr, S., Ofori, E.K., Porhajašová, J.I., Babošová, M., Kačániová, M., & Dimnwobi SK. (2024). The role of financial inclusion and technological innovation in stimulating environmental sustainability in the European countries: A new perspective based on load capacity factor. *Heliyon*. https://doi.org/10.1016/j.heliyon.2024.e39970

Solaymani, S., & Montes, O. (2024). The role of financial development and good governance in economic growth and environmental sustainability. *Energy Nexus*, 13, 100268. https://doi.org/10.1016/j.nexus.2023.100268

Rahman, F. N., Sen, K. K., Karmaker, S. C., & Saha, B. B. (2025). Good governance and energy justice: Pathways to human development. *Utilities Policy*, 94, 101897. <https://doi.org/10.1016/j.jup.2025.101897>

Nam, H., & Ryu, D. (2023). FDI and human development: The role of governance, ODA, and national competitiveness. *Journal of International Financial Markets, Institutions and Money*, 85, 101769. https://doi.org/10.1016/j.intfin.2023.101769

Saba, C. S., & Pretorius, M. (2024). The impact of artificial intelligence (AI) investment on human well-being in G-7 countries: Does the moderating role of governance matter? *Sustainable Futures*, 7, 100156. <https://doi.org/10.1016/j.sftr.2024.100156>

Saleem, S.H., Ahmed, D.H., & Samour, A. (2024). Examining the impact of external debt, natural resources, foreign direct investment, and economic growth on ecological sustainability in Brazil. *Sustainability*, 16, 10-37. <https://doi.org/10.3390/su16031037>

Samour, A., & Adebayo, T.S. (2024). External debt, renewable energy, and environmental quality in BRICS countries: Novel findings based on the load capacity factor. *Environment Systems and Decisions*. <https://doi.org/10.21203/rs.3.rs-2328886/v1>

Turunen, E., & Hiilamo, H. (2014). Health effects of indebtedness: A systematic review. *BMC Public Health*, 14, 489-525. <https://doi.org/10.1186/1471-2458-14-489>

Verma, A., Giri, A.K. & Debata, B. (2023) The role of ICT diffusion in sustainable human development: an empirical analysis from SAARC economies. *Environmental Science and Pollution Research*, 30, 14518-14532. <https://doi.org/10.1007/s11356-022-23174-7>

World Bank (2023). World development indicators. https://data.worldbank.org/indicator