BLUE ECONOMY AND SUSTAINABLE DEVELOPMENT: EMPIRICAL EVIDENCE FROM NIGERIAN ENVIRONMENT

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Abstract

This study assessed how blue economy affected sustainable development in the Nigerian environment from 1981 to 2022. Due to the constraint of data availability, the study examined the effect of two blue economy variables; revenue from fishing as well as revenue from water transport, on sustainable development from two perspectives-economic and health (per capita income and life expectancy respectively).
The study used the fully modified ordinary least squares (FMOLS) regression technique to estimate the two models using data collected from the Central Bank of Nigeria's Statistical Bulletin.
In the first model, the study found that revenue from fishing had a significantly positive effect on per capita income proxied by GDPCI (coeff. = 5.733343, p = 0.0000<0.05) while revenue from water transport also affected per capita income positively but insignificantly (coeff. = 220.7889, p = (0.0941>0.05). In the second model, findings revealed that revenue from fishing had a positive and significant effect on life expectancy (coeff. = 0.001847, p = 0.0000<0.05) while the effect of revenue from water transport on life expectancy was positive but insignificant (coeff. = 0.205509, p = 0.6969>0.05).
Finally, the study found out that per capita income and fishing revenue had no significant causal relationship, while revenue from water transport had a significant unidirectional causality with per capita income. Furthermore, while fishing revenue had a bidirectional causality with life expectancy, revenue from water transport had a unidirectional causality with life expectancy.
The study thus recommended increased investment through specific policies and initiatives, necessary support for research and development in innovative fishing technologies by the government and enhanced infrastructure for improved water transport in Nigeria

Keywords: *Blue economy, sustainable development, FMOLS*

1. INTRODUCTION

Africa is the planet's second-largest continent, bordered by the Mediterranean Sea and the Red Sea to the north, the Atlantic Ocean to the west, and the Indian Ocean to the east, endowing it with an extensive coastline teeming with diverse coastal and marine ecosystems. These ecosystems serve as vital arteries for the coastal nations and communities across the continent, providing sustenance, livelihoods, and economic opportunities while also serving as barriers against the adverse effects of climate change, which disproportionately affect Africa's underprivileged and vulnerable populations (World Bank, 2022).

A perceived connection exists between the blue economy and sustainable development. Described by the World Bank as the "sustainable utilization of oceanic resources for economic progress, improved livelihoods, and job creation while safeguarding the health of marine ecosystems"

(Oyedele, 2023), The blue economy encompasses the essential aquatic expanses comprising approximately 70% of the Earth's surface, including oceans, seas, rivers, lakes, and streams (Allison et al., 2020). As emphasized by Sandifer and Sutton-Grier (2014), the ocean serves as a cornerstone of global prosperity, offering

sustenance, clean water, employment, fresh air, climate regulation, waste management, biodiversity conservation, and the preservation of coastal and marine ecosystems.

The European Union has taken the lead in implementing a blue growth strategy to promote the sustainable utilization of marine resources, while the African Union has introduced the Blue Economy Strategy, aiming for sustainable economic growth, food security, and job creation through responsible marine resource management (Bond, 2019; Henderson, 2019).

According to the World Bank (2022), the blue economy injected nearly US$300 billion into Africa's economy in 2018, generating a remarkable 49 million employment opportunities. These advantages, spanning crucial aspects such as food security, livelihoods, biodiversity conservation, and resilience to climate change, are heavily reliant on the health and productivity of coastal and marine ecosystems.

Furthermore, the Blue Economy offers a promising avenue for addressing some of humanity's most pressing challenges, including food security, climate change mitigation, biodiversity preservation, and sustainable energy generation (World Bank, 2017).

Nigeria, as Africa's largest economy, has experienced substantial economic growth in recent decades, mainly driven by its oil and gas sector (World Bank, 2020). However, the country's excessive dependence on oil revenues has exposed its economy to global price fluctuations and internal challenges such as corruption, infrastructure deficiencies, and socioeconomic inequalities (IMF, 2019). Alongside oil, Nigeria's economy is diversified, with sectors like agriculture, manufacturing, telecommunications, and services playing significant roles in driving growth and employment. Notably, the agricultural sector engages a considerable portion of the population and contributes significantly to GDP, making it a crucial engine for poverty reduction and food security. Nevertheless, the blue economy has yet to make substantial progress in promoting sustainable socio-economic development (World Bank, 2020)

This study examined the effect of blue economy on sustainable development from two angles: per capita income and life expectancy. It also assessed the causality between blue economy and sustainable development. Hence, the study answered three questions:

i. How does blue economy affect per capita income in Nigeria?
ii. What is the effect of blue economy on the life expectancy of Nigerian?
iii. Does blue economy have significant causal relationship with per capita income and life expectancy?

2. Literature Review

2.1 Blue Economy

The blue economy, often interchangeably referred to as the ocean or maritime economy, signifies the responsible utilization of oceanic resources to foster economic advancement, enhance livelihoods, and preserve oceanic health. Spanning various sectors such as fisheries, aquaculture, shipping, energy, tourism, and marine biotechnology, its potential to contribute to sustainable development and poverty alleviation has garnered significant attention from policymakers, academics, and stakeholders (Youssef, 2023; Smith-Godfrey, 2016). Nonetheless, the blue economy grapples with contemporary challenges that imperil its sustainability and the advantages it offers. Climate change, overfishing, pollution, and habitat destruction emerge as substantial threats to oceanic health and resources, with ramifications extending to the environment, economy, and society, including biodiversity loss, livelihood disruptions, and erosion of cultural heritage (Bari, 2017).

The concept of the Blue Economy has risen as a transformative framework within sustainable development discourse, presenting a comprehensive approach to harnessing oceanic resources to propel economic growth, social equity, and environmental resilience. Over recent years, the global community has increasingly recognized the vast potential of oceans, seas, and coastal regions as engines of prosperity and sustainability, culminating in the integration of the Blue Economy concept into policy agendas and development strategies worldwide (UNEP, 2012).

Central to the Blue Economy concept lies the acknowledgment of the interconnectedness between economic prosperity, social well-being, and environmental sustainability. Through the embrace of principles such as ecosystem-based management, integrated coastal zone management, and sustainable resource utilization, the Blue Economy charts a course towards achieving the triple bottom line of economic, social, and environmental benefits (OECD, 2016).

The Blue Economy stands as the linchpin of economic development and competitiveness for African coastal nations. Sectors pivotal in job creation, such as tourism, and essential for food production, such as fisheries, rely on pristine coastal environments. Future prospects in sustainable blue energy and ocean mining are pivotal for enhancing countries' competitiveness. Moreover, ecosystem services provided by mangroves and coastal habitats, upon which coastal populations rely, can be bolstered through innovative revenue-generating mechanisms such as blue carbon. However, the productivity of coastal marine ecosystems on the African continent faces threats from unsustainable infrastructure development, pollution, and inadequate natural habitat and resource management. Climate change-related events, including sea level rise and coastal flooding, exacerbate the region's vulnerability. The pressing challenge today revolves around how coastal countries can effectively manage their coastal landscapes to stimulate economic growth, reduce poverty, and adapt to the effects of climate change (World Bank, 2022).

Furthermore, Nigeria's oil industry, characterized by its extractive nature, has precipitated widespread environmental degradation, pollution, and social unrest in the Niger Delta region, underscoring the urgent need for diversification and sustainable management of the country's natural resources (Nwankwo, 2018)

2.2 Dimensions of Blue Economy

Youssef (2023) delineated six dimensions within the blue economy framework: economic, social, environmental, cultural, technological, and governance dimensions. Each dimension embodies principles and practices aimed at ensuring the sustainable utilization of oceanic resources for the benefit of both current and future generations (Lee et al., 2021; Sarwat, 2022).

The economic dimension of the blue economy is primarily concerned with fostering economic growth and development while upholding sustainability. It encompasses diverse activities such as fishing, aquaculture, marine biotechnology, tourism, shipping, and renewable energy. Principles within this dimension prioritize the creation of value from ocean resources, promotion of innovation, and cultivation of sustainable business models that uplift local communities (Lee et al., 2021).

The social dimension of the blue economy revolves around equitable distribution of benefits derived from oceanic resources among all stakeholders. Addressing various social issues including human rights, labor standards, gender equality, and community development, this dimension emphasizes building partnerships, engaging with local communities, and considering the social impacts of economic activities (Sarwat, 2022).

Concerned with safeguarding the health and integrity of ocean ecosystems, the environmental dimension of the blue economy tackles a range of issues such as biodiversity conservation, climate change mitigation and adaptation, pollution prevention, and ecosystem-based management. Its principles aim to ensure that economic endeavours do not compromise the ecological sustainability of ocean resources (Sarwat, 2022).

The technological dimension of the blue economy is dedicated to advancing and applying new technologies to support sustainable economic activities in the ocean. Encompassing areas such as marine robotics, sensors, artificial intelligence, renewable energy technologies, and biotechnology, this dimension promotes innovation, technology transfer, and responsible use of emerging technologies (Youssef, 2023).

The cultural dimension of the blue economy emphasizes the recognition and preservation of cultural heritage and traditional knowledge associated with ocean resources. It encompasses diverse artistic practices such as fishing, seafaring, storytelling, and cultural tourism. Guided by principles of respecting cultural diversity, acknowledging the cultural dimensions of ocean resources, and fostering cultural exchange and collaboration (Lee et al., 2021).

The governance dimension of the blue economy focuses on establishing effective governance mechanisms that facilitate the sustainable management of ocean resources. Encompassing issues such as institutional frameworks, policy coordination, and stakeholder engagement, this dimension advocates for transparent, participatory, and accountable governance mechanisms that promote the sustainable utilization of ocean resources (Lee et al., 2021).

2.3 Blue Economy and Sustainable Development

The Blue Economy concept is underpinned by principles of sustainability, equity, and inclusivity, which are pivotal for ensuring that economic development benefits both present and future generations while safeguarding the health of marine ecosystems (UNDP, 2020).

Numerous assessments and forward-looking projections highlight the significant potential of the blue economy (Wenhai et al., 2019). According to the OECD's 2016 report, the ocean economy contributed approximately USD 1.5 trillion to the global economy, constituting roughly 2.5% of the world's GDP. Projections suggest that by 2030, with the implementation of suitable policies and investments, this contribution could double. This report particularly emphasizes the promising prospects of emerging sectors like offshore wind energy, aquaculture, and marine biotechnology in stimulating economic growth and job creation (Youssef, 2023).

In a 2019 report by the World Wildlife Fund (WWF), it was estimated that by 2030, the blue economy could generate up to USD 3 trillion in value and provide employment opportunities for about 40 million people. This report underscores the importance of nurturing a sustainable blue economy that balances economic growth with environmental and social sustainability. It highlights the transformative potential of sustainable fishing practices, coastal tourism initiatives, and marine renewable energy projects in fostering economic advancement (Pendleton et al., 2020).

Similarly, a study commissioned by the European Commission in 2019 revealed that the blue economy contributed approximately EUR 750 billion to the EU economy in 2018, sustaining approximately 5.4

million jobs. The study projected that by 2030, with strategic policies and investments, the blue economy's contribution to the EU economy could reach an estimated EUR 1.3 trillion. These findings point to the critical role of effective governance and targeted investments in unlocking the full economic potential of the blue economy (Dalton et al., 2019).

Notwithstanding the potentials identified, empirical evidence on the relationship between blue economy and sustainable development from different eco-health perspectives in Nigeria remains scanty. Therefore, studying the impact of the blue economy on sustainable development in Nigeria is crucial for several reasons. For example, Nigeria's coastline and abundant marine resources hold immense potential for economic growth, including fisheries, tourism, shipping, and offshore oil and gas exploration. Understanding the interactions between economic activities and environmental sustainability is essential for formulating policies that promote responsible resource management, equitable distribution of benefits, and long-term viability. Through comprehensive research and analysis, Nigeria can harness the potential of its blue economy while safeguarding its natural heritage for future generations.

2.4 Some Relevant Theories

One specific theory that is highly relevant to the nexus between blue economy and sustainable development is the ecological-economic theory, particularly as it pertains to the concept of ecosystem services. This theory emphasizes the interconnectedness of ecological systems and economic activities, highlighting the dependence of economic prosperity on the health and functioning of natural ecosystems (Costanza, et al. 1997). This theory underlines the importance of maintaining the health and resilience of marine ecosystems and emphasizes that economic development should not come at the expense of ecosystem degradation, as healthy oceans provide a wide range of ecosystem services essential for human well-being, such as fisheries, coastal protection, carbon sequestration, and tourism. In essence, to facilitate sustainable development, there must be a due recognition of the value of ecosystem services provided by marine environments and incorporating this value into economic decision-making processes.
There are other theoretical foundations that are applicable to the research subject, including the theory of resilience which focuses on the ability of social-ecological systems to withstand and recover from disturbances, emphasizing the importance of building resilience in marine ecosystems and coastal communities to adapt to environmental changes and ensure sustainable development (Folke, 2006). There is also the political ecology theory which assesses the political and economic factors influencing environmental management and resource distribution. This theory helps to analyze the power dynamics, conflicts of interest, and social justice issues related to marine resource use and conservation (Peet & Watts, 1996). The socio-ecological systems theory is also applicable. This theory considers the complex interactions between social and ecological components of a system. It emphasizes the need to integrate social, economic, and environmental considerations in decision-making processes to achieve sustainability and resilience in marine ecosystems and coastal communities (Berkes & Folke, 1998).

2.5 Empirical Literature

Osuji and Agbakwuru (2024) conducted a comprehensive analysis of oceanic and coastal resources and their role in Nigeria's sustainable development. Their findings revealed that among the ten blue economic components studied, oil/gas exploration, maritime transport/shipping, and fisheries emerge as the dominant contributors, with oil/gas exploration alone accounting for a staggering 90% of the blue economic value in Nigeria. This underscores the necessity for concerted efforts from both the government and private sectors to capitalize on the abundant opportunities, particularly in non-oil/gas exploration sector, to foster sustainable economic growth and generate substantial employment opportunities for Nigeria's burgeoning population.

Alharthi and Hanif (2020) delved into the impact of various factors associated with the blue economy on the economic growth of the South Asian Association for Regional Cooperation (SAARC) countries. Their analysis, spanning from 1995 to 2018 across eight nations, highlighted fishing production metrics such as total aquaculture and fisheries production, along with agriculture, forestry, and fishing, as significant contributors. They also identified trade and inflation rates as control variables. Employing the feasible generalized least square technique, their findings underscored the statistically significant role of blue economy factors in driving economic growth across SAARC countries, aligning with the United Nations' Sustainable Development Goal 14 aimed at conserving and sustainably utilizing oceans, seas, and marine resources.

Mmom and Chukwu-Okeah (2011) focused on Nigeria's blue economy potential, particularly within the context of its oil and gas industry, while Ebeh (2017) explored the transformative possibilities of marine biotechnology in addressing societal challenges and fostering economic growth, encouraging trends such as increased interest in sustainable practices, technological innovation, renewable energy, circular economy concepts, sustainable tourism, and blue finance point towards a promising future for the blue economy (Marwan, 2023).

Akomolafe et al. (2022) identified resources, challenges, and efficient implementation strategies for the blue economy in Ondo state, highlighting its potential. Alubeze and Samuel (2018) emphasized the economic viability of Nigeria's maritime and shipping industry, while Jacob and Umoh (2022) proposed regional collaboration to transition the Niger Delta area from an oil-centric economy to one driven by the blue economy for sustained regional prosperity. Popoola and Olajuyigbe (2023) outlined challenges hindering the transition to a blue economy in the Gulf of Guinea, including poor institutional frameworks and climate change impacts.

Gbadegesin and Akintola (2021) argued that Nigeria's current legal framework could support profitable ocean-based businesses, urging diversification away from oil towards a sustainable economy to meet the Sustainable Development Goals. Similarly, Giwa (2018) advocated for public-private partnerships to be integrated into the blue economy through executive orders or policies.

These assessments and forecasts underscore the profound impact that a sustainably managed blue economy can have on the global economic landscape. However, it's vital to recognize that the significance of the blue economy goes beyond economic metrics, encompassing critical social and environmental dimensions such as enhancing food security, improved health situation, alleviating poverty, enhanced standard of living and preserving marine biodiversity.

Estimating the contributions of each blue economic component to Nigeria's sustainable development is important given its significance and relevance in the light of trends in global transportation of goods and services and surge in the exploration of marine resources. The primary objective of this study, therefore, is to examine the effect of blue economy resources on sustainable development in Nigeria from 1981 to 2022.

3. Methodology

The data used for this study were obtained from the World Bank Development Indicators (WDI) for the various years. The study covered 41 years (1981 – 2022) and used the historical data for gross domestic product per capita, life expectancy, annual fishing production and monetary value of water transport.

3.1 Research Model

The relationship between the blue economy and sustainable development is expressed in a functional equation as follows:

SSD = f(BLE) …………………………………………………………………(i)

SSD = GDPCI; LEXP…………………………………………………………(ii)

BLE = FISHI; WATR………………………………………………………… (iii)

Where:

SSD = Sustainable Development

BLE = Blue Economy

GDPCI = Per Capital Income

LEXP = Life Expectancy

FISHI = Revenue from fishing

WATR = Revenue from water transport

The models for this study are two, one for each of the objectives and they are expressed in econometric forms as follows:

$GDPCI = \beta_0 + \beta_1 FISHI + \beta_2 WATR + \mathcal{E}_{it}$ ………………………………………… (iv)

and,

$LEXP = \beta_0 + \beta_1 FISHI + \beta_2 WATR + \mathcal{E}_{it}$ ………………………………………… (v)

Where:

β = Intercept

$\beta_{1,} \beta_2$ = Regression coefficients

Ɛ = Stochastic error term

All our study variables were subjected to selected preliminary diagnostics and tests, including the descriptive statistics, correlations, stationarity and co-integration tests. While the Fully Modified Ordinary Least Squares (FMOLS) was used to address research questions 1 and 2, the Granger causality test was used to address the third objective - determine the existence and direction of causality between the variables.

4. Results and Discussion

4.1 Preliminary Diagnosis and Tests – Models 1 and 2

Selected preliminary diagnostics and tests are conducted on each of the research variables.

a). Descriptive Statistics

Table 1 contains the descriptive statistics for all the research variables.

Table 1: Descriptive Statistics

	GDPCI	LEXP	FISHI	WATR
Mean	1381.519	48.92600	184.8598	3.656047
Median	1222.629	46.83500	143.9100	3.370000
Maximum	3098.986	56.28100	386.2400	7.210000
Minimum	270.2240	45.63700	40.65000	0.950000
Std. Dev.	866.1513	3.539743	116.0324	1.084572
Skewness	0.292260	0.695844	0.574371	0.696256
Kurtosis	1.636155	1.913160	1.847931	4.521033
Jarque-Bera	3.944780	5.586446	4.742307	7.619300

Probability	0.139124	0.061224	0.093373	0.022156
Sum	59405.31	2103.818	7948.970	157.2100
Sum Sq. Dev.	31509158	526.2507	565467.6	49.40443
Observations	43	43	43	43

Source: Author (2024).

The means of GDPCI, LEXP, FISHI and WATR are 1381.519, 48.92600, 184.8598 and 3.656047 respectively. All the variables are positively skewed to the right of the mean although very close to it (0.292260, 0.695844, 0.574371 and 0.696256 for GDPCI, LEXP, FISHI and WATR respectively). Whereas the kurtosis of GDPCI, LEXP and FISHI show that they are platykurtic (below 3), that of WATR is leptokurtic (greater than 3). According to the Jarque-Bera Statistics, while GDPCI, LEXP and FISHI are normally distributed with probabilities 0.139124>0.05 (level of significance – LOS), 0.061224>0.05 LOS and 0.093373>0.05 LOS respectively. WATR is not normally distributed with probabilities value of 0.022156<0.05 LOS.

b). Correlations

Table 2 summarizes the degree of co-movement between the independent and dependent variables for the two research models.

Table 2. Pearson's Correlation Coefficients

Dependent Variable = GDPCI			
	GDPCI	FISHI	WATR
GDPCI	1		
FISHI	0.798679	1	
WATR	0.522276	0.447962	1
Dependent Variable = LEXP			
	LEXP	FISHI	WATR
LEXP	1		
FISHI	0.928144	1	
WATR	0.332302	0.447962	1

Source: Author (2024).

For model 1, while FISHI has a very high degree of positive co-movement with GDPCI (0.798679 or 80%), WATR has a high degree of positive co-movement with it (0.522276 or 52%). For model 2, while FISHI has a very high positive correlation with LEXP (0.928144 or 93%), the correlation between WATR and LEXP is fairly low (0.332302 or 33%).

c). Unit Root Test

In order to determine whether the variables are stationary and at what level, all the variables were tested for the presence (or otherwise) of unit root. The Augmented Dickey Fuller (ADF) technique was used for this purpose. Table 3 summarizes the results for the ADF stationarity tests.

Table 3: Stationarity Tests Results

Variable	Level		1st Difference		Order @ 5%
	ADF Stat	Prob	ADF Stat	Prob	
GDPCI	-1.210327	0.6609	-4.026079	0.0032	1(1)
FISHI	-1.850469	0.3517	-5.476077	0.0004	1(1)
WATR	-2.435565	0.1390	-4.253684	0.0016	1(1)
LEXP	-3.171434	0.0871	-4.402310	0.0015	1(1)

Source: Author (2024).

A variable is stationarity at a level when the probability of its ADF Stat is less than the 5% LOS. As shown in Table 3, all the variables are non-stationary at level (all greater than 0.05), but became stationary at first difference with probabilities 0.1132, 0.0004, 0.0016 and 0.0015 for GDPCI, FISHI, WATR and LEXP respectively. The stationarity of all these variables at first difference in addition to the existence of long-run relationship, also provides the basis for using the FMOLS technique to estimate the relationship between the dependent and explanatory variables.

d) Co-integration Test

The Johansen Trace and Max-Eigen tests of co-integration was used to ascertain whether there exists long-run relationship between the dependent and explanatory variables. The results for the two models are presented in Table 4.

Table 4: Co-integration Test Results

Model 1									
	Trace Statistics				Max-Eigen Statistic				
Hypothesized	Eigen value	Trace Stat	0.05 Critical value	Prob.	Eigen value	Max-Eigen Stat	0.05 Critical value	Prob.	Remarks
None *	0.638243	50.02918	29.79707	0.0001	0.638243	40.67125	21.13162	0.0000	Co-integration exists (1)
At most 1	0.173586	9.357928	15.49471	0.3333	0.173586	7.626353	14.26460	0.4180	
At most 2	0.042366	1.731575	3.841466	0.1882	0.042366	1.731575	3.841466	0.1882	
Model 2									
	Trace Statistics				Max-Eigen Statistic				
Hypothesized	Eigen value	Trace Stat	0.05 Critical value	Prob.	Eigen value	Max-Eigen Stat	0.05 Critical value	Prob.	Remarks
None *	0.698474	64.57966	29.79707	0.0000	0.698474	47.95598	21.13162	0.0000	Co-integration exists (2)
At most 1 *	0.308183	16.62368	15.49471	0.0337	0.308183	14.73735	14.26460	0.0421	
At most 2	0.046063	1.886325	3.841466	0.1696	0.046063	1.886325	3.841466	0.1696	

Source: *Author (2024).*

In model 1 test results, both the Trace and Max-Eigen statistics show that at least a co-integration equation exists between GDPCI and the explanatory variables (FISHI and WATR). However, results of model 2 show that both statistics reveal that at least two co-integration equations exist between them. Again, this confirmation of long-run relationship between theses variables further provides the basis for determining the effect as indicated in the models.

4.2 Objective 1: Effect of Blue Economy on Per-capita Income of Nigerians

Here, we examined the effect of FISHI and WATR on GDPCI with FMOLS. The FMOLS estimates for model 1 are presented in Table 5.

Table 5: FMOLS Results for Model 1

Method = FMOLS. Dependent Variable = GDPCI				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FISHI	5.733343	1.156797	4.956224	0.0000
WATR	220.7889	128.6804	1.715793	0.0941
C	-518.4975	414.7843	-1.250041	0.2187
R^2	0.677384			
Adjusted R^2	0.660839			

Source: *Author (2024).*

FISHI exerts a positive effect on GDPCI such that a unit increase in national fish production led to a rise of 5.733343 in GDPCI. The effect was significant given its probability (*p)* value of 0.0000<0.05 LOS. However, the effect of WATR on GDPCI, though positive, was insignificant during the period (p = 0.0941>0.05 LOS). FISHI and WATR explained about 0.677384 or 68% of the variations in GDPCI during the period.

4.3 Objective 2: Effect of Blue Economy on Life Expectancy of Nigerians

In this section, we assessed the effect of FISHI and WATR on LEXP with FMOLS (model 2). The estimates for model 2 are presented in Table 6.

Table 6: FMOLS Results for Model 2

Method = FMOLS. Dependent Variable = LEXP				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FISHI	0.030286	0.001847	16.39343	0.0000
WATR	-0.080638	0.205509	-0.392381	0.6969
C	43.55070	0.662431	65.74377	0.0000
R^2	0.858898			
Adjusted R^2	0.851662			

Source: *Author (2024).*

FISHI exerts a positive effect on LEXP such that a unit increase in national fish production led to a significant rise of 0.030286 in LEXP. The probability (*p)* value of 0.0000<0.05 LOS indicates that the effect is not only positive but also significant. However, the effect of WATR on LEXP, though negative,

was insignificant (*p* = 0.6969>0.05 LOS). In this model, FISHI and WATR explained about 0.0.858898 or 86% of the variations in LEXP.

Objective 3: Causality between Blue Economy and Sustainable Development
We employed the Granger causality modelling to investigate the presence and direction of causality between GDPCI and FISHI and WATR as well as between LEXP and FISHI and WATR. The results are presented in Table 7.

Table 7: Granger Causality Test Results

Dependent Variable = GDPCI			
Null Hypothesis:	Obs	F-Statistic	Prob.
FISHI does not Granger Cause GDPCI	41	1.79522	0.1806
GDPCI does not Granger Cause FISHI		1.16049	0.3248
WATR does not Granger Cause GDPCI	41	0.18913	0.8285
GDPCI does not Granger Cause WATR		4.11963	0.0245
Dependent Variable = LEXP			
FISHI does not Granger Cause LEXP	41	4.34176	0.0205
LEXP does not Granger Cause FISHI		27.2033	6.E-08
WATR does not Granger Cause LEXP	41	0.29571	0.7458
LEXP does not Granger Cause WATR		20.3334	1.E-06

Source: *Author (2024).*

As shown in table 7, although the FMOLS estimates indicated that FISHI has a significant positive effect on GDPCI, there exists no significant causal relationship between them (Prob of F-Stat = 0.1806>0.05 and 0.3248>0.05. However, it was found that WATR has a significant unidirectional causality that runs from it to GDPCI. This implies that even when the effect of the former on the latter is insignificant, previous changes in it still caused greater present changes in latter more than what the previous changes caused in itself presently. Therefore, the null hypothesis that no significant causal relationship exists between blue economy and sustainable development cannot be accepted and is therefore rejected.

For model 2, while FISHI has a bidirectional causality with LEXP, WATR only has a unidirectional causality with it as shown by the respective probabilities of their F-Statistics (<0.05). Again, these findings indicate that the null hypothesis of no significant causal relationship between blue economy and life expectancy cannot be accepted but must be rejected.

4.4 Discussion of Findings

Fishing has a positive and significant effect on economic sustainable development, measured by GDP per capita. This relationship is expected and can be attributed to several factors. Firstly, the blue economy, which encompasses activities such as fishing, aquaculture, and marine tourism, provides livelihood opportunities for millions of people worldwide. In coastal communities and developing countries, fishing serves as a primary source of income and sustenance for local populations (FAO, 2019). As these industries thrive, they contribute to economic growth by generating employment, income, and trade opportunities. Furthermore, the linkage of the blue economy with other sectors further enhances its contribution to sustainable development. For instance, fisheries supply chains create linkages with

processing, transportation, and retail industries, thereby stimulating economic activity along the entire value chain (World Bank, 2019). In addition, investments in infrastructure, technology, and innovation can enhance productivity and efficiency in fishing activities, leading to increased yields and profitability (UNCTAD, 2018). These advancements not only boost per capita income but also promote sustainability by reducing resource wastage and environmental impacts.

In the same vein, fishing has a significant and positive effect on life expectancy. Blue economy plays a crucial role in providing nutritious food, including fish, which contributes to improved public health and longevity. Fish is rich in essential nutrients such as omega-3 fatty acids, proteins, vitamins, and minerals, which are vital for maintaining overall health and well-being (FAO, 2019). Incorporating fish into diets has been linked to various health benefits, including reduced risk of cardiovascular diseases, improved cognitive function, and enhanced immune system function (Mozaffarian & Rimm, 2006).

Additionally, the livelihood opportunities provided by fishing communities contribute to socio-economic development, which in turn can positively impact life expectancy. For example, employment opportunities in the fishing industry enable individuals to access income, healthcare, education, and other essential services that are critical for improving living standards and health outcomes (UNEP, 2021). As socio-economic conditions improve, communities may experience better access to healthcare facilities, clean water, sanitation, and disease prevention programs, leading to increased life expectancy.

Unexpectedly, water transport did not have significant effect on sustainable development from the two perspectives examined. Water transport sector, while important for facilitating trade, commerce, and connectivity, may not directly translate into significant improvements in per capita income in all contexts. Unlike other sectors within the blue economy, such as fishing or marine tourism, the contribution of water transport to income generation and economic growth may vary depending on factors such as infrastructure development, market access, and regulatory frameworks (UNCTAD, 2019). In regions where water transport infrastructure is underdeveloped or inefficiently managed, the potential economic benefits may not be fully realized, leading to limited impacts on per capita income.

Furthermore, although water transport is essential for facilitating trade, commerce, and connectivity, its direct impact on public health and life expectancy may be limited. Unlike sectors such as healthcare or sanitation, which have a more direct influence on population health outcomes, the contribution of water transport to life expectancy may be indirect and less pronounced (World

Bank, 2020). Water transport primarily focuses on the movement of goods and people rather than directly addressing health determinants such as access to healthcare services, clean water, and sanitation infrastructure.

The significant causal relationship between blue economy and life expectancy is also reasonable, arising from the significant positive effect the former has on the latter. When ocean resources are well-exploited, the standard of living of the people is improved through increased income and nutrition which invariably prolong their life progressively.

5. Conclusion and Recommendations

Our study assessed the effect of blue economy on sustainable development from two perspectives in Nigeria: economic and health. While the economic perspective was captured by gross domestic product per capita, the health perspective was captured by the life expectancy of Nigerians during the study years. Aggregate revenues from fishing and water transport were used as the blue economic variables. The study found that fishing revenue positively and significantly affected both the per capita income and life expectancy. However, water transport did not have significant effect on sustainable development from the two perspectives. Finally, the study found that revenues from fishing and water transport have significant causal relationship with per capita income and life expectancy. While per capita income Granger caused water transport revenues, fishing and life expectancy had bidirectional causal relationship and life expectancy Granger caused water transport revenues.

Based on the findings of this study, we recommend that there should be increased investment in fishing by encouraging specific policies and initiatives that promote sustainable fishing practices, such as quotas, selective fishing gear, and marine protected areas. Secondly, since fishing revenues facilitates income and improves life expectancy, the government should give necessary support for research and development in innovative fishing technologies which can help sustainable fishing. Added to this is that there is need to provide enhanced infrastructure for improved water transport so it can contribute significantly to sustainable development.

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