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Blue Economy and Sustainable Development in Nigeria

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Abstract- This study examined the effect of blue economy on sustainable development in Nigeria from 1990 to 2023, using human development index as the measure of sustainable development. Blue economy was proxied by fishery production, maritime transport, aquaculture production, maritime tourism and renewable energy. The study adopted ex-post facto research design and made use of annual time series data mainly sourced from the Central Bank of Nigeria (CBN) statistical bulletin, World Bank Development Indicators and International Energy Agency (IEA) reports. The techniques of data analysis adopted include trend analysis, descriptive statistics, multicollinearity test using correlation matrix, Augmented Dickey-Fuller (ADF) unit root test, bounds cointegration test and Autoregressive Distributed Lag (ARDL) approach. The findings of the study showed that fishery production, maritime transport, maritime tourism and renewable energy have positive and significant effects on human development index in Nigeria in both the short run and long run, while aquaculture production has a positive but non-significant effect on human development index in both the short run and long run. Based on the findings, the study concluded that the blue economy holds substantial potential for promoting human development in Nigeria, but sustainable regulatory frameworks are necessary to sustain and deepen these gains. It was recommended, among others, that government should scale up investment in sustainable fisheries development, including enforcing anti-illegal fishing regulations, promoting modern fishing technologies, improving cold-chain logistics, and supporting artisanal fishers with credit facilities.

I. INTRODUCTION

The blue economy, encompassing the sustainable use of ocean, sea and inland water resources for economic growth, improved livelihoods and employment while preserving the health of aquatic ecosystems, has emerged as a critical pathway for structural transformation in coastal and maritime nations. As countries increasingly recognise the economic potential embedded in oceans, seas, rivers, and other aquatic resources, the blue economy framework has shifted global attention away from traditional exploitative models toward sustainability, environmental stewardship, and inclusive growth (World Bank, 2017). For Nigeria, with its extensive coastline along the Gulf of Guinea, abundant inland waterways, and significant marine resources, the blue economy represents a substantial and largely untapped avenue for advancing human development, understood broadly as improvements in health, education, and living standards that extend beyond mere increases in national income. Human development index, as a composite measure of life expectancy, educational attainment and standard of living, captures the extent to which economic activities translate into genuine improvements in human welfare. Blue economy sectors such as fisheries, maritime transport, aquaculture, maritime tourism and renewable energy each carry the potential to influence human development through multiple channels, including direct employment creation, income generation for coastal households, foreign exchange earnings that support public investment in health and education, and, in the case of renewable ocean energy, expanded access to clean power (UNEP, 2020). At the same time, unmanaged exploitation of marine resources threatens to undermine these very gains through pollution, habitat destruction and resource depletion, raising the question of whether Nigeria's blue economy has, in practice, been translating into measurable improvements in human development. This study examines the effect of fishery production, maritime transport, aquaculture production, maritime tourism and renewable energy on human development index in Nigeria between 1990 and 2023.

Statement of the Problem

Despite Nigeria's vast marine and coastal endowments, the country's human development outcomes remain comparatively weak, with the nation's human development index hovering around the medium human development category for much of the review period. Nigeria's blue economy sectors have historically been underdeveloped relative to their potential: fisheries suffer from illegal, unreported and unregulated (IUU) fishing, aquaculture remains a minor contributor to output despite abundant freshwater and brackish water resources, maritime transport is constrained by inadequate port infrastructure and regulatory inefficiencies, and renewable ocean energy remains at a nascent stage of development. These structural weaknesses raise concerns about whether the blue economy, as currently configured, is capable of meaningfully improving health, education and living-standard outcomes for the Nigerian population.

Furthermore, much of the existing literature on the blue economy in Nigeria and comparable coastal economies has focused on its contribution to aggregate economic growth or sector-specific outcomes such as trade volumes and port throughput, with comparatively limited empirical attention paid to its direct effect on human development index as a composite welfare measure. Where blue economy sectors expand without being matched by improvements in the underlying social infrastructure, health systems and educational access that translate income into genuine human development, the promise of the blue economy risks remaining unrealised. It is against this background that this study empirically investigates the effect of blue economy on human development index in Nigeria.

II. LITERATURE REVIEW

Theoretical Framework

The theories adopted in this study are discussed below

i. Sustainable Development Theory

The sustainable development theory was initially highlighted by the Brundtland Commission in 1987. The theory assumes that development must strike a balance between economic growth, environmental protection, and social equity, and suggests that countries like Nigeria should pursue economic progress while conserving resources, ensuring that future generations have access to the same natural assets. A basic assumption of the theory is intergenerational equity, which requires that development strategies do not deplete resources for future generations; in the context of Nigeria, this implies managing maritime and coastal resources in a way that supports long-term human development, since overfishing or excessive resource extraction would be counterproductive to sustainable development. Another assumption is that economic, social, and environmental dimensions of development must be integrated, such that efforts to grow the blue economy also strengthen health, education and living standards. Herman Daly contributed the notion that economic activity should operate within ecological boundaries, while Amartya Sen expanded the theory's scope to include social equity, arguing that sustainable development should free people from poverty and deprivation, ideas that highlight the need for Nigeria's blue economy to benefit local communities and not merely industries.

Sustainable Development Theory is highly relevant to this study because the blue economy, which involves the sustainable use of ocean and inland water resources for economic growth, improved livelihoods, and jobs, aligns with the theory's core principles. Nigeria's blue economy sectors, such as fisheries, maritime transport, maritime tourism and renewable energy, are vital not only to GDP but to the non-income dimensions of development captured in the human development index, including health and education. The theory suggests that growth in these sectors, if pursued sustainably, conserves marine ecosystems and ensures the long-term availability of resources needed to sustain improvements in life expectancy, schooling and living standards. It also underscores the need for social inclusion, whereby coastal communities that rely on marine resources for their livelihoods are not marginalised by large corporations, but are actively engaged in the human development gains generated by the blue economy.

ii. Natural Capital and Ecosystem Service Theory

The natural capital and ecosystem service theory was advanced by Robert Costanza in 2005. The core assumption of the theory is that natural ecosystems provide a wide range of services that are essential for human survival and economic activity, including provisioning services such as food and raw materials, regulating services such as climate regulation, supporting services such as nutrient cycling, and cultural services such as recreational and aesthetic benefits. The theory posits that the value of these services should be recognised and incorporated into economic and policy decisions, since natural capital and ecosystem services are often undervalued in traditional economic systems, leading to degradation of ecosystems and the loss of essential services. Proponents such as Costanza and the Millennium Ecosystem Assessment (2005) have emphasised the need to account for ecosystem services in economic analyses, valuing the economic benefits of preserving natural capital and the potential costs of ecosystem degradation.

Natural Capital and Ecosystem Service Theory is particularly relevant to this study given Nigeria's rich biodiversity and reliance on marine and coastal ecosystems for economic and social development. Nigeria's marine and coastal ecosystems provide essential services such as fisheries productivity, water purification, and climate regulation, all of which underpin human health and livelihoods captured in the human development index. The theory explains that when the value of these ecosystem services is properly recognised and factored into blue economy planning, such as through sustainable fisheries management, marine spatial planning, and pollution control, the resulting healthier ecosystems support more resilient fishing and tourism livelihoods, better nutritional and health outcomes, and, ultimately, improvements in human development. Conversely, where ecosystem services are undervalued and overexploited, as with unregulated fishing or coastal pollution, the resulting ecological degradation threatens to erode the very human development gains that the blue economy is meant to generate.

Empirical Review

Alwell and Oladosu (2024) empirically examined the effect of blue economy on poverty alleviation in Nigeria from 1990 to 2023, using annual time series data sourced from the Central Bank of Nigeria (CBN) statistical bulletin, World Bank Development Indicators, International Energy Agency (IEA) reports and National Bureau of Statistics (NBS) reports, analysed through correlation matrix, Augmented Dickey-Fuller (ADF) unit root, bounds cointegration and ARDL techniques. The findings revealed that fisheries production, aquaculture production, maritime transportation and hydropower energy have significant negative effects on poverty rate in both the short run and long run, indicating strong welfare-enhancing potential of these blue economy variables, and the study recommended government-led initiatives to promote sustainable fishing practices and expand aquaculture production through subsidies, training and credit access.

Odey (2023) examined the blue economy and its impact on the economic growth of the Niger Delta region and the Nigerian state. The findings revealed that the blue economy contributes to employment, job creation, and poverty eradication, while also addressing challenges relating to food security, sustainable fisheries, sustainable energy and natural resources, alongside fostering community and societal wellbeing. However, the study identified challenges such as sea piracy, illegal arms trafficking, pollution and overreliance on oil and gas as threats to the sector's contribution to broader development outcomes, recommending comprehensive policy reforms, coast guard employment for youths, and maritime education centres to strengthen the sector's developmental impact.

Hammoud, Munqith and Omar (2022) examined the impact of blue economy variables, represented by total fish production and total goods transported through ports, on economic growth in eleven European countries using panel data for 2010 to 2019. The research found that total fish production and goods transported through ports have a positive impact on economic growth in the short run, though total fish production showed a negative long-run effect, while goods transported through ports maintained a positive long-run impact, illustrating the differentiated and time-dependent nature of blue economy contributions to growth and, by extension, to broader development indicators.

Miller and Robinson (2022) found that fishery production is an important indicator of the blue economy that positively and significantly impacts employment and life expectancy in coastal economies, directly reinforcing the welfare dimensions captured in composite human development measures. The study emphasised that where fishery production is supported by stable access to markets and credit, coastal households experience improved income stability, nutritional outcomes and access to healthcare, all of which are core components of human development.

Yildiz (2022) examined the relationship between gross domestic product and maritime exports, maritime imports, and the construction sector in Turkey, given the recent decline in maritime transport. Using unit root and Granger causality methods, the study found that GDP is the Granger cause of maritime exports, maritime imports, and the construction industry, while the construction industry Granger-causes maritime exports, suggesting a complex, growth-driven relationship between maritime trade and broader economic and social indicators.

Naidoo and Andrews (2021) provided an in-depth analysis of maritime transport and port development in South Africa, examining their economic impact using a mixed-methods approach combining quantitative trade data with qualitative stakeholder interviews. The findings revealed that port development and maritime transport efficiency are strongly correlated with economic growth, with investments in port infrastructure improving handling capacity and trade facilitation, while also highlighting the role of human capital development and workforce training in translating maritime sector growth into broader socioeconomic benefits.

GolLogisch and Weller (2021) investigated the economic benefits of blue economy initiatives in Small Island Developing States (SIDS), which are highly dependent on marine and coastal resources. Using case studies and mixed qualitative-quantitative methods, the study revealed that blue economy initiatives significantly enhance economic resilience and sustainability, with improvements in tourism, fisheries, and renewable energy sectors, and recommended scaling up successful initiatives, investing in capacity building for local stakeholders, and strengthening policy frameworks to support sustainable practices that improve overall wellbeing.
Dey and Kabir (2020) examined the role of the blue economy in promoting sustainable development in Bangladesh, focusing on the economic, social, and environmental dimensions, and using a combination of econometric modelling and GIS mapping. The findings indicated that blue economy activities positively influence sustainable development in Bangladesh, contributing to economic growth and environmental conservation, with improvements in coastal livelihoods, marine biodiversity, and resilience to climate change, advocating for the integration of blue economy planning with marine resource management and increased investment in sustainable technologies.

Egre and Bjorneras (2020) found that marine renewable energy has a positive effect on human development index as a measure of sustainable development in Nigeria, emphasising that expanding clean, ocean-based energy sources can support improvements in health and education outcomes by reducing reliance on polluting energy sources and expanding electricity access in coastal communities.
Brown and White (2020) revealed that renewable energy has positive and statistically significant impact on real gross domestic product and human development index as major indicators of sustainable development in Nigeria, underscoring those investments in ocean-based renewable energy infrastructure yield welfare benefits that extend beyond conventional economic growth measures.

Humayun, Rezwana and Mohammad (2020) explored the prospects of a sea-based economy in helping Bangladesh transition from a middle-income country to a developed country through the sustainable use of marine resources. The study, based mostly on secondary data analysis, found that Bangladesh can accelerate its socioeconomic progress through effective use of sea resources, particularly in its coastal zones, and proposed pathways for promoting sustainable development anchored on the Sustainable Development Goals.

Okemwa (2019) carried out a study to establish how Kenya can harness the potential of the blue economy for sustainable development, administering questionnaires to 35 respondents from state agencies and departments responsible for blue economy governance. The results revealed that for blue economy resources to be fully and sustainably exploited to spur economic growth and development in Kenya, an Integrated National Maritime Policy should be implemented to foster coordination among state agencies.

Santos and Almeida (2019) investigated how the blue economy contributes to economic growth in Portugal, analysing fisheries, tourism, and marine renewable energy sectors using input-output analysis and econometric modelling. The study found that the blue economy plays a crucial role in Portugal's economic growth, with marine tourism and renewable energy showing significant contributions to GDP and employment, and recommended enhancing support for blue economy sectors through targeted investments and improved regulatory frameworks.

Mensah and Agyeman (2019) investigated the critical role of maritime entrepreneurship in fostering economic growth in Ghana, using a mixed-methods approach that combined quantitative analysis of GDP contributions, trade volumes and employment statistics with qualitative interviews of maritime entrepreneurs. The findings revealed that maritime entrepreneurship significantly contributes to Ghana's economic growth and job creation, while identifying access to capital, supportive regulatory frameworks, and skilled labour as key facilitators of successful maritime entrepreneurship that ultimately benefit broader socioeconomic welfare.

Igbodo (2018) studied the performance of the maritime subsector and economic growth in Nigeria from 1995 to 2015, adopting an ex-post facto research design with secondary data from the Central Bank of Nigeria and National Bureau of Statistics. The findings showed a positive relationship between indicators of maritime subsector performance and indicators of economic growth in Nigeria, concluding that the maritime subsector is a veritable engine of growth when properly harnessed, and recommending that government shift policy emphasis and investment toward this viable subsector.

Jansen and Bremer (2018) evaluated the economic impacts of marine spatial planning (MSP) across various European Union member states, using a comparative analysis of MSP implementations supported by policy documents, economic reports and stakeholder interviews. The study found that MSP has generally positive economic impacts, including increased efficiency in marine resource use, reduced conflicts between marine activities, and enhanced economic opportunities in marine sectors, alongside improvements in environmental sustainability that support broader development goals.

Amarh (2017) emphasised the contributions of the blue economy to national development, noting that the blue economy provides significant advantage in terms of the economic development of a country and plays a major role in international trade and national defence. The study, focused on Ghana, identified pollution from illegal mining and unregulated fishing as challenges requiring better ocean governance, and recommended proper attention from central government and local authorities to ensure the blue economy is put to efficient use in advancing national development.

Miller and Yates (2017) explored the impact of blue economy strategies on economic development in Caribbean countries, which rely heavily on marine resources, using a combination of econometric analysis and case studies. The research found that blue economy strategies significantly boost economic development in the Caribbean, with enhanced tourism revenues, improved fisheries management, and growth in marine biotechnology sectors, recommending strengthened regional cooperation and increased investment in marine research and development to sustain these welfare gains.

Cummings and Miller (2016) assessed the economic impacts of marine protected areas (MPAs) in the South Pacific, focusing on their effects on local economies and biodiversity conservation using a mixed-methods approach. The study found that MPAs contribute positively to local economic development by enhancing tourism and improving fish stocks, with increased biodiversity supporting

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sustainable fisheries and tourism, recommending expansion of MPA networks and increased support for affected local communities to maximise long-run welfare benefits.

Jansen and Liu (2015) found that maritime tourism has a significant positive impact on sustainable development in coastal regions, highlighting that well-managed maritime tourism generates revenue and employment that translate into improved living standards and social infrastructure investment in host communities, reinforcing the welfare-enhancing potential of the blue economy tourism subsector.

III. METHODOLOGY

Research Design

Ex-post facto research design was adopted for this study. This design is appropriate because the study seeks to investigate the causal relationship between blue economy (independent variable) and human development index (dependent variable) using already existing time series data which cannot be controlled or manipulated by the researcher.

Data Collection Method and Sources

The study made use of annual time series data covering the period 1990 to 2023, mainly sourced from the Central Bank of Nigeria (CBN) statistical bulletin, World Bank Development Indicators and International Energy Agency (IEA) reports.

Model Specification

This section developed and specified the model adopted in this study to empirically determine the effect of blue economy on human development index in Nigeria. The analytical framework of this study is hinged on Sustainable Development Theory and Natural Capital and Ecosystem Service Theory. The model of this study was based on the model of Hammoud, Munqith and Omar (2022), who measured the impact of the blue economy on economic growth, modified to accommodate the variables of interest to this study.

The functional model is specified as follows:

$$HDI = f(FPD, MTP, AQP, TUR, REG) \quad (3.1)$$

The mathematical model is specified as follows:

$$HDI_t = \beta_0 + \beta_1 FPD_t + \beta_2 MTP_t + \beta_3 AQP_t + \beta_4 TUR_t + \beta_5 REG_t \quad (3.2)$$

The econometric model is specified as follows:

$$HDI_t = \beta_0 + \beta_1 FPD_t + \beta_2 MTP_t + \beta_3 AQP_t + \beta_4 TUR_t + \beta_5 REG_t + \mu \quad (3.3)$$

Equation (3.3) is transformed into an Autoregressive Distributed Lag (ARDL) specification incorporating an error correction term (ECMt-1) to capture both short-run and long-run dynamics between blue economy and human development index:

$$\begin{aligned}\Delta \mathrm{Log}(HDI_t) = {} & \beta_0 + \beta_{1i}\Delta \mathrm{Log}(HDI_{t-1}) + \beta_{2i}\Delta \mathrm{Log}(FPD_{t-1}) + \beta_{3i}\Delta \mathrm{Log}(MTP_{t-1}) + \beta_{4i}\Delta \mathrm{Log}(AQP_{t-1}) \\ & + \beta_{5i}\Delta \mathrm{Log}(TUR_{t-1}) + \beta_{6i}\Delta \mathrm{Log}(REG_{t-1}) + \sum_{t=1}^{p} \delta_{1i}\Delta Log(RGDP_{t-1}) \\ & + \sum_{t=1}^{q} \delta_{2i}\Delta Log(FPD_{t-1}) + \sum_{t=1}^{p} \delta_{3i}\Delta Log(MTP_{t-1}) \\ & + \sum_{t=1}^{q} \delta_{4i}\Delta Log(AQP_{t-1}) \sum_{t=1}^{q} \delta_{5i}\Delta Log(TUR_{t-1}) + \sum_{t=1}^{P} \delta_{6i}\Delta Log(REG_{t-1}) + \delta ECMT_{t-1} \\ & + \varepsilon_{1i} \qquad (3.4)\end{aligned}$$

Where: HDI = Human Development Index; FPD = Fishery Production; MTP = Maritime Transport; AQP = Aquaculture Production; TUR = Maritime Tourism; REG = Renewable Energy; μ = Error term; $\beta0$ = Constant; $\beta1$-$\beta5$ = Estimated parameters.

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A Priori Expectation: The parameters of fishery production, maritime transport, aquaculture production, maritime tourism and renewable energy are expected to have positive signs, denoting a positive relationship with human development index: $\beta 1 > 0$; $\beta 2 > 0$; $\beta 3 > 0$; $\beta 4 > 0$; $\beta 5 > 0$.

Pre-Estimation Tests

Unit root test and cointegration test were conducted as pre-estimation tests in this study. The Augmented Dickey-Fuller (ADF) technique was adopted for the unit root test, while the ARDL bounds testing approach developed by Pesaran, Shin and Smith (2001) was used to test for cointegration among the variables.

Data Analysis Technique

The study utilized Autoregressive Distributed Lag (ARDL) approach as the data analysis technique for this study, given the mixed order of stationarity, that is, a combination of I(0) and I(1) series, revealed by the unit root test. The ARDL model captures both the short-run and long-run dynamics between blue economy and human development index, with the accompanying error correction mechanism revealing the speed of adjustment toward long-run equilibrium.

IV. DATA ANALYSIS AND DISCUSSION OF FINDINGS

Descriptive Statistics

The descriptive statistics for the study variables are summarized in Table 1:

Table 4.1: Descriptive Statistics

	HDI	FPD	MTP	AQP	TUR	REG
Mean	0.494088	447.6659	232.9800	146337.0	127.6229	6338.824
Median	0.479000	156.8150	158.2300	84832.50	92.65000	5995.000
Maximum	0.598000	2335.490	777.8400	358919.0	418.5500	8349.000
Minimum	0.445000	3.210000	10.67000	7347.000	4.840000	4387.000
Std. Dev.	0.040144	684.5399	226.5305	132715.6	112.9717	1066.157
Skewness	0.839750	1.899503	0.872218	0.334791	1.182141	0.452437
Kurtosis	2.756406	5.333629	2.688599	1.353991	3.455785	2.290589
Jarque-Bera	4.080087	28.16088	4.448371	4.473388	8.213218	1.872922
Probability	0.130023	0.000001	0.108155	0.106811	0.016464	0.392013
Observations	34	34	34	34	34	34

The mean human development index over the study period is 0.494, with a median of 0.479, showing moderate improvement in human development indicators across Nigeria, with a maximum of 0.598 and minimum of 0.445 indicating variations in health, education and living standards over the years. The standard deviation of 0.040 indicates relatively low variability, reflecting gradual improvements rather than abrupt changes, and the Jarque-Bera probability of 0.130 confirms that human development index does not significantly deviate from normality. Fishery production shows a mean of approximately 447.67 billion naira with a median of 156.82 billion naira, reflecting significant recent growth relative to earlier periods, though a Jarque-Bera probability of 0.000001 confirms significant deviation from normality. Maritime transport, aquaculture production, maritime tourism and renewable energy similarly show considerable variability and growth over the period, with aquaculture production and renewable energy exhibiting approximate normality (Jarque-Bera probabilities of 0.107 and 0.392 respectively), supporting their suitability for regression analysis.

Unit Root Test

The results of the Augmented Dickey-Fuller unit root test are presented in Table 4.2 below:

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Table 4.2: Augmented Dickey-Fuller Unit Root Test

Variables	ADF at Level	Critical Value @5%	ADF at 1st Diff.	Critical Value @5%	Order of Integration
LOG(HDI)	2.002290	-2.954021	-5.485369	-2.957110	I(1)
LOG(FPD)	-1.987925	-2.957110	-3.034010	-2.957110	I(1)
LOG(MTP)	-1.451376	-2.960411	-6.697430	-2.960411	I(1)
LOG(AQP)	-0.459882	-2.960411	-3.408152	-2.960411	I(1)
LOG(TUR)	-3.771096	-2.954021	-	-	I(0)
LOG(REG)	-2.959383	-2.954021	-6.704812	-2.957110	I(1)

The unit root test results show that maritime tourism (TUR) is stationary at level, integrated of order zero, I(0), while human development index (HDI), fishery production (FPD), maritime transport (MTP), aquaculture production (AQP) and renewable energy (REG) attained stationarity after first differencing, integrated of order one, I(1). This mixed order of integration justifies the use of the ARDL bounds testing approach in this study.

Multicollinearity Test

The multicollinearity test was carried out using correlation matrix and the results are presented in Table 4.3:

Table 4.3: Correlation Matrix

	LOG(HDI)	LOG(FPD)	LOG(MTP)	LOG(AQP)	LOG(TUR)	LOG(REG)
LOG(HDI)	1					
LOG(FPD)	0.433745	1				
LOG(MTP)	0.463583	0.564161	1			
LOG(AQP)	0.588275	0.201795	0.157820	1		
LOG(TUR)	0.386917	0.463175	0.080399	0.311357	1	
LOG(REG)	0.509985	0.567553	0.413810	0.456860	0.228068	1

The correlation test results show that fishery production, maritime transport, aquaculture production, maritime tourism and renewable energy all have weak positive relationships with human development index, and correlations among the independent variables themselves are all below the 0.80 multicollinearity threshold, indicating the absence of multicollinearity and giving confidence to proceed with the econometric analysis.

Bound Cointegration Test

The results of bounds cointegration test are presented in Table 4.4 below:

Table 4.4: Bounds Cointegration Test

Significance	I(0) Bound	I(1) Bound	F-Statistic
10%	2.08	3.00	
5%	2.39	3.38	5.388129
2.5%	2.70	3.73	
1%	3.06	4.15	

The ARDL bounds cointegration test shows that the F-statistic value of 5.388129 is greater than both the upper and lower bound critical values at the 5% level, leading to the rejection of the null hypothesis of no long-run relationship. This confirms the existence of a long-run relationship among human development index, fishery production, maritime transport, aquaculture production, maritime tourism and renewable energy, justifying estimation of the ARDL model.

Short-Run and Long-Run ARDL Estimation

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The short-run and long-run dynamic effects of blue economy on human development index in Nigeria are presented in Table 4.5:

Table 4.5: Short Run Autoregressive Distributive Lag (ARDL) HDI Model

Dependent Variable = LOG(HDI)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DLOG(HDI(-1))	0.750616	0.222830	3.368564	0.0151
DLOG(HDI(-2))	0.367232	0.204378	1.796827	0.1225
DLOG(HDI(-3))	-0.556574	0.205969	-2.702221	0.0355
DLOG(FPD)	0.210897	0.084493	2.496021	0.0468
DLOG(FPD(-1))	-0.127637	0.092562	-1.378940	0.2171
DLOG(FPD(-2))	-0.779535	0.148059	-5.265021	0.0019
DLOG(FPD(-3))	-0.678649	0.131726	-5.151988	0.0021
DLOG(MTP)	0.414322	0.096594	4.289338	0.0052
DLOG(MTP(-1))	-0.561870	0.111292	-5.048620	0.0023
DLOG(MTP(-2))	-0.033232	0.070051	-0.474394	0.6520
DLOG(MTP(-3))	-0.112855	0.070839	-1.593134	0.1622
DLOG(AQP)	0.126611	0.161788	0.782573	0.4636
DLOG(AQP(-1))	-0.177572	0.084640	-2.097968	0.0807
DLOG(AQP(-2))	-0.348311	0.176946	-1.968455	0.0966
DLOG(AQP(-3))	0.134913	0.074232	1.817465	0.1190
DLOG(TUR)	0.638361	0.113677	5.615579	0.0014
DLOG(TUR(-1))	0.890098	0.179743	4.952073	0.0026
DLOG(TUR(-2))	0.915121	0.184177	4.968700	0.0025
DLOG(REG)	2.113619	0.349851	6.041478	0.0009
DLOG(REG(-1))	0.582600	0.148612	3.920265	0.0078
DLOG(REG(-2))	-1.548897	0.285089	-5.433039	0.0016
DLOG(REG(-3))	-0.781801	0.209554	-3.730781	0.0097
CointEq(-1)*	-0.209081	0.048703	-4.292947	0.0002

Adjusted R-squared = 6.486293; Durbin-Watson stat = 2.349702

The short run ARDL result in Table 4.5 reveals that fishery production (FPD) has a positive coefficient value (0.210897) and probability value (0.0468) that is less than 5 percent level of significance. This indicates that fishery production (FPD) has positive and significant effect on human development index (HDI) in the short run. Hence, human development index (HDI) will increase by 0.210897 percent given a percentage increase in fishery production (FPD) and vice-versa. Also, maritime transport (MTP) has a positive coefficient value (0.414322) and probability value (0.0052) that is less than 5 percent level of significance. This indicates that maritime transport (MTP) has positive and significant effect on human development index (HDI) in the short run. Hence, human development index (HDI) will increase by 0.414322 percent given a percentage increase in maritime transport (MTP) and vice-versa. Additionally, aquaculture production (AQP) has a positive coefficient value (0.126611) and probability value (0.4636) that is greater than 5 percent level of significance. This indicates that aquaculture production (AQP) has positive and non-significant effect on human development index (HDI) in the short run. Hence, human development index (HDI) will increase by 0.126611 percent given a percentage increase in aquaculture production (AQP) and vice-versa.

Furthermore, maritime tourism (TUR) has a positive coefficient value (0.638361) and probability value (0.0014) that is less than 5 percent level of significance. This indicates that maritime tourism (TUR) has positive and significant effect on human development index (HDI) in the short run. Hence, human development index (HDI) will decrease by 0.638361 percent given a percentage increase in maritime tourism (TUR) and vice-versa.

Furthermore, renewable energy (REG) has a positive coefficient value (2.113619) and probability value (0.0009) that is less than 5 percent level of significance. This indicates that renewable energy (REG) has positive and significant effect on human development index (HDI) in the short run. Hence, human development index (HDI) will increase by 2.113619 percent given a percentage increase in renewable energy (REG) and vice-versa.

In furtherance, the short run ARDL result in Table 4.5 shows that the expected negative sign 0.209081) of CointEq(-1) is significant (0.0002). This confirms the existence of the long run relationship among the variables with their various significant lags. The coefficient of CointEq(-1) which is -0.209081 indicates low speed of adjustment while the deviation from human development index long-term is corrected by 21% by the following year.

Additionally, the adjusted R-squared (R2) value of 0.648629 indicates that 65 percent of the systematic variation in human development index is explained by fishery production (FPD), maritime transport (MTP), aquaculture production (AQP), maritime tourism (TUR) and renewable energy (REG) in the short-run while the remaining 35 percent are explained by other factors (variables) outside the model. Lastly, the Durbin Watson statistic of 2.349702 indicates that there is absence of serial correlation in the model.

Table 4.6: Long Run Autoregressive Distributive Lag (ARDL) HDI Model

Dependent Variable = LOG(HDI)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(FPD)	0.279741	0.108827	2.570508	0.0162
LOG(MTP)	0.940156	0.357548	2.629452	0.0198
LOG(AQP)	0.063500	0.103202	0.615301	0.5610
LOG(TUR)	1.837051	0.335188	5.480660	0.0001
LOG(REG)	1.076061	0.407888	2.638131	0.0386
C	2.912686	1.439474	2.023438	0.0895

The long run ARDL result reveals that fishery production (FPD) has a positive coefficient value (0.279741) and probability value (0.0162) that is less than 5 percent level of significance. This indicates that fishery production (FPD) has positive but significant effect on human development index (HDI) in the long run. Hence, human development index (HDI) will increase by 0.279741 percent given a percentage increase in fishery production (FPD) and vice-versa. In addition, the long run ARDL result reveals that maritime transport (MTP) has a positive coefficient value (0.940156) and probability value (0.0198) that is less than 5 percent level of significance. This indicates that maritime transport (MTP) exerts a significant and positive effect on human development index (HDI) in the long run. Hence, human development index (HDI) will increase by 0.940156 percent given a percentage increase in maritime transport (MTP) and vice-versa. Moreover, the long run ARDL result reveals that aquaculture production (AQP) has a positive coefficient value (0.063500) and probability value (0.5610) that is greater than 5 percent level of significance. This indicates that aquaculture production (AQP) has positive and non-significant effect on human development index (HDI) in the long run. Hence, human development index (HDI) will increase by 0.063500 percent given a percentage increase in aquaculture production (AQP).

Furthermore, the long run ARDL result reveals that maritime tourism (TUR) has a positive coefficient value (1.837051) and probability value (0.0001) that is less than 5 percent level of significance. This indicates that maritime tourism (TUR) has positive and significant effect on human development index

(HDI) in the long run. Hence, human development index (HDI) will decrease by 1.837051 percent given a percentage increase in maritime tourism (TUR) and vice-versa. Lastly, the long run ARDL result reveals that renewable energy (REG) has a positive coefficient value (1.076061) and probability value (0.0386) that is less than 5 percent level of significance. This indicates that renewable energy (REG) has positive and significant effect on human development index (HDI) in the long run. Hence, human development index (HDI) will increase by 1.076061 percent given a percentage increase in maritime tourism (TUR).

Post-Estimation Tests

The results of the Post-Estimation Tests are presented in Table 4.6:

Table 4.7: Post-Estimation Tests

Test	F-Statistic	P-value	Null Hypothesis	Decision
Jarque-Bera Normality Test	1.412340	0.493531	Normally distributed	Retain H0
Breusch-Godfrey Serial Correlation LM Test	1.700911	0.2920	No serial correlation	Retain H0
Heteroskedasticity Test	0.538717	0.8759	Homoscedasticity	Retain H0
Ramsey RESET Test	2.127241	0.2045	Correctly specified	Retain H0

The post-estimation tests confirm that the estimated HDI model is statistically sound. The Jarque-Bera test ($p = 0.493531$) confirms normally distributed residuals; the Breusch-Godfrey LM test ($p = 0.2920$) confirms the absence of serial correlation; the Breusch-Pagan-Godfrey test ($p = 0.8759$) confirms homoscedasticity; and the Ramsey RESET test ($p = 0.2045$) confirms that the model is correctly specified. The cumulative sum (CUSUM) stability test further shows that the CUSUM line remained within the 5 percent critical bound throughout the review period, confirming the stability of the long-run coefficients.

Discussion of Findings

The finding that fishery production has a positive and significant effect on human development index in Nigeria in both the short run and long run is consistent with the a priori expectation of this study and aligns with the Sustainable Development Theory's emphasis on integrating economic, social and environmental dimensions of development. This finding is supported by Miller and Robinson (2022), who found that fishery production positively and significantly impacts employment and life expectancy in coastal economies, and by Alwell and Oladosu (2024), whose finding that fisheries production significantly reduces poverty in Nigeria reinforces the welfare-enhancing channel through which fishery production supports human development.

The finding that maritime transport has a positive and significant effect on human development index is consistent with Naidoo and Andrews (2021) and Igbodo (2018), who found that maritime transport and port development are strongly associated with economic growth and, by extension, the resources needed to fund health and education. Theoretically, this aligns with the Natural Capital and Ecosystem Service Theory's emphasis on the economic value generated by well-managed marine and coastal infrastructure, provided that environmental externalities such as port pollution are appropriately managed.

Similarly, the finding that maritime tourism has a positive and significant effect on human development index resonates with Jansen and Liu (2015) and Santos and Almeida (2019), who found that maritime tourism significantly enhances sustainable development outcomes and GDP contributions in coastal and maritime economies. This is consistent with the Sustainable Development Theory's emphasis on social inclusion, since well-managed maritime tourism generates income and employment for coastal communities. The finding on renewable energy having a positive and significant effect on human development index is supported by Egre and Bjorneras (2020) and Brown and White (2020), both of whom found that renewable energy positively affects human development index in Nigeria, consistent with the Natural Capital and Ecosystem

Service Theory's framing of clean energy as a valuable ecosystem-linked service. Finally, the finding that aquaculture production has a positive but non-significant effect on human development index suggests that, unlike capture fisheries, Nigeria's aquaculture subsector remains underdeveloped and has yet to generate welfare effects large enough to register statistical significance, a concern echoed by GolLogisch and Weller (2021), who emphasised the need for scaled-up investment in blue economy subsectors that remain underutilised.

V. CONCLUSION AND RECOMMENDATIONS

Conclusion

This study empirically examined the effect of blue economy on human development index in Nigeria from 1990 to 2023. The findings revealed that fishery production, maritime transport, maritime tourism and renewable energy have positive and significant effects on human development index in both the short run and long run, while aquaculture production has a positive but non-significant effect. Premised on these findings, the study concludes that the blue economy holds substantial potential for promoting human development in Nigeria, although sustainable regulatory frameworks are necessary to sustain and deepen these welfare gains.

Recommendations

1. Government should scale up investment in sustainable fisheries development, including enforcing anti-illegal fishing regulations, promoting modern fishing technologies, improving cold-chain logistics, and supporting artisanal fishers with credit facilities, given the significant positive effect of fishery production on human development index.
2. Policymakers should prioritize modernization of port infrastructure, digitization of port operations, and expansion of inland waterways, alongside adoption of green shipping policies, to sustain the human-development-enhancing effect of maritime transport while managing associated environmental externalities.
3. Nigeria should invest in coastal infrastructure, security, and destination marketing to attract both domestic and international tourists, while enforcing eco-tourism standards and waste management regulations, so as to sustain the strong positive contribution of maritime tourism to human development.
4. Government should accelerate investment in offshore wind, tidal, and solar energy systems, particularly in coastal regions, through tax credits, feed-in tariffs, and concessional financing, to sustain the strong positive effect of renewable energy on human development index.
5. Given the non-significant effect of aquaculture production, government intervention is needed to unlock its full potential through targeted subsidies, affordable credit, improved hatchery systems, and training programmes for fish farmers, so that aquaculture can become a more significant contributor to human development in Nigeria.

REFERENCES

[1] Alwell, T., & Oladosu, M. (2024). Blue economy and poverty alleviation in Nigeria. Journal of Marine Economics and Policy, 9(1), 12-30.

[2] Amarh, K. (2017). The contributions of the blue economy to national development. Ghana Journal of Maritime Studies, 5(2), 40-58.

[3] Brown, T., & White, R. (2020). Renewable energy, real gross domestic product and human development index in Nigeria. Journal of Energy and Sustainable Development, 11(3), 66-84.

[4] Costanza, R. (2005). The value of ecosystem services. Ecological Economics Review, 12(4), 3-15.

[5] Cummings, L., & Miller, J. (2016). Marine protected areas and local economic development in the South Pacific. Pacific Economic Review, 21(3), 210-228.

[6] Dey, S., & Kabir, R. (2020). Blue economy and sustainable development in Bangladesh. Journal of South Asian Development, 15(2), 145-166.

[7] Egre, D., & Bjorneras, C. (2020). Marine renewable energy and human development in Nigeria. Journal of Renewable Energy Policy, 8(1), 22-38.

[8] GolLogisch, H., & Weller, S. (2021). Blue economy initiatives in Small Island Developing States. Island Economies Review, 6(2), 55-73.

[9] Hammoud, M., Munqith, A., & Omar, K. (2022). Blue economy and economic growth in Europe. European Journal of Maritime Economics, 14(1), 30-49.

[10] Humayun, T., Rezwana, N., & Mohammad, S. (2020). Prospects of a sea-based economy in Bangladesh. Journal of Blue Growth Studies, 4(3), 88-104.

[11] Igbodo, C. (2018). Performance of the maritime subsector and economic growth in Nigeria (1995-2015). Nigerian Journal of Maritime Economics, 3(2), 14-32.

[12] Jansen, P., & Bremer, S. (2018). Economic impacts of marine spatial planning in the European Union. Marine Policy Review, 10(1), 60-79.

[13] Jansen, P., & Liu, Y. (2015). Maritime tourism and sustainable development in coastal regions. Journal of Coastal Tourism Studies, 7(2), 45-63.

[14] Mensah, A., & Agyeman, B. (2019). Maritime entrepreneurship and economic growth in Ghana. Journal of African Maritime Business, 6(1), 20-41.

[15] Miller, J., & Robinson, C. (2022). Fishery production, employment and life expectancy in coastal economies. Journal of Fisheries Economics, 13(4), 102-120.

[16] Miller, J., & Yates, P. (2017). Blue economy strategies and economic development in Caribbean countries. Caribbean Economic Journal, 9(3), 75-93.

[17] Naidoo, R., & Andrews, K. (2021). Maritime transport and port development in South Africa. South African Journal of Maritime Economics, 8(2), 34-56.

[18] Okemwa, E. (2019). Harnessing the potential of the blue economy for sustainable development in Kenya. East African Journal of Marine Policy, 5(1), 11-27.

[19] Santos, M., & Almeida, F. (2019). The blue economy and economic growth in Portugal. Iberian Journal of Marine Economics, 7(2), 58-77.

[20] Yildiz, B. (2022). GDP, maritime exports, maritime imports and the construction sector in Turkey. Turkish Journal of Economics and Trade, 12(1), 15-33.