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EVALUATING THE IMPACT OF BLUE ECONOMY SECTORS ON NIGERIA'S ECONOMIC GROWTH: A TIME-SERIES ANALYSIS (1981–2024)

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ABSTRACT : This study evaluates the impact of blue economy sectors on Nigeria's economic growth over the period 1981–2024, using advanced econometric techniques to uncover long-run relationships. With increasing global emphasis on sustainable ocean-based development, understanding the economic potential of blue economy sectors such as fisheries, maritime transport, coastal and marine tourism, marine renewable energy, and marine biotechnology is crucial for a coastal nation like Nigeria seeking to diversify its economy beyond oil. The study employs Fully Modified Ordinary Least Squares (FMOLS) and Johansen Cointegration Tests to assess the long-term contributions of these sectors to Nigeria's Gross Domestic Product (GDP). Unit root tests confirm the stationarity of the data, while diagnostic tests such as the Breusch-Godfrey serial correlation LM test, White's heteroscedasticity test, and CUSUM stability test validate the robustness and reliability of the estimated models. Empirical results reveal that all five blue economy sectors have a statistically significant and positive long-run relationship with Nigeria's GDP, with marine biotechnology and renewable energy emerging as untapped but high-potential contributors. These findings are consistent with similar studies in other developing and coastal economies and highlight the need for strategic investment in these underutilized sectors. The study further identifies key gaps in previous literature, including the neglect of integrated sectoral analysis, insufficient empirical coverage beyond 2020, and limited application of robust time-series models. The findings underscore the necessity of policy frameworks that prioritize blue economy development as a pathway to economic diversification, sustainable growth, and environmental stewardship. Recommendations and implications for policy and future research are provided.

KEYWORDS: *Blue Economy, Economic Growth, Nigeria, Fully Modified Ordinary Least Squares (FMOLS), Sustainable Development*

I. INTRODUCTION

1.1 Background of the Study

The blue economy encompasses the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of marine and coastal ecosystems. In recent years, it has gained significant traction as a viable growth frontier for many developing countries, including Nigeria, whose vast maritime domain remains largely untapped. Nigeria, with a coastline stretching over 850 kilometers and a sizable exclusive economic zone (EEZ), possesses immense potential to harness sectors such as fisheries, maritime transport, marine tourism, renewable ocean energy, and marine biotechnology to drive inclusive economic growth. However, despite the strategic importance of these sectors, their actual contributions to national GDP have been insufficiently explored in a consolidated and empirical manner.

The lack of empirical studies examining the relationship between blue economy sectors and Nigeria's macroeconomic performance creates a significant research gap, especially given the increasing global interest in sustainable ocean-based development (Olaniyi & Okonkwo, 2023). While various government initiatives and policy frameworks have highlighted the importance of leveraging marine resources, these efforts are often hampered by limited data integration and fragmented sectoral planning. Moreover, studies focusing on Nigeria's economy tend to prioritize traditional sectors such as oil and gas, agriculture, and manufacturing, with minimal focus on the ocean economy despite its long-term growth potential (Adebayo & Onuoha, 2022).

As Nigeria diversifies away from hydrocarbons, understanding how each blue economy sector contributes to GDP growth becomes vital for evidence-based policymaking. Coastal and marine tourism, for example, remains underdeveloped despite Nigeria's natural attractions, while maritime transport continues to be constrained by

infrastructure challenges and policy inconsistencies (Nwachukwu & Ibrahim, 2024). Additionally, marine renewable energy and biotechnology, though nascent, represent promising future revenue streams. By applying rigorous econometric methods such as the FMOLS and Johansen cointegration test, this study aims to quantify the long-run impacts of these sectors on economic growth over the period 1981–2024. It will provide policymakers with actionable insights into which areas of the blue economy hold the greatest potential for sustainable growth and economic resilience in the face of environmental and global economic uncertainties (Eze & Salami, 2025).

1.2 Statement of the Problem

Despite Nigeria's extensive marine and coastal endowments, the country has yet to fully leverage the economic potential embedded within its blue economy sectors. Existing literature and national development strategies have largely centered on traditional economic drivers such as oil and gas, agriculture, and manufacturing, with limited empirical focus on marine-based sectors (Adebayo & Onuoha, 2022). This oversight persists despite mounting evidence from other coastal nations that investments in fisheries, maritime transport, marine tourism, and ocean-based renewable energy can significantly boost GDP, create jobs, and enhance environmental sustainability (UNCTAD, 2023). In Nigeria, although government policy documents acknowledge the blue economy as a frontier for economic diversification, there remains a significant research gap in quantifying the sectoral contributions of its components to long-run economic growth.

Most studies that touch on the blue economy in Nigeria tend to be descriptive or policy-based, with insufficient econometric validation to support strategic planning (Olaniyi & Okonkwo, 2023). Additionally, there is a dearth of comprehensive time-series analyses that examine the dynamic interactions between marine economic sectors and national output. This has led to a lack of empirical clarity on the causal and cointegrated relationships between Nigeria's GDP and variables such as fisheries revenue, maritime transport income, marine tourism receipts, marine renewable energy output, and biotechnology exports. Without such insights, policymakers are left with little quantitative basis to prioritize investments or measure sectoral impact.

Moreover, the fragmented nature of data collection across marine sectors further complicates efforts to understand their macroeconomic implications (Eze & Salami, 2025). As Nigeria grapples with economic volatility and the urgent need for diversification, research in this direction becomes crucial. This study seeks to bridge these gaps by applying robust econometric techniques to determine the extent to which blue economy sectors have influenced Nigeria's GDP from 1981 to 2024, thereby guiding informed policy interventions and sustainable development planning.

1.3 Aim and Objectives of the Study

To evaluate the impact of key sectors within Nigeria's blue economy on the country's Gross Domestic Product (GDP) from 1981 to 2024, using time-series econometric analysis. Other specific objectives are:

1. To examine the effect of revenue from fisheries (capture and aquaculture) on the Gross Domestic Product (GDP) of Nigeria.
2. To assess the impact of revenue from maritime transport on Nigeria's Gross Domestic Product (GDP).
3. To evaluate how coastal and marine tourism receipts influence the Gross Domestic Product (GDP) of Nigeria.
4. To determine the contribution of marine renewable energy output to the Gross Domestic Product (GDP) of Nigeria.
5. To analyse the relationship between marine biotechnology exports and the Gross Domestic Product (GDP) of Nigeria.

1.4 Research Questions

The study provides answers to the following research questions:

1. To what extent does revenue from fisheries (capture and aquaculture) affect the Gross Domestic Product (GDP) of Nigeria?
2. What is the impact of maritime transport revenue on Nigeria's Gross Domestic Product (GDP)?
3. How do receipts from coastal and marine tourism influence the Gross Domestic Product (GDP) of Nigeria?
4. What contribution does marine renewable energy output make to the Gross Domestic Product (GDP) of Nigeria?
5. How do marine biotechnology exports relate to the Gross Domestic Product (GDP) of Nigeria?

1.5 Research Hypotheses

The study is guided with the following null hypotheses:

1. H_{01}: Revenue from fisheries (capture and aquaculture) has no significant effect on the Gross Domestic Product (GDP) of Nigeria.

2. H_{02}: Revenue from maritime transport does not significantly influence the Gross Domestic Product (GDP) of Nigeria.
3. H_{03}: Coastal and marine tourism receipts have no significant impact on the Gross Domestic Product (GDP) of Nigeria.
4. H_{04}: Marine renewable energy output does not significantly contribute to the Gross Domestic Product (GDP) of Nigeria.
5. H_{05}: Marine biotechnology exports have no significant relationship with the Gross Domestic Product (GDP) of Nigeria.

1.6 Significance of the Study

This study is significant as it offers a comprehensive assessment of how Nigeria's blue economy sectors influence national economic growth. By focusing on key industries such as fisheries, maritime transport, coastal tourism, marine renewable energy, and marine biotechnology, the research highlights untapped opportunities that could drive sustainable development and economic diversification. With Nigeria's heavy dependence on oil revenues, there is a pressing need to explore alternative growth sectors—especially those linked to the country's vast marine and coastal resources.

The findings will provide empirical evidence to support policy formulation and investment in the blue economy, helping stakeholders identify which sectors hold the highest potential for economic transformation. Government agencies, development partners, and private investors can use the insights from this research to guide resource allocation, infrastructure development, and regulatory reforms.

Academically, the study fills a gap in existing literature by integrating multiple blue economy variables into a single time-series analysis over a substantial period (1981–2024), offering a long-term perspective on sectoral impacts. Furthermore, it contributes to achieving global sustainable development goals (SDGs), particularly SDG 14 (Life Below Water) and SDG 8 (Decent Work and Economic Growth), by promoting inclusive and sustainable use of marine resources for economic advancement in Nigeria.

1.7 Scope and Limitations of the Study

This study focuses on examining the impact of key blue economy sectors—fisheries, maritime transport, coastal and marine tourism, marine renewable energy, and marine biotechnology—on Nigeria's Gross Domestic Product (GDP) from 1981 to 2024. The scope is limited to a macroeconomic evaluation using time-series data sourced from the Central Bank of Nigeria, National Bureau of Statistics, World Bank, and UNCTAD. The study applies econometric models such as Fully Modified Ordinary Least Squares (FMOLS) and Johansen Cointegration Test to analyse long-run relationships.

However, the study faces several limitations. First, data availability and reliability, especially for emerging sectors like marine renewable energy and marine biotechnology, may be constrained for earlier years. Second, the exclusion of informal and unrecorded marine-based activities may understate the true contribution of the blue economy. Lastly, external factors such as global economic shocks and environmental disruptions are not explicitly modelled, which may affect the robustness of the results.

II. LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Blue Economy

The blue economy is a multifaceted concept referring to the sustainable use of ocean resources for economic growth, improved livelihoods, and job creation while preserving the health of marine and coastal ecosystems (UNCTAD, 2022). It includes diverse sectors such as fisheries, maritime transport, tourism, renewable energy, marine biotechnology, and ecosystem services. In the Nigerian context, the blue economy represents a largely untapped opportunity that aligns with the country's aspirations for economic diversification and resilience against oil dependence (Olawumi & Ibe, 2023).

The global emphasis on the blue economy has grown due to increasing awareness of ocean-related sustainability and the potential for job creation in marine-based industries (FAO, 2021). Nigeria's extensive coastline and marine biodiversity offer a comparative advantage, particularly in fisheries, marine transport, and coastal tourism (Ezekwesili & Bala, 2024). However, effective policy frameworks and investments are critical to unlocking these potentials. As such, the blue economy is not only an economic asset but also a strategic avenue for green and inclusive development.

2.1.2 Economic Growth

Economic growth, traditionally measured by the increase in a country's Gross Domestic Product (GDP), reflects the overall health and productivity of an economy. It is a function of several dynamic factors, including capital accumulation, labour productivity, and sectoral performance (World Bank, 2023). In recent years, scholars have begun integrating ecological and marine sectors into economic growth models, recognizing

that non-traditional sectors like the blue economy can contribute significantly to national output (Okonkwo & Ede, 2022).

In developing countries like Nigeria, economic growth is often hampered by overreliance on mono-cultural resources—especially crude oil—which leaves the economy vulnerable to price volatility and environmental risks. Hence, the incorporation of alternative, sustainable sources of revenue such as blue economy sectors offers a viable path for inclusive and stable growth (Nwankwo & Akpan, 2021). Through this study, GDP is used as the dependent variable to measure how well the various blue economy sectors impact Nigeria's macroeconomic performance over time.

2.1.3 Fisheries and Aquaculture

Fisheries, encompassing both capture fisheries and aquaculture, form one of the most vital sectors of the blue economy, especially in Nigeria where they significantly contribute to food security and employment. According to the Food and Agriculture Organization (FAO, 2021), fisheries contribute to the livelihoods of millions in coastal communities and are essential for nutrition and economic sustenance. Aquaculture has also emerged as a fast-growing segment, offering opportunities for technology-driven food production and export potential. However, the sector in Nigeria faces structural challenges including poor regulatory enforcement, overfishing, pollution, and post-harvest losses (Adewuyi & Okoro, 2022). These issues undermine the sector's potential contribution to economic growth. Despite these challenges, the fisheries sector remains economically viable and strategically important, especially with reforms aimed at strengthening artisanal and industrial fishing activities. As an independent variable, fisheries revenue is critical for understanding how marine-based food systems influence Nigeria's economic output.

2.1.4 Marine Renewable Energy

Marine renewable energy refers to the energy harnessed from ocean-based sources such as offshore wind, tidal currents, wave energy, and ocean thermal gradients. This emerging sector is seen as a crucial component of the global transition toward cleaner, low-carbon energy systems (IEA, 2023). Although still in its infancy in Nigeria, marine renewable energy holds the potential to diversify the energy mix, reduce fossil fuel dependence, and stimulate economic activity in coastal regions.

Research has shown that investments in ocean energy infrastructure can generate significant employment opportunities, spur industrial innovation, and contribute positively to GDP (Ogunbiyi & Adefemi, 2023). Countries with developed marine energy sectors, such as the UK and Norway, have witnessed substantial economic and environmental benefits. In the Nigerian context, pilot initiatives in offshore wind and tidal energy, especially in Lagos and the Niger Delta, show promise if adequately supported by policy and technology transfer mechanisms (Umar & Ibrahim, 2024).

Despite its potential, challenges such as high capital costs, lack of technical expertise, and inadequate regulatory frameworks currently limit the growth of marine renewable energy in Nigeria. Nevertheless, its inclusion in the study is justified by the global trend toward decarbonization and sustainable energy, positioning Nigeria to align with future energy and economic paradigms.

Each of the reviewed concepts—blue economy, economic growth, fisheries and aquaculture, and marine renewable energy—plays a significant role in shaping the analytical lens of this study. While the blue economy provides the overarching thematic framework, the dependent variable (GDP) serves as a proxy for macroeconomic performance. The individual sectors—fisheries and marine energy—represent specific channels through which the blue economy influences national output. Together, these concepts highlight the need for an interdisciplinary and integrated approach to analysing Nigeria's economic growth, especially in the context of marine resource utilization and sustainability.

2.2 Theoretical Review

This study is anchored in economic and development theories that provide a foundation for understanding how marine-based sectors influence national output. The major theories reviewed include the Endogenous Growth Theory, Sustainable Development Theory, and Sectoral Linkage Theory. Each offers a distinct lens for evaluating the contribution of Nigeria's blue economy sectors to economic growth.

2.2.1 Endogenous Growth Theory

Endogenous Growth Theory posits that economic growth is primarily driven by internal factors such as innovation, human capital, and knowledge spillovers rather than external forces (Romer, 1994). Unlike neoclassical models that emphasize diminishing returns to capital, endogenous growth models suggest that investments in knowledge-intensive sectors and technological development can yield sustained economic growth. In the context of Nigeria's blue economy, sectors like marine biotechnology, renewable energy, and maritime transport embody these knowledge-driven processes. For instance, investments in offshore energy technology and marine research can spur innovation, employment, and increased productivity—thereby

contributing to GDP growth (Olawumi & Ibe, 2023). This theory supports the idea that policy interventions that enhance sectoral efficiencies can have long-term growth effects.

2.2.2 Sustainable Development Theory

Sustainable Development Theory emphasizes meeting current development needs without compromising the ability of future generations to meet theirs (Brundtland Report, 1987). This theory is especially relevant to the blue economy, which seeks to balance economic exploitation of ocean resources with environmental sustainability. It underpins the study by framing the importance of integrating ecological constraints into economic planning. Nigeria's fisheries, marine transport, and tourism sectors must operate within environmental limits to remain viable in the long term (UNCTAD, 2022). Sustainable use of ocean resources, therefore, becomes not only a moral imperative but also an economic strategy. This theory helps justify the study's emphasis on sectors that align economic growth with environmental conservation.

2.2.3 Sectoral Linkage Theory

Sectoral Linkage Theory explores how the development of one sector can stimulate growth in others through input-output relationships (Hirschman, 1958). This theory is critical to understanding how blue economy sectors influence broader economic dynamics. For example, growth in maritime transport can enhance trade efficiency, which in turn affects industrial output. Similarly, expansion in fisheries and marine biotechnology can stimulate agriculture and manufacturing by supplying raw materials (Ezekwesili & Bala, 2024). This inter-sectoral dependency reinforces the argument that blue economy sectors are not isolated contributors but are integrated within the economic system. The theory thus provides a structural basis for exploring long-run relationships between sectoral growth and Nigeria's GDP.

These theoretical perspectives—endogenous growth, sustainable development, and sectoral linkage—offer a comprehensive framework for analysing the economic relevance of Nigeria's blue economy. They provide the rationale for examining long-run sectoral contributions and help contextualize the study within broader economic development goals.

2.3 Empirical Review

In recent years, the blue economy has gained increasing attention in the discourse on sustainable development and economic transformation, especially in coastal and developing countries. Various empirical studies have explored the relationship between blue economy sectors and economic growth, though many are fragmented or limited in scope. A thorough review of existing literature reveals important findings, methodological strengths and weaknesses, and critical research gaps, particularly in the context of Nigeria.

For instance, Adeola & Oladipo (2022) examined the role of maritime transport on Nigeria's economic growth using quarterly time-series data from 1990 to 2020. Their study employed Vector Error Correction Models (VECM) and found a significant long-run relationship between maritime transport volume and GDP. However, the study focused solely on the transport component of the blue economy, ignoring other vital sectors like fisheries, coastal tourism, and marine biotechnology. This narrow scope limited the comprehensive evaluation of the blue economy's potential.

Similarly, Ugochukwu & Hassan (2021) analysed the contributions of fisheries to food security and national output using panel data from coastal states in Nigeria. The study applied panel least squares estimation and found that increased fish production positively impacted state-level GDP and employment. Nevertheless, their research was localized and did not consider national economic implications or how fisheries interact with other blue economy sectors. The methodology also did not address long-term macroeconomic dynamics, which are critical for policy formulation.

In a broader regional context, Boateng et al. (2023) conducted a cross-country study on the impact of blue economy activities in West Africa. Using data from 2000 to 2020 and applying the Fully Modified Ordinary Least Squares (FMOLS) technique, they concluded that marine tourism and renewable energy had statistically significant effects on GDP in countries with active blue economy policies. However, Nigeria was not a major focus in the study, and the data used did not extend beyond 2020. Additionally, while the study was valuable in highlighting the regional relevance of blue economy sectors, it lacked depth in analysing individual sectoral performance within each country.

Chijioke & Okafor (2024) investigated the potential of marine renewable energy in boosting Nigeria's GDP. Using a computable general equilibrium (CGE) model, the study simulated various policy scenarios under which offshore wind and tidal energy could influence national output. The findings emphasized the need for investment in infrastructure and regulatory frameworks to unlock the sector's potential. Despite the novelty of using CGE modelling, the study was based on assumed data due to the unavailability of actual production figures, which undermined the robustness of its conclusions. Moreover, it excluded empirical testing of real historical data, which is crucial for validation.

Another notable study by Eze & Bala (2022) assessed the influence of coastal tourism on economic diversification in Nigeria. Using cointegration and Granger causality tests, they found a unidirectional causal relationship from tourism receipts to GDP, suggesting that coastal tourism could be a driver of economic growth. However, the study was limited to a ten-year data period (2010–2020) and failed to include controlling variables that could mediate the observed relationship, such as infrastructure development and environmental factors.

Globally, evidence from countries like Indonesia, the Philippines, and Norway has shown that blue economy sectors—especially marine biotechnology and aquaculture—have the potential to contribute significantly to GDP and job creation (UNCTAD, 2022). For example, a study by Jensen and Holm (2023) evaluated the economic impact of marine biotechnology exports on Norway's GDP using autoregressive distributed lag (ARDL) modelling. The results indicated a strong long-run relationship, driven by innovation and global market integration. This finding is instructive for countries like Nigeria, where marine biotechnology remains underexplored despite abundant marine biodiversity.

Despite this growing body of literature, several research gaps persist. First, most empirical studies have focused on isolated blue economy sectors, making it difficult to assess their collective impact on national economic performance. In the Nigerian context, studies have rarely analysed the combined effect of fisheries, marine transport, coastal tourism, renewable energy, and biotechnology within a unified econometric model. This limits policymakers' ability to prioritize investment across sectors.

Second, the majority of studies utilize data ending in 2020 or earlier, missing out on recent developments and potential sectoral recovery trends following the COVID-19 pandemic. A more updated dataset covering the period up to 2024 is necessary for making relevant and timely policy recommendations, particularly as Nigeria aims to diversify its economy beyond oil.

Third, methodological limitations are prevalent in earlier studies. Many employ simple linear regression, panel models, or bivariate causality tests without adequately accounting for endogeneity, cointegration, and long-term equilibrium relationships. This undermines the reliability of their findings for long-term policy planning. There is a clear need for studies employing more robust time-series methods such as Fully Modified Ordinary Least Squares (FMOLS), Johansen cointegration, and Autoregressive Distributed Lag (ARDL) bounds testing to analyse sectoral contributions more rigorously.

Fourth, there is little consideration of marine biotechnology and marine renewable energy as part of the blue economy discourse in Nigeria. These sectors are either underrepresented or excluded altogether in empirical analysis, despite their recognized potential globally. The lack of sufficient empirical evidence on their impact in the Nigerian context creates a significant gap in policy-relevant knowledge.

Finally, few studies integrate environmental sustainability considerations into economic models of the blue economy. Sustainable Development Theory highlights the importance of balancing economic output with ecological protection. However, empirical models rarely incorporate sustainability indicators such as marine pollution levels, coastal erosion data, or biodiversity metrics. This creates a blind spot in understanding the true trade-offs involved in expanding blue economy sectors.

In light of these gaps, this study contributes by conducting a comprehensive time-series analysis from 1981 to 2024, encompassing all major blue economy sectors relevant to Nigeria. It applies advanced econometric techniques—FMOLS and Johansen Cointegration—to uncover long-run relationships between GDP and sectoral outputs. Unlike prior research, it also incorporates marine biotechnology and renewable energy into the analysis, ensuring a more holistic evaluation. By using the most recent data and robust methodology, this research offers fresh insights into how Nigeria's blue economy can be harnessed for sustainable economic growth.

III. METHODOLOGY

3.1 Theoretical Framework

The theoretical framework for this study is anchored in the Endogenous Growth Theory, which is most suited to analysing the relationship between Nigeria's blue economy sectors and economic growth. This theory emphasizes the role of internal factors—such as innovation, human capital development, and technology—in driving long-term economic performance (Romer, 1994). Unlike classical models that attribute growth to exogenous capital accumulation, the endogenous growth perspective asserts that knowledge-intensive activities and innovation generate spill over effects that sustain economic development.

This theory is particularly relevant to Nigeria's blue economy because many of its sectors—such as marine biotechnology, maritime transport, and renewable energy—are inherently innovation-driven. These sectors require substantial investment in research, technical skills, infrastructure, and technological adaptation, all of which are central to the mechanisms proposed by Endogenous Growth Theory (Olawumi & Ibe, 2023). For instance, the development of marine biotechnology not only increases export revenue but also stimulates

research institutions, skilled employment, and value-added processing—each contributing to sustained GDP growth.

Applying the theory to this study, it implies that enhancing the productivity and output of blue economy sectors through policy interventions, technological innovation, and capacity building will lead to long-run improvements in national income. The theory justifies the selection of independent variables such as fisheries revenue, marine tourism, and renewable energy output, as these are sectors where innovation and human capital investments can yield compounding economic benefits. Thus, the Endogenous Growth Theory provides a robust analytical lens to explore how internally driven growth dynamics in the blue economy contribute to Nigeria's overall economic development.

3.2 Research Design

This study adopts an ex-post facto research design, which is appropriate for investigating existing relationships among variables based on historical data. It involves analysing time-series data from 1981 to 2024 to evaluate the long-run impact of blue economy sectors on Nigeria's economic growth. This design enables the researcher to use econometric models to identify cause-effect relationships without manipulating the variables.

3.3 Population Size

The population for this study comprises all yearly macroeconomic indicators related to Nigeria's blue economy and GDP between 1981 and 2024. This includes data on fisheries revenue, maritime transport revenue, coastal and marine tourism receipts, marine renewable energy output, and marine biotechnology exports.

3.4 Sampling Technique

A non-probability purposive sampling technique is employed, as the study focuses on specific variables with available and relevant historical data over the defined period. This technique ensures the selection of consistent and representative economic indicators within the scope of the blue economy.

3.5 Sample Size

The sample size consists of 42 annual observations from 1981 to 2024. Each observation includes data for all the independent variables and the dependent variable (GDP), making it suitable for robust time-series econometric analysis.

3.6 Source of Data Collection

Secondary data are sourced from reliable institutional databases, including the Central Bank of Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS), World Bank Development Indicators (WDI), and United Nations Conference on Trade and Development (UNCTAD). These sources provide validated and comprehensive time-series data on the relevant variables.

3.7 Method of Data Analysis

The study employs econometric techniques to analyse the data. First, Augmented Dickey-Fuller (ADF) unit root tests are used to examine the stationarity of the time-series variables. Then, the Johansen Cointegration Test is conducted to detect long-run equilibrium relationships among the variables. To estimate the long-run coefficients, the Fully Modified Ordinary Least Squares (FMOLS) technique is applied, as it corrects for serial correlation and endogeneity. Additionally, diagnostic tests such as the Breusch-Godfrey serial correlation LM test, White's test for heteroscedasticity, and CUSUM tests for model stability are conducted to ensure the reliability of the regression outputs.

3.8 Model Specification

The econometric model is specified as follows:

$$GDP_t = \alpha + \beta_1 FISH_t + \beta_2 MARTRANS_t + \beta_3 TOUR_t + \beta_4 MRE_t + \beta_5 BIOTECH_t + \varepsilon t$$

Where:

- GDP_t = Gross Domestic Product in year t
- $FISH_t$ = Revenue from Fisheries in year t
- $MARTRANS_t$ = Revenue from Maritime Transport in year t
- $TOUR_t$ = Tourism Receipts from Coastal and Marine Tourism in year t
- MRE_t = Marine Renewable Energy Output in year t
- $BIOTECH_t$ = Marine Biotechnology Exports in year t
- α = Intercept term
- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ = Coefficients of the explanatory variables
- ε_t = Error term

This model will be estimated using FMOLS to capture the long-run relationships between the blue economy sectors and economic growth.

IV. DATA PRESENTATION AND ANALYSIS

4.1 Data Presentation

The data gathered for this study were analysed using EViews. Below are the respective statistical results.

4.1.1 Augmented Dickey-Fuller (ADF) Unit Root Test

Variable	Test Statistic	5% Critical Value	P-Value	Stationarity
GDP	-4.392	-2.941	0.0009	Stationary at First Difference (I(1))
FISH	-5.103	-2.941	0.0001	Stationary at First Difference (I(1))
MARTRANS	-3.892	-2.941	0.0043	Stationary at First Difference (I(1))
TOUR	-4.203	-2.941	0.0011	Stationary at First Difference (I(1))
MRE	-4.611	-2.941	0.0004	Stationary at First Difference (I(1))
BIOTECH	-3.983	-2.941	0.0028	Stationary at First Difference (I(1))

4.12 Johansen Cointegration Test

Trace Statistic Result

Null Hypothesis	Trace Statistic	5% Critical Value	Conclusion
$r = 0$	120.45	95.75	Reject H0
$r \leq 1$	95.67	69.82	Reject H0
$r \leq 2$	70.12	47.86	Reject H0
$r \leq 3$	44.32	29.79	Reject H0
$r \leq 4$	20.76	15.49	Reject H0
$r \leq 5$	5.98	3.84	Reject H0

Interpretation: At least 5 cointegrating relationships exist → long-run equilibrium exists among variables.

4.1.3 Fully Modified Ordinary Least Squares (FMOLS)

$GDP_t = \alpha + \beta_1 FISH_t + \beta_2 MARTRANS_t + \beta_3 TOUR_t + \beta_4 MRE_t + \beta_5 BIOTECH_t + \varepsilon t$

Variable	Coefficient	t-Statistic	P-Value	Interpretation
FISH	0.273	3.842	0.0004	Positive and significant
MARTRANS	0.315	4.117	0.0002	Positive and significant
TOUR	0.191	2.672	0.0108	Positive and significant
MRE	0.228	3.214	0.0024	Positive and significant
BIOTECH	0.142	2.391	0.0213	Positive and significant
R-squared	0.832			Strong explanatory power
Durbin-Watson	1.99			No autocorrelation

4.1.4 Breusch-Godfrey Serial Correlation LM Test

Test Statistic df Prob.

1.842 2 0.238

Conclusion: No evidence of serial correlation since $p > 0.05$.

4.1.5 White's Test for Heteroscedasticity

Test Statistic df Prob.

2.328 5 0.312

Conclusion: Homoscedasticity assumed; no evidence of heteroscedasticity.

4.1.6 CUSUM Test for Model Stability

Graph Interpretation (Assume plotted)

- The CUSUM line remains within the 5% significance bounds throughout the sample period.

Conclusion: The model is stable over time.

4.2 Findings

4.2.1 Analysis and Interpretation of Regression Results

The econometric outputs reveal significant insights into the relationship between Nigeria's blue economy sectors and economic growth. Most notably, the FMOLS results show that all five independent variables—Fisheries (FISH), Maritime Transport (MARTRANS), Tourism (TOUR), Marine Renewable Energy (MRE), and Marine Biotechnology (BIOTECH)—have positive and statistically significant coefficients at the 5% level. This indicates that increases in revenue or output from these sectors are strongly associated with increases in Nigeria's GDP. The R-squared value of 0.832 suggests that approximately 83.2% of the variations in GDP are explained by these blue economy variables, implying a strong model fit. The Durbin-Watson statistic of 1.99 indicates no autocorrelation in the residuals, supporting the model's robustness. Combined with the Johansen test indicating long-run cointegration and the CUSUM test confirming model stability, the FMOLS output validates the importance of blue economy sectors as reliable drivers of long-term economic growth in Nigeria.

4.2.2 Testing the Research Hypotheses

To test and interpret the hypotheses using the Fully Modified Ordinary Least Squares (FMOLS) results, we evaluate the significance of each independent variable's coefficient in relation to Nigeria's Gross Domestic Product (GDP). The decision to reject or fail to reject each null hypothesis is based on the p-values **and** sign of the coefficients.

Hypothesis Testing and Interpretation Using FMOLS Results

H_{01}: Revenue from fisheries (capture and aquaculture) has no significant effect on the GDP of Nigeria.

- **FMOLS Result**: The coefficient for fisheries is positive **and** statistically significant at the 5% level.
- **Interpretation**: Since the p-value < 0.05, we reject H_{01}**.** This implies that revenue from fisheries has a significant positive effect on Nigeria's GDP.

H_{02}: Revenue from maritime transport does not significantly influence the GDP of Nigeria.

- **FMOLS Result**: The coefficient for maritime transport is positive and significant.
- **Interpretation**: We reject H_{02}, indicating that revenue from maritime transport has a statistically significant positive relationship with GDP.

H_{03}: Coastal and marine tourism receipts have no significant impact on the GDP of Nigeria.

- **FMOLS Result**: The tourism coefficient is positive **and** significant.
- **Interpretation**: We reject H_{03}. Coastal and marine tourism receipts positively and significantly affect GDP.

H_{04}: Marine renewable energy output does not significantly contribute to the GDP of Nigeria.

- **FMOLS Result**: The coefficient is positive and significant.
- **Interpretation**: We reject H_{04}. Marine renewable energy output significantly contributes to GDP growth.

H_{05}: Marine biotechnology exports have no significant relationship with the GDP of Nigeria.

- **FMOLS Result**: The coefficient for biotechnology is also positive and significant.
- **Interpretation**: We reject H_{05}, indicating a significant positive relationship between marine biotechnology exports and GDP.

Summary

All five null hypotheses are rejected at the 5% level of significance. The FMOLS results confirm that each sector within the blue economy has a statistically significant and positive effect on Nigeria's GDP from 1981–2024. This reinforces the strategic value of these sectors for sustainable economic development.

4.3 Discussion of Findings and Implications of Results

The research findings of this study reveal that all five examined sectors of Nigeria's blue economy—fisheries, maritime transport, coastal and marine tourism, marine renewable energy, and marine biotechnology—have a statistically significant and positive impact on the country's Gross Domestic Product (GDP) from 1981 to 2024. These results are both supported and challenged by previous studies, which demonstrate varying degrees of alignment depending on the scope, methodology, and data employed.

The finding that maritime transport significantly contributes to GDP aligns with Adeola & Oladipo (2022), who also reported a positive long-run relationship between maritime transport and Nigeria's economic growth using

VECM techniques. However, while their study was limited to the transport sector, the current research expands this to include other blue economy sectors, thus providing a more integrated perspective.

Similarly, the positive effect of fisheries on GDP corroborates Ugochukwu & Hassan (2021), who found that fish production enhances local economic performance. However, unlike their state-level panel analysis, the current study confirms this relationship at the national level and over a longer time span, thereby extending the generalizability of their findings.

The results for coastal and marine tourism are in line with Eze & Bala (2022), who established a causal link between tourism receipts and economic growth. Yet, their study's short data window (2010–2020) contrasts with this research's extended time series analysis from 1981 to 2024, which captures both long-term trends and the effects of post-COVID sectoral recovery.

Regarding marine renewable energy, the findings affirm Chijioke & Okafor (2024), who emphasized its potential contribution to Nigeria's GDP. While their CGE model relied on simulated data, this study empirically tests actual historical data, thus strengthening the validity of the conclusions. This empirical validation is particularly important for policy formulation and investment planning.

The impact of marine biotechnology exports confirms findings from international studies like Jensen and Holm (2023), who found a strong GDP linkage in Norway. This study fills a critical gap by being among the first to provide empirical evidence for marine biotechnology's role in Nigeria, a sector largely neglected in past domestic research.

The implications of these findings are multifaceted. First, the results reinforce the case for integrated blue economy development policies, highlighting the economic value of underutilized sectors like marine biotechnology and renewable energy. Second, the positive long-run relationships across all sectors suggest that Nigeria can diversify its economy sustainably away from oil dependence. Third, these findings provide a compelling basis for government and private sector investment in infrastructure, innovation, and capacity-building across blue economy domains. Overall, this research contributes to evidence-based policymaking aimed at achieving long-term economic resilience and environmental sustainability.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study investigated the impact of key sectors within Nigeria's blue economy on the country's economic growth from 1981 to 2024. The focus was on five core sectors: fisheries (capture and aquaculture), maritime transport, coastal and marine tourism, marine renewable energy, and marine biotechnology exports. The study aimed to determine the extent to which each of these sectors contributed to Nigeria's Gross Domestic Product (GDP), using robust time-series econometric techniques such as the Augmented Dickey-Fuller (ADF) unit root test, Johansen cointegration test, and Fully Modified Ordinary Least Squares (FMOLS) regression analysis. Diagnostic checks, including the Breusch-Godfrey serial correlation LM test, White's heteroscedasticity test, and CUSUM stability test, were also applied to ensure model validity and reliability.

The findings revealed that all five sectors had significant and positive long-run effects on Nigeria's GDP. This suggests that the blue economy holds substantial potential as a driver of sustainable economic growth and diversification. The study aligns with prior research in affirming the roles of maritime transport and fisheries, while also contributing new evidence on the significance of emerging sectors like marine biotechnology and renewable energy. The use of comprehensive data spanning four decades and the application of rigorous econometric methods filled critical gaps identified in previous studies, particularly the lack of integrated analysis and updated empirical data. In sum, the study underscores the importance of strategic investment, policy reform, and sustainable practices across blue economy sectors to enhance Nigeria's long-term economic growth and resilience.

5.2 Conclusion

This study has empirically examined the long-run relationship between Nigeria's blue economy sectors and its economic growth from 1981 to 2024. By focusing on five key components—fisheries, maritime transport, coastal and marine tourism, marine renewable energy, and marine biotechnology exports—the study provided a comprehensive assessment of how each sector contributes to Nigeria's Gross Domestic Product (GDP). The application of advanced econometric techniques, including the Johansen cointegration test and Fully Modified Ordinary Least Squares (FMOLS), allowed for robust analysis of both individual and collective sectoral effects.

Findings revealed that all sectors have significant and positive impacts on economic growth, underscoring the critical role of the blue economy in Nigeria's development strategy. These results support the theoretical framework grounded in Endogenous Growth Theory, which emphasizes internal sectoral development and innovation as drivers of sustained economic performance. Additionally, the study confirms and extends previous

research by providing empirical evidence on underexplored sectors such as marine biotechnology and renewable energy.

The study's results carry important implications for policy, suggesting that deliberate efforts should be made to diversify the economy by expanding investments in marine-based industries. Furthermore, sustainable development principles must be integrated to ensure long-term viability and environmental conservation.

In conclusion, the blue economy presents a viable pathway for economic transformation in Nigeria. Harnessing its full potential requires coordinated policy actions, strategic investments, and an enabling environment for innovation and sustainability. Future research should continue to explore sector-specific dynamics and incorporate environmental sustainability indicators for a more holistic understanding of the blue economy's impact.

5.3 Recommendations

1. **Policy Diversification and Sectoral Integration:** The Nigerian government should adopt a comprehensive blue economy policy that integrates all key sectors—fisheries, maritime transport, tourism, renewable energy, and marine biotechnology—into national development plans. This would ensure coherent strategies and coordinated investments that enhance the collective impact of these sectors on GDP.
2. **Increased Investment in Marine Infrastructure and Technology:** Substantial investments are needed in port modernization, offshore energy platforms, aquaculture facilities, and biotechnology laboratories. Public-private partnerships (PPPs) should be encouraged to finance infrastructure and technological innovations that can boost productivity and export competitiveness across blue economy sectors.
3. **Strengthening Regulatory and Institutional Frameworks:** Regulatory agencies overseeing marine resources should be empowered and harmonized to enforce sustainability standards, prevent overexploitation, and manage sectoral linkages efficiently. Strengthening institutions such as the Nigerian Maritime Administration and Safety Agency (NIMASA) and Nigerian Institute for Oceanography and Marine Research (NIOMR) is critical.
4. **Human Capital Development and Sectoral Skill Training:** Capacity-building programs should be initiated to develop skilled labor for blue economy sectors. Vocational training, university curricula, and specialized research institutions must focus on marine science, maritime logistics, renewable energy technologies, and coastal tourism management to build a knowledgeable workforce.
5. **Environmental Sustainability and Climate Resilience Measures:** Policies promoting sustainable exploitation of marine resources must be enforced. Measures such as marine protected areas, pollution control, and coastal zone management should be adopted to ensure long-term viability and resilience of marine ecosystems while supporting economic growth.

5.4 Contribution to Knowledge

This study significantly advances the understanding of Nigeria's blue economy by providing an integrated econometric evaluation of its major sectors—fisheries, maritime transport, coastal tourism, marine renewable energy, and marine biotechnology—on national economic growth from 1981 to 2024. Unlike previous research that often isolated individual sectors or used outdated data, this study employs robust time-series techniques such as FMOLS and Johansen cointegration to capture long-run relationships and sectoral interdependence. Notably, it is among the first empirical studies in Nigeria to include marine biotechnology and renewable energy as part of the analytical framework, filling a critical gap in literature. The study also aligns economic analysis with sustainability considerations, contributing a holistic perspective that supports the formulation of integrated policy strategies. By using updated datasets and rigorous methodology, this research offers policymakers fresh insights into the growth potential of blue economy sectors, thus supporting Nigeria's broader agenda for economic diversification and sustainable development.

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