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NATURAL CAPITAL DEPLETION AND SUSTAINABLE DEVELOPMENT: EVIDENCE FROM NIGERIA

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ABSTRACT

This study is an empirical investigation into the relationship between sustainable development and natural capital depletion in Nigeria. The study uses time series data from 1990 to 2020 on adjusted net saving, including particulate emission damage as a percentage of Gross National Income (GNI) using Adjusted Net Saving (ANS) as a proxy variable for sustainable development, while natural capital depletion is proxied using total natural resources rents as a percentage of GDP for capturing Natural capital (NC). The gross national income per capita (GNI) and the inflation rate (INF) are considered control variables in the study. Adopting the Autoregressive Distributed Lag (ARDL) model and the Bounds test approach to cointegration, the study finds a long-run relationship among the variables. While the main independent variable, NC positively relates to ANS, the relationship is found to be statistically insignificant. GNI is found to negatively impact ANS while INF showed a mixed relationship with ANS across the short and long run. The study concludes that Nigeria must look beyond depleting the stock of natural resources for the purpose of driving sustainable development.

JEL Classification Code: Q2, Q01, C32, P28

Keywords: Natural capital, Sustainable development, Renewable and non-renewable resources, Autoregressive distributed lag, Adjusted net saving.

1. Introduction

Natural resources play a pivotal role in promoting economic growth and elevating living standards across nations (Williams, 2011; Zeeshan, *et al.*, 2021). As a form of capital that yields valuable goods and services over time, natural capital provides humanity with fundamental and invaluable benefits (Costanza and Daly, 1992; Mace *et al.*, 2015; Brandon, *et al.*, 2021). These

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Volume:08, Issue:08 "August 2023"

resources, such as land, minerals, fossil fuels, forests, and fisheries, generate a flow of goods (e.g., food and energy), services (e.g., climate regulation, waste management, and environmental amenities), and income (Goodland and Ledec, 1987; Acosta *et al.*, 2020). Collectively, natural capital and its accompanying flow of valuables are referred to as natural resources (Bateman and Mace, 2020). Thus, nations are blessed with abundant land, forests, fossil fuels, and solid minerals, which serve as essential inputs in the production of goods and services. However, concerns have been mounting over the potential adverse impacts of depleting these natural endowments on the environment, health, and overall welfare (Zhang, Khan and Zafar, 2022).

The work of Hotelling (1931) brought to light the dangers of unregulated exploitation of exhaustible resources, which could jeopardise the well-being of future generations. Subsequent researchers have also argued that the prevailing pattern of global economic growth is unsustainable, fueling the increasing demand for sustainable development (Repetto *et al.*, 1989; Islam and Jolley, 1996; Hobson, 2002; Arrow *et al.*, 2012, Ahmed *et al.*, 2022). The World Commission on Environment and Development (WCED) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987, p.54). This definition underscores the United Nations' pursuit of seventeen sustainable development goals (SDGs) and one hundred and sixty-nine targets, many of which revolve around the environment and natural resources. Examples include SDG 13: Climate Action, SDG 14: Life Below Water, and SDG 15: Life on Land (Dasgupta, Managi and Kumar, 2022). Hence, sustainability encompasses not only the economy but also the environment and society, implying that sustainable development occurs when a nation's overall capital, or comprehensive wealth, is not diminishing over time (Arrow *et al.*, 2012).

Importantly, sustainable development does not demand that nations leave commercially viable resources untapped; rather, it requires channeling the income generated from natural resource exploitation towards enhancing other forms of capital, especially human and produced capital, to offset potential welfare losses resulting from natural capital depletion (Basiago, 1995; Kuhlman and Farrington, 2010). Echoing this sentiment, Collier *et al.* (2010) recommend that resource revenues should be cautiously directed towards increasing domestic investment, particularly in resource-rich developing economies like Nigeria. Therefore, various measures of comprehensive wealth have been developed to track sustainability, with sustainable development inferred when the stock of comprehensive wealth is maintained over time (Arrow *et al.*, 2012). Using the United Nations Environment Programme (UNEP) inclusive wealth indicator, Figure 1 depicts that Nigeria's inclusive wealth was approximately $49,966 billion in 2014, with human capital accounting for the largest and consistently increasing share in inclusive wealth between 1990-2014. However, natural capital has experienced a steady decline, while Nigeria's produced

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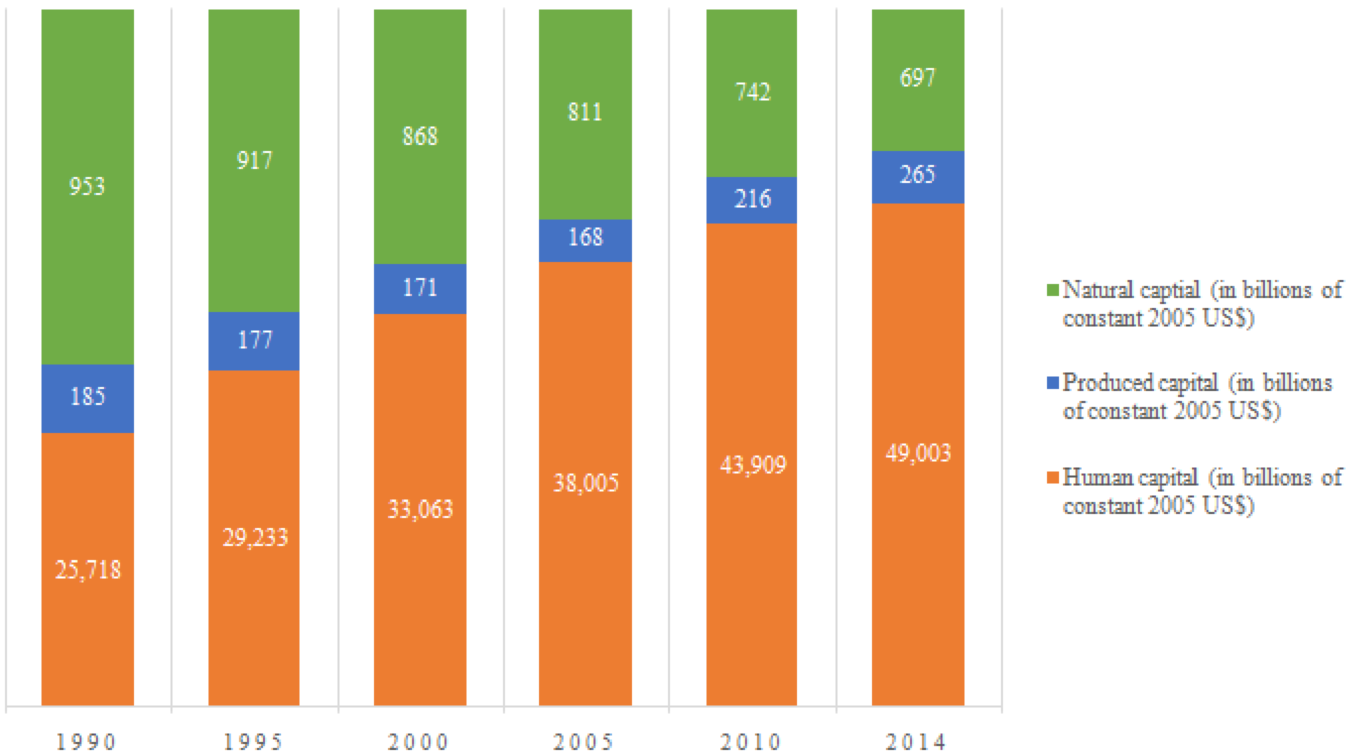
Volume:08, Issue:08 "August 2023"

capital has been increasing, maintaining a relatively constant share over the five-year period as highlighted in Figure 1.

Figure 1: Share of Natural, Produced and Human Capital in Nigeria's Inclusive Wealth



Source: Authors' computation from UNEP (2018).

Focusing on Nigeria's natural capital, a critical examination of its resource dynamics reveals intriguing trends as shown in Figure 2. Over the years from 1990 to 2014, the stock of renewable natural resources in Nigeria has experienced a marginal decline. Even more alarming is the significant reduction of non-renewable resources in Nigeria, which surpassed 33% over the same period as presented in Figure 2. The substantial depletion of non-renewable resources, such as fossil fuels, solid minerals, and other finite assets, calls for urgent attention to explore alternative pathways for economic growth and development that are less reliant on exhaustible resources (Barbier, 2013). Figure 2 vividly illustrates the decline of both renewable and non-renewable natural resources in Nigeria. While renewable resources have shown a gradual downward trend, the depletion of non-renewable resources has been more pronounced and raises questions about the nation's ability to effectively manage and preserve its natural endowments for future generations.

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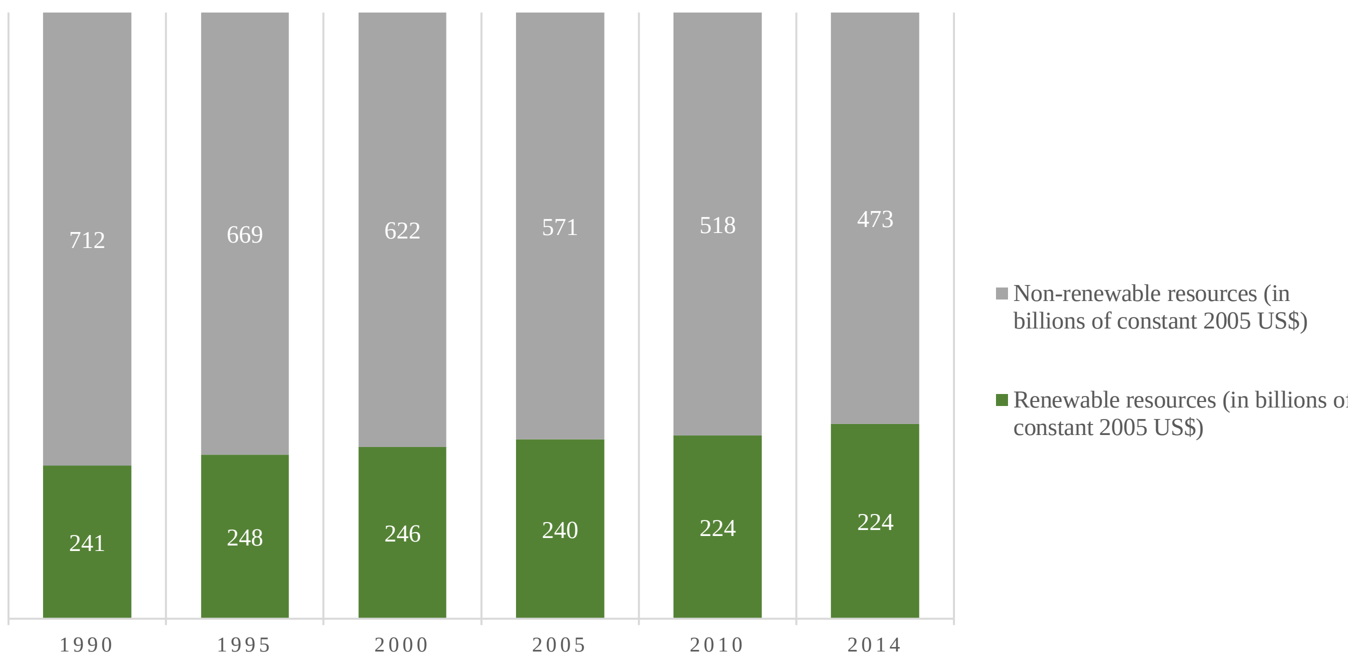
ISSN: 2455-8834

Volume:08, Issue:08 "August 2023"

Figure 2: Share of Renewable and Non-Renewable Resources in Nigeria's Natural Capital



Source: Authors' computation from UNEP (2018)

Moreover, agricultural land, forests, and fishery, which represent renewable natural resources, contribute 21%, 7%, and 1% respectively to the overall natural capital. These renewable resources hold immense potential to support food security, biodiversity conservation, and sustainable livelihoods for Nigeria's growing population. However, their relatively modest shares in the overall natural capital emphasises the importance of sound environmental policies and resource management strategies to safeguard their long-term viability. The question then is, "has Nigeria's natural capital depletion significantly contributed to her sustainable development?" Nigeria is a resource-abundant nation, endowed with arable land for agriculture, forest resources, and solid minerals. The 1970s oil boom significantly increased the nation's earnings from its oil reserves, accounting for 95% of foreign exchange and 80% of government revenue (Watts, 2004). Despite this, studies like Ekeuwei, Vareba and Akpan (2023) suggest that the use of natural resources has not been sufficiently diversified since Nigeria's oil dependence began, giving rise to the Dutch Disease syndrome. Others advocate for embracing renewable and environmentally-friendly sources over fossil fuels, emphasising the need for cautious and restrained resource exploitation (Adejumo, 2020; Oyeranti, 2021).

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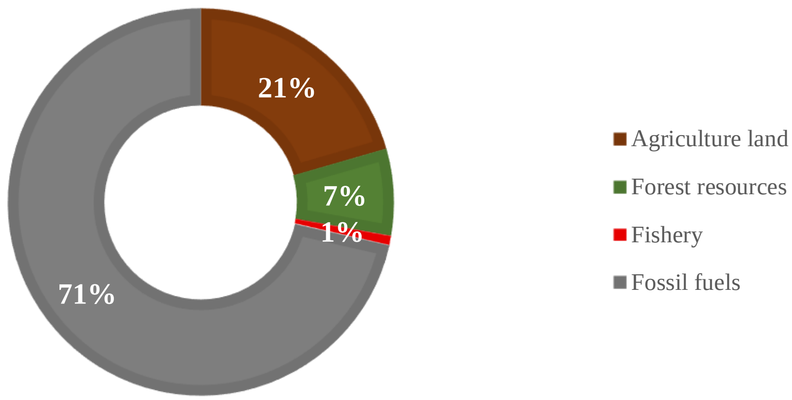
Volume:08, Issue:08 "August 2023"

Figure 3: Composition of Nigeria's Natural Capital (Average %)



Source: Authors' computation from UNEP (2018)

While the relationship between natural capital depletion and sustainable development has been a subject of much interest and research, there is no consensus in the economic literature. Studies conducted across nations to empirically assess this relationship have yielded mixed findings. For instance, Lashitew and Werker (2020), as well as Lu and Sohail (2022), find evidence that some nations have succeeded in converting their depleted natural capital into human and produced capital, while studies like Koirala and Pradhan (2020) and van Krevel (2021) indicate a negative relationship between natural capital depletion and comprehensive wealth. With a focus on sustainable development, this study significantly contributes to the budding literature on natural capital depletion and sustainability in Nigeria. While most existing studies have either taken a descriptive approach to assess the relationship or examined natural capital depletion in light of economic growth and other economic development indicators (Ike, 2019; Adejumo, 2020; Ekeuwei *et al.*, 2023), this study aims to empirically investigate whether Nigeria's natural capital is being transformed to enhance its overall wealth projections. Specifically, the study analyses the long-run and short-run relationship between sustainable development and natural capital depletion in Nigeria between 1990 and 2020.

Following the introductory segment, this study is organised into five sections; Section Two provides a review of related studies on natural capital depletion and sustainable development. Section Three presents the theoretical framework of the study while Section Four involves the methodology utilised for the study. The results and the discussion are presented in Section Five. The conclusion and policy implications of the study are presented in Section Six.

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Volume:08, Issue:08 "August 2023"

2. Empirical Review

The measurement of sustainable development has garnered substantial attention from environmental and ecological economists, leading to a plethora of empirical studies examining the nexus between sustainable development and natural capital depletion. The empirical literature on sustainable development and natural capital depletion reveals varying results, with different studies reporting positive, negative, or mixed relationships. For instance, van Krevel (2021) emphasises the heterogeneity among countries in their ability to convert natural capital to other forms. Similarly, Lange (2004) finds that rents from natural resources impact per capita wealth differently in Botswana and Namibia, stressing the significance of explicit policies in managing the proceeds from natural capital depletion to foster sustainable development. Moreover, Kurniawan, Sugiawan and Managi (2021) support the Environmental Kuznets Curve hypothesis, revealing a non-linear relationship between economic growth and natural capital, indicating that natural capital degradation increases with economic growth at higher income levels across 140 countries in their study.

In the context of Nigeria and Africa, several studies support the notion that natural resource rents negatively impact economic outcomes (Adejumo, 2020; Udoh, Ukere and Ekpenyong, 2023). Ogwu (2019) highlights the unique challenges of urbanisation on land, water, and natural resources in Africa, further underscoring the need for sustainable development approaches. Additionally, Koirala and Pradhan (2019), using adjusted net saving (ANS) as a proxy for sustainable development, report a negative relationship for 12 Asian countries, reinforcing the importance of prudent resource management in achieving sustainable outcomes. In the United Kingdom, Abbasi *et al.* (2021) find adverse effects of natural capital depletion on the carbon neutrality dimension of sustainable development in the short run. Hou, Liu and Zhang (2019) reveal a significant dependence on the depletion of natural capital stock for economic development in China's "Belt and Road" countries, raising concerns about the limits of sustainable development in the future. Moreover, Barbier and Burgess (2023) highlight the trade-offs between sustainable development gains and environmental degradation in developing economies, estimating the welfare impact of reducing poverty (SDG 1) and overall SDGs net gains in Nigeria. The study reveals substantial natural capital depletion in the country, signaling the urgent need for sustainable policies and practices.

Contrastingly, there are studies supporting the hypothesis that resources earned from the depletion of natural capital can be effectively utilised to advance other dimensions of sustainable development. Lu and Sohail (2022) demonstrate that natural capital depletion positively impacted Chinese happiness and well-being between 1993 and 2020. Lashitew and Werker (2020) find a direct positive relationship between resource abundance and development, attributing the paradox of the resource curse to weak institutions rather than resource abundance

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Volume:08, Issue:08 "August 2023"

itself. Their insights emphasis the importance of governance and policy frameworks in managing natural resources sustainably for holistic development.

3. Theoretical Framework

This study adopts the theoretical framework of weak sustainability, which posits that natural capital can be substituted with other forms of capital to achieve sustainable development. The concept of weak sustainability allows for the trade-off between different forms of capital, such as human, produced, and natural capital, as long as the overall wealth or comprehensive capital remains constant or increases over time (Pearce, Hamilton and Atkinson, 1996). In this context, genuine savings, popularised by Pearce, Hamilton and Atkinson (1996), serves as a veritable indicator of weak sustainability. Genuine savings, represented by the World Bank's adjusted net saving (ANS), captures the net change in comprehensive wealth after accounting for investments in human capital, produced capital, and depletion of natural capital (Ferreira and Vincent, 2005; Yamaguchi, Islam and Managi, 2023). Hence, it reflects the extent to which the economic activities of a country can contribute positively or negatively to its overall wealth and well-being.

Although the perfect substitutability of natural capital with other forms of capital under weak sustainability is debated (Qasim and Grimes, 2022), ANS remains a valuable proxy for measuring sustainable development, particularly when longitudinal time series data on sustainable development are scarce for single-country studies like this study. Several studies have utilised adjusted net savings as an indicator of sustainable development (Koirala and Pradhan, 2019; Larissa *et al.*, 2020), emphasising its significance in capturing the complex interplay between economic activities, natural resource use, and the preservation of comprehensive wealth. In this study, ANS serves as a key metric to assess the impact of natural capital depletion on Nigeria's sustainable development prospects.

Within the framework of weak sustainability, the direction of the relationship between different forms of capital and sustainable development is not predetermined (Pearce, Hamilton and Atkinson, 1996; Shi *et al.*, 2019). While the various forms of capital can influence the level of sustainable development, the outcomes may vary across countries and contexts. As a result, there are no concrete a priori expectations regarding the impact of natural capital depletion on adjusted net savings in the Nigerian economy. By incorporating genuine savings as a proxy for weak sustainability, this study captures the intricate dynamics of capital interactions, illuminating how the depletion of natural resources impacts the overall wealth and well-being of a nation.

4. Methodology

Drawing on the theory of weak sustainability, this study adopts a Cobb-Douglas production function framework to examine the relationship between natural capital depletion and sustainable

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Volume:08, Issue:08 "August 2023"

development in Nigeria. The model specifies in Equation 1 below similar to Koirala and Pradhan (2019):

$$ANS = F(NC, GNI, INF), \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where sustainable development is represented by ANS, Natural Capital Depletion is proxied by total natural resource rents. Following the approach of Koirala and Pradhan (2019), two additional control variables, gross national income per capita (GNI) and inflation rate (INF), are included to account for other factors influencing well-being and sustainable development. Table 1 provides details on the variables and their sources, which are pooled from annual data spanning 1990 to 2020.

Table 1: Variables and definitions

Variable	Definition	Source
ANS	Adjusted net savings, including particulate emission damage (% of GNI)	World Bank
NC	Total natural resources rents (% of GDP)	World Bank
GNI	GNI per capita (current LCU)	World Bank
INF	Inflation, GDP deflator (annual %)	World Bank

Source: Authors' compilation based on data from World Bank (2023).

To estimate the specified functional form and capture both the short-run and long-run dynamics of the relationship between natural capital depletion and sustainable development, this study proposes the Autoregressive Distributed Lag (ARDL) model along with the Bounds testing cointegration approach developed by Pesaran, Shin and Smith (2001). The general specification of the ARDL model is specified in Equation 2 below:

$$\Delta ANS_t = \alpha_0 + \sum_{j=1}^{n1} \alpha_{1_j} \Delta ANS_{t-j} + \sum_{j=0}^{n2} \alpha_{2_j} \Delta NC_{t-j} + \sum_{j=0}^{n3} \alpha_{3_j} \Delta GNI_{t-j} + \sum_{j=0}^{n4} \alpha_{4_j} \Delta INF_{t-j} + \beta_1 ANS_{t-1} + \beta_2 NC_{t-1} + \beta_3 GNI_{t-1} + \beta_4 INF_{t-1} + \epsilon_t \ldots..(2)$$

where α_0, α_1, α_2, α_3, and α_4 capture the short-run dynamics, and β_1, β_2, β_3, and β_4 represent the long-run parameters, provided that a long-run cointegrating relationship is present as determined by the Bounds test. In the event of a cointegration relationship, the Error-Correction Model (ECM) is given in Equation 3 below:

$$\Delta ANS_t = \alpha_0 + \sum_{j=1}^{n1} \alpha_{1_j} \Delta ANS_{t-j} + \sum_{j=0}^{n2} \alpha_{2_j} \Delta NC_{t-j} + \sum_{j=0}^{n3} \alpha_{3_j} \Delta GNI_{t-j} + \sum_{j=0}^{n4} \alpha_{4_j} \Delta INF_{t-j} + \lambda \widehat{ECT}_{t-1} + \epsilon_t \ldots\ldots\ldots\ldots\ldots(3)$$

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Volume:08, Issue:08 "August 2023"

where the error-correction term, ECT, encapsulates the adjustment towards the long-run equilibrium, and λ represents the speed of adjustment parameter.

The selection of the ARDL approach is motivated by its suitability for the study's objectives. This methodology allows to model both the short-run and long-run dynamics between natural capital depletion and sustainable development in Nigeria between 1990 and 2020. Moreover, the ARDL method accommodates series with mixed orders of integration, making it applicable to both stationary (I(0)) and integrated (I(1)) variables (McNown, Sam and Goh, 2018). This is crucial in the context of our study, as we may encounter variables that exhibit different levels of stationarity, and ARDL can handle such data appropriately.

5. Result

5.1. Descriptive statistics

Before reporting the results from the model, a brief discussion of the summary statistics for the empirical analysis is undertaken. Table 2 shows that the average ANS as a percentage of GNI stands at approximately 12.95%, indicating that, on average, sustainable development accounts for around 12.95% of the nation's total income. Meanwhile, NC expressed as a percentage of GDP, average at approximately 15.63%, reflecting the extent of natural capital depletion relative to the economy's output. GNI with an average value of N238,462.27, provides valuable insights into the economic well-being of individuals in Nigeria during the study period. Additionally, INF with an average of 16.99%, helps gauge the overall price stability and economic conditions prevailing over the years.

Table 2: Descriptive Statistics of the Variables

Statistics	ANS	NC	GNI	INF
Mean	12.954	15.626	238426.27	16.992
Std. Deviation	9.274	6.726	230944.741	15.93
Minimum	1.544	4.554	4917.448	0.686
Maximum	33.519	34.27	713416.75	75.402
Median	12.062	15.861	152089.13	10.228
Skewness	0.798	0.429	0.68	2.015
Kurtosis	2.667	3.326	2.086	7.235
Observations	31	31	31	31

Source: Authors' computation using EViews 9.

To visualise the trends in the variables, Figure 4 offers graphical representations. Notably, NC and ANS have exhibited a declining trend over the study period. This indicates a positive

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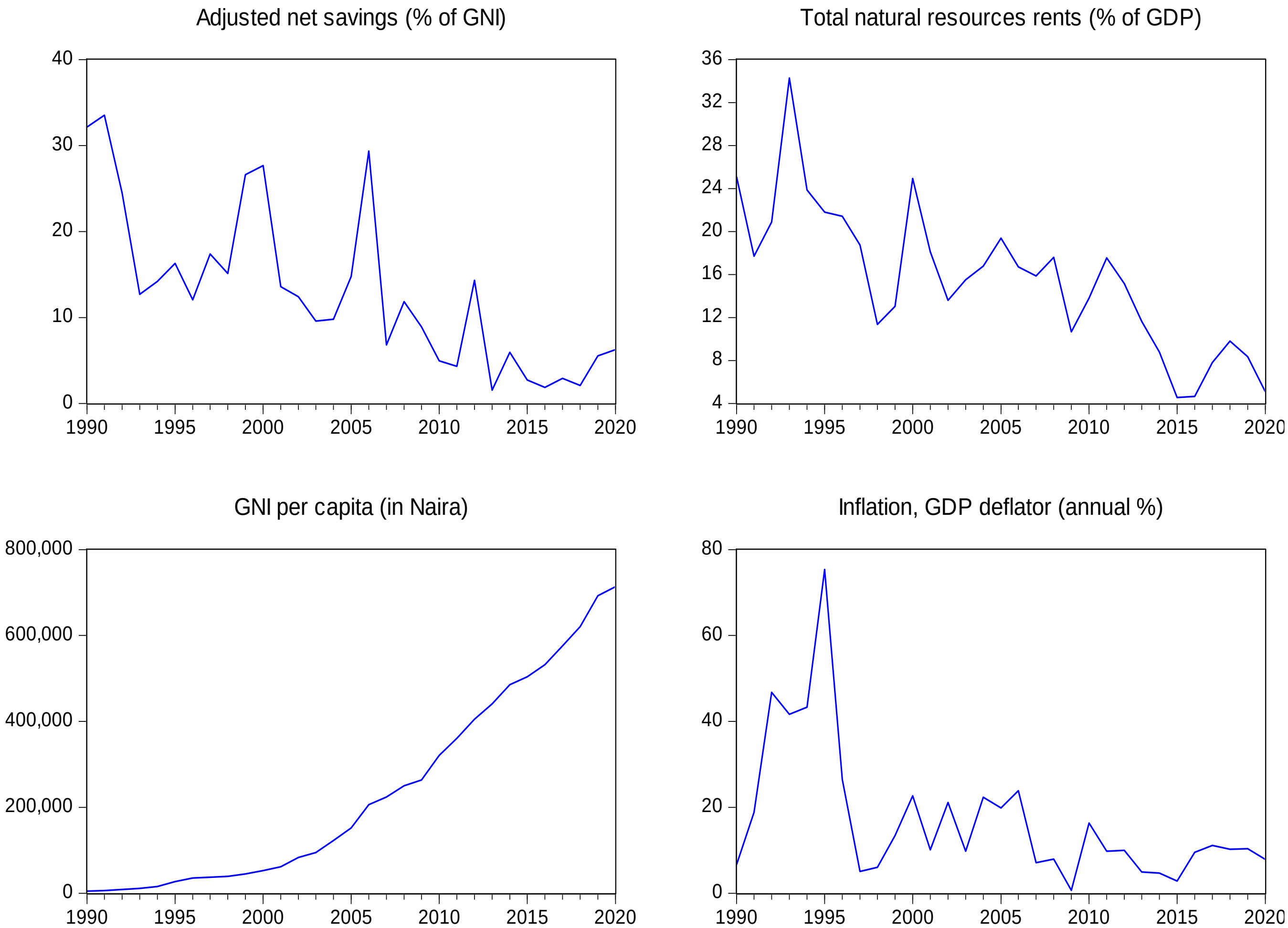
Volume:08, Issue:08 "August 2023"

development, suggesting efforts to manage natural resources more sustainably. On the other hand, INF has shown fluctuations, indicative of varying economic conditions and policy interventions. The GNI has demonstrated an upward trajectory, implying a positive trend in the nation's economic prosperity on a per-person basis.

Figure 4: Trend Analysis of the Variables



Source: Authors' computation using EViews 9

Furthermore, Table 3 provides a summary of the correlations between the variables. The correlation matrix reveals relationships between adjusted net savings (ANS) and the independent variables (natural resource rents, GNI, and INF). It also indicates moderate covariation among the independent variables, implying the absence of perfect multicollinearity, ensuring the reliability of the subsequent econometric analysis.

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ISSN: 2455-8834

Volume:08, Issue:08 "August 2023"

Table 3: Correlation Matrix

	(1)	(2)	(3)	(4)
(1) Adjusted net savings	1			
(3) Natural resource rents	0.558***	1		
(3) GNI per capita	-0.698***	-0.772***	1	
(4) Inflation	0.307*	0.584***	-0.468***	1

, ** and * represent significance at 10%, 5% and 1% respectively*

Source: Authors' Computation using EViews 9.

5.2 Unit root test

To ensure the validity of the ARDL model, unit root tests are conducted using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests (ref). These tests robustly examine the presence of unit roots at both the levels and first differences of the variables (ref). Table 4 reveals that the unit root tests confirm that ANS, NC and INF are stationary at the level (I(0)), indicating stable long-run relationships. On the other hand, GNI requires first differencing to achieve stationarity. These stationarity properties enable the estimation of the ARDL model, providing valuable insights into the dynamic relationship between natural capital depletion and sustainable development in Nigeria.

Table 4: Summary of the Unit Root Tests

	Augmented Dickey-Fuller (ADF)			**Phillips-Perron (PP)**		
	Level	**1st Diff.**	**I(d)**	**Level**	**1st Diff.**	**I(d)**
ANS	-4.269**[b]	-	I(0)	-4.283**[b]	-	I(0)
NC	-4.943***[b]	-	I(0)	-4.079**[b]	-	I(0)
GNI	-0.996[c]	-3.969**[b]	I(1)	-1.624[b]	-5.500***[b]	I(1)
INF	-1.849*[c]	-	I(0)	-3.870**[b]	-	I(0)

, ** and * represent significance at 10%, 5% and 1% respectively*

a, b, and c represent specifications with intercept, intercept and trend, and none respectively

Source: Authors' computation using EViews 9

5.3 Bounds Co-integration test results

Given the limited number of observations (31), this study utilises the ARDL model with unrestricted constant and no trend (ref). To strike a balance between model complexity and statistical power, the maximum number of lags for both the regressors and the response variable was two, which helped maintain an acceptable degree of freedom (ref). Through model selection

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Volume:08, Issue:08 "August 2023"

techniques, the study automatically derives the most parsimonious and optimal ARDL model, denoted as ARDL(1,0,0,1), based on the Akaike Information Criterion (AIC).

Following the estimation of optimal lag selection, the Bounds cointegration test is conducted to assess the presence of a long-run relationship among the variables (ref). The test yields an F-Statistic of 4.687, surpassing the critical values of 3.23 and 4.35 at the 10% and 5% significance levels, respectively (see Table 5). This result indicates that co-integration exists among the variables, implying a stable and balanced long-run relationship between natural capital depletion and sustainable development in Nigeria.

Table 5: Summary of the Bounds Co-integration test

F-statistic: 4.687	Remark: Cointegration	
Critical values	*10%*	*5%*
I(0) Bound	2.72	3.23
I(1) Bound	3.77	4.35

Source: Authors' computation using EViews 9

5.4 ARDL Estimation

From Table 6 below, the speed of the adjustment parameter, that is, the coefficient of the error correction term (ECT(-1)) is -0.748 and statistically significant at the 1% level. The negative sign and absolute value between 0 and 1 indicate a stable long-run relationship between adjusted net savings (ANS) and the other variables. Specifically, any deviations from the long-run equilibrium quickly correct at a rate of approximately 74.8% in each period. This suggests that the model exhibits a strong tendency to revert to the long-run equilibrium after experiencing shocks, ensuring long-term stability. Additionally, Table 6 show that natural resources rents are positively related to the adjusted net saving in both the short-run and the long-run; however, the relationship is not statistically significant. GNI per capita negatively relates with ANS in both runs, while INF has a mixed relationship, albeit statistically insignificant.

Table 6: ECM and long-run form estimates

	ΔANS	
Variable	Coefficient	t-Statistic
ECM		
ECT(-1)	-0.748***	-4.153
ΔNC	0.080	0.238
ΔGNI	-0.000019**	-2.147
ΔINF	0.099	1.023

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ISSN: 2455-8834

Volume:08, Issue:08 "August 2023"

Long-Run		
Constant	18.492**	2.330
NC	0.108	0.240
GNI	-0.000026**	-2.487
INF	-0.103	-0.653

, ** and * represent significance at 10%, 5% and 1% respectively*

Source: Authors' computation using EViews 9

5.5 ARDL model diagnostics

Table 7 presents a summary of the post-estimation diagnostic tests, ensuring the reliability of the ARDL model results. The Breusch-Godfrey LM test and the Breusch-Pagan-Godfrey heteroscedasticity test are conducted to examine whether the residuals in the model exhibit serial correlation and heteroscedasticity, respectively (ref). The p-values associated with these tests are 0.4930 and 0.8177, both exceeding the 10% significance level. As a result, the null hypothesis is not rejected, indicating that the residuals of the model are free from serial correlation and heteroscedasticity. Also, the R-squared value of 0.5818 indicates an acceptable goodness-of-fit, suggesting that the model effectively captures the variance in the data (ref). Additionally, the Durbin-Watson statistic of 1.9578 reveals the absence of serial correlation in the residuals of the model (ref). Furthermore, the F-statistic with a probability value of 0.0004 indicates that the regressors in the model are jointly significant (ref). This signifies that the independent variables, including natural capital depletion and other control variables, collectively contribute to explaining the changes in adjusted net savings (ANS).

Table 7: Summary of the ARDL Model Diagnostics

Diagnostic tests	Value	P-value	Remark
Breusch Godfrey LM test	0.7304	0.4930	No serial correlation
Breusch-Pagan-Godfrey test	0.4378	0.8177	No heteroscedasticity
R-Squared	0.5818		Acceptable goodness-of-fit
Durbin-Watson test	1.9578		No serial correlation
F-test	6.6786***	0.0004	Jointly significant regressors
CUSUM test			Stable model
CUSUMSQ test			Stable model

, ** and * represent significance at 10%, 5% and 1% respectively*

Source: Authors' computation using EViews 9

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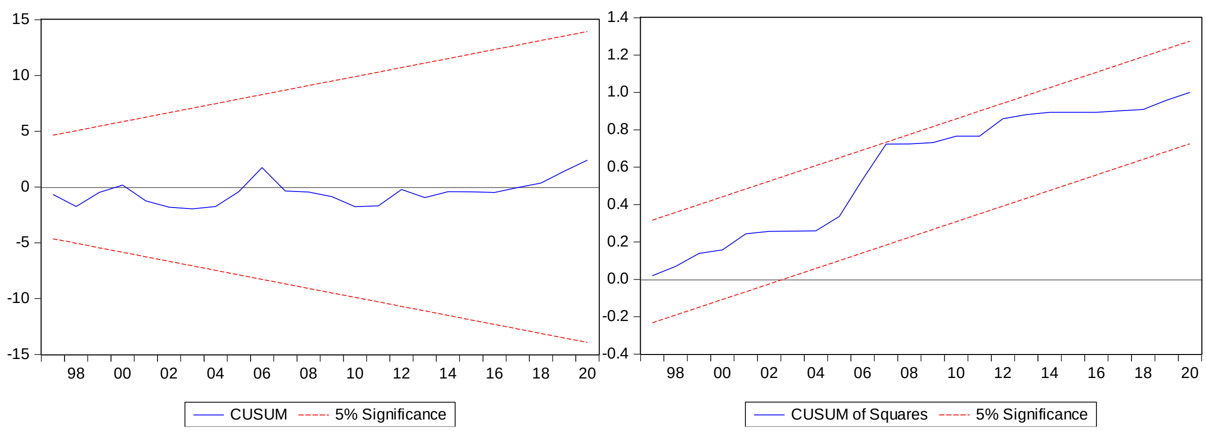
ISSN: 2455-8834

Volume:08, Issue:08 "August 2023"

To ensure the reliability and robustness of the estimated error correction model, the CUSUM and CUSUM of Squares (CUSUMSQ) tests were conducted (ref). These tests are essential for assessing the stability of the model over time and verifying that the relationships captured by the model remain valid and consistent (ref). The results of the CUSUM and CUSUMSQ tests, presented in Figure 5, demonstrate that the estimated error correction model is stable at the 5% significance level. This means that the coefficients and parameters of the model remain constant over the study period, and the relationships between natural capital depletion and sustainable development are reliable and consistent.

Figure 5: CUSUM and CUSUMSQ Graphs



Source: Authors' computation using EViews 9

6. Discussion of Findings

The estimated ARDL model reveals a positive relationship between natural capital depletion and sustainable development in Nigeria. However, it is important to note that the coefficient of this relationship is not statistically significant. This suggests that while there may be some association between the depletion of natural resources and improvements in adjusted net savings, this relationship lacks statistical robustness. In the short run, a percentage-point increase in natural resource rents led to a slight 0.08 percentage-point increase in adjusted net savings, which became marginally higher at about 0.11% in the long run. These results differ from some previous studies, such as Lashitew and Werker (2020) and Lu and Sohail (2022), which found significant positive relationships between natural capital depletion and sustainable development in other contexts. For Nigeria, however, it appears that more complex and nuanced factors may be at play, warranting further investigation into the drivers of sustainable development in the country.

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Volume:08, Issue:08 "August 2023"

The study also examines the relationship between gross national income per capita (GNI) and adjusted net savings. The results show a statistically significant negative relationship, indicating that increases in Nigeria's per capita income do not necessarily translate into corresponding improvements in the country's capacity to accumulate wealth for future needs. As GNI per capita increases by N10,000, adjusted net savings decrease by about 0.26 percentage points on average in the long run, with a smaller negative effect observed in the short run (0.19 percentage points). This finding aligns with insights from the Environmental Kuznets Curve (EKC) theory by Grossman and Krueger (1991), which suggests that higher income levels should lead to positive environmental outcomes and contribute to sustainable development. However, the results for Nigeria suggest that the relationship between income and sustainable development is more complex than a simple inverse U-shaped curve, possibly due to other structural and policy-related factors influencing the link between economic growth and environmental outcomes.

The study further explores the impact of inflation on Nigeria's adjusted net savings. The results reveal a mixed and statistically insignificant relationship. In the short run, as the inflation rate increases, adjusted net savings also increase by 0.099 percentage points, but in the long run, they decrease by 0.103 percentage points. While the long-run negative relationship aligns with economic theory, indicating that inflationary pressures can reduce the incentive to save and potentially hinder sustainable development, the short-run positive relationship may be influenced by other factors. It is worth noting that Koirala and Pradhan (2019) found adjusted net savings to increase with inflation in their study of 12 Asian countries, highlighting the importance of considering country-specific contexts when examining the relationship between inflation and sustainable development. In the case of Nigeria, the findings suggest that inflation may not be a significant driver of changes in adjusted net savings, prompting the need for further exploration of other determinants that impact the country's progress toward sustainable development.

7. Policy Implication and Conclusion

The findings of this study have significant policy implications for Nigeria's pursuit of sustainable development amidst concerns about natural capital depletion. While the theoretical debate surrounding the relationship between these variables continues, the empirical analysis reveals some evidence of a positive association between sustainable development and natural capital depletion in the Nigerian context, albeit weak and statistically insignificant. The weak relationship implies that Nigeria must adopt a more comprehensive and strategic approach to drive sustainable development beyond relying solely on the depletion of natural resources. Although increased resource exploitation, particularly from crude oil, can generate income for the nation, the impact on sustainable development has not been as substantial as expected, as seen in some oil-rich Arab countries like Saudi Arabia. This suggests that other factors may be

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Volume:08, Issue:08 "August 2023"

hindering the optimal conversion of natural capital into other forms of capital, such as human and produced capital.

Therefore, policymakers in Nigeria should prioritize improving institutional frameworks and regulatory mechanisms related to natural resource management. Strengthening institutions can enhance transparency, accountability, and efficiency in resource allocation and revenue management. By doing so, Nigeria can minimize the negative effects of resource depletion on sustainable development and ensure that the income generated from natural resources is channelled toward investments that foster long-term economic growth and human development. Additionally, it is essential for Nigeria to diversify its economy and reduce its heavy reliance on non-renewable resources. Exploring and investing in renewable energy sources, sustainable agriculture, and other environmentally-friendly industries can lead to more sustainable and inclusive economic growth. By fostering a diversified economy, Nigeria can reduce its vulnerability to fluctuations in commodity prices and strengthen its resilience against economic shocks.

In conclusion, this study provides valuable insights into the relationship between natural capital depletion and sustainable development in Nigeria. While the empirical evidence suggests a weak and insignificant association, the results underscore the importance of adopting a holistic and forward-thinking approach to achieve sustainable development goals. Nigeria must prioritise institutional improvements, economic diversification, and investments in renewable resources to ensure a more resilient and sustainable future for its citizens and the environment. By taking proactive steps to address these challenges, Nigeria can position itself on a path of sustainable development that balances economic growth, social well-being, and environmental preservation.

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