Shipping Operations and Human Development in Nigeria: An ARDL Analysis of Container, Bulk Cargo, Tanker and Liquid Cargo Shipping (1990–2025)

Precious Osaruchi Okwu, Dr. Newman Enyioko, Dr. Ibekwe Wechie, Prof. Justin Gabriel

Maritime Science, Rivers State University, Port Harcourt, International, Nigeria

DOI: https://doi.org/10.51584/IJRIAS.2026.11110025

Received: 31 October 2026; Accepted: 05 November 2026; Published: 23 November 2026

ABSTRACT

Shipping operations constitute a critical component of international trade and economic transformation, particularly in developing economies where maritime transport serves as the primary medium for the movement of goods, services, and strategic commodities. Despite Nigeria's strategic maritime location and increasing shipping activities, evidence on the contribution of shipping operations to human development remains limited. This study investigates the relationship between shipping operations and human development in Nigeria over the period 1990-2025 using the Autoregressive Distributed Lag (ARDL) modelling approach. Specifically, the study examines the effects of Container Shipping Operations (CSO), Bulk Cargo Shipping Operations (BCSO), Tanker Shipping Operations (TSO), and Liquid Cargo Shipping Operations (LCSO) on Human Development Index (HDI), while Infrastructure Development (IND) is incorporated as a moderating variable to evaluate its enhancement effect on the shipping-human development nexus.

The study adopts annual time-series data sourced from the Nigerian Ports Authority (NPA), Nigerian Maritime Administration and Safety Agency (NIMASA), United Nations Conference on Trade and Development (UNCTAD), World Bank Development Indicators, and United Nations Development Programme (UNDP). Preliminary unit root tests reveal a mixed order of integration among the variables, justifying the application of the ARDL Bounds Testing framework. The bounds test confirms the existence of a stable long-run relationship among the variables, indicating that shipping operations and human development are cointegrated over the study period.

The empirical findings reveal that all categories of shipping operations exert positive and statistically significant long-run effects on human development. The estimated long-run coefficients indicate that container shipping operations ($\beta = 0.006996$, $p < 0.05$), bulk cargo shipping operations ($\beta = 0.055806$, $p < 0.01$), tanker shipping operations ($\beta = 0.005763$, $p < 0.01$), and liquid cargo shipping operations ($\beta = 0.031939$, $p < 0.01$) contribute significantly to improvements in human development outcomes. Among the shipping indicators, bulk cargo shipping operations emerge as the most influential determinant of human development, reflecting the strategic role of industrial raw materials, agricultural commodities, and construction inputs in driving socio-economic welfare. Short-run estimates further reveal that container shipping, bulk cargo shipping, and tanker shipping positively influence human development, while liquid cargo shipping exhibits a delayed developmental effect.

The moderation analysis demonstrates that infrastructure development significantly amplifies the positive effects of container shipping, bulk cargo shipping, and tanker shipping on human development. Specifically, the interaction between infrastructure and shipping activities enhances trade efficiency, logistics performance, employment opportunities, industrial productivity, and accessibility of social services. The findings suggest that investments in transport infrastructure, port modernization, cargo handling facilities, logistics corridors, and multimodal transport networks substantially strengthen the developmental benefits of maritime activities.

The study contributes to maritime economics and development literature by extending the discourse beyond traditional economic growth indicators to a multidimensional human development framework. Unlike previous studies that focus primarily on gross domestic product and trade performance, this research demonstrates how

shipping operations influence broader welfare indicators through income generation, employment creation, educational advancement, poverty reduction, and improvements in living standards. The study further provides one of the first comprehensive assessments of the moderating role of infrastructure in the relationship between disaggregated shipping operations and human development in Nigeria.

The study concludes that shipping operations represent a strategic instrument for achieving sustainable human development in Nigeria. Consequently, policy interventions aimed at expanding port capacity, improving maritime infrastructure, promoting digitalization of shipping services, strengthening logistics integration, and encouraging private sector participation in maritime investments are essential for maximizing the developmental impact of Nigeria's maritime sector. The findings offer important insights for policymakers, maritime regulators, development planners, and investors seeking to leverage shipping activities as a catalyst for inclusive growth and long-term human development.

Keywords: Shipping Operations, Human Development Index, Maritime Transport, Container Shipping, Bulk Cargo Shipping, Tanker Shipping, Infrastructure Development, ARDL Model, Sustainable Development, Nigeria.

1. INTRODUCTION

1.1 Background to the Study

The maritime transport sector constitutes one of the most strategic pillars of the global economy, serving as the principal mechanism through which international trade, investment, and economic integration are facilitated. Maritime transportation accounts for the movement of most of the global merchandise trade, making shipping indispensable to global supply chains, industrial production, and sustainable economic development. In an era characterized by globalization, technological advancement, and increasing interdependence among nations, shipping operations have evolved beyond their traditional transport function to become critical drivers of socio-economic transformation, employment generation, and human welfare.

For developing economies, maritime transport performs an even more critical role because it provides the essential link between domestic production systems and international markets. Countries with efficient shipping services and well-developed maritime infrastructure often experience increased trade competitiveness, greater inflows of foreign direct investment, improved industrial productivity, and enhanced economic opportunities. These outcomes contribute significantly to improvements in living standards, poverty reduction, healthcare access, educational attainment, and overall human development. Consequently, the maritime sector is increasingly recognized not merely as a facilitator of trade but as a catalyst for broader development outcomes.

Nigeria occupies a strategically advantageous position along the Gulf of Guinea and possesses over 850 kilometres of coastline, extensive inland waterways, numerous seaports, and abundant maritime resources. The country's maritime domain serves as a gateway to West and Central African markets and supports both domestic and international trade activities. Major ports such as Apapa, Tin Can Island, Onne, Warri, Calabar, and Port Harcourt handle large volumes of containerized cargo, dry bulk commodities, liquid bulk cargoes, petroleum products, and industrial equipment that are essential for economic growth and national development.

As Africa's most populous nation and one of the continent's largest economies, Nigeria depends heavily on maritime transportation for the movement of imports and exports that sustain industrial production and consumer demand. The country's maritime sector facilitates the importation of machinery, raw materials, pharmaceuticals, vehicles, construction materials, and manufactured products, while supporting the export of crude oil, natural gas, agricultural commodities, and other products. Given that crude oil exports account for a substantial proportion of Nigeria's foreign exchange earnings, tanker shipping operations remain particularly important to national economic performance and government revenue generation.

Shipping operations contribute to development through multiple transmission mechanisms. First, efficient maritime transport reduces transaction and logistics costs, thereby improving the competitiveness of domestic

industries and facilitating international trade. Second, shipping activities stimulate port operations, warehousing, freight forwarding, customs services, marine engineering, ship maintenance, logistics management, and other ancillary services that generate employment opportunities across numerous sectors of the economy. Third, increased shipping activities attract both public and private investments in transportation infrastructure, industrial development, and logistics facilities, which further support economic expansion. Fourth, maritime transportation enhances access to local and international markets, enabling businesses to expand production and consumers to access a wider variety of goods at competitive prices.

Beyond these direct economic benefits, shipping operations possess significant implications for human development. Human development, as conceptualized by the United Nations Development Programme (UNDP), extends beyond income growth to encompass improvements in health, education, welfare, capabilities, and quality of life. Economic activities stimulated by shipping generate employment opportunities, increase household incomes, enhance government revenues, and support investments in social infrastructure such as schools, hospitals, transportation networks, and public utilities. Consequently, an efficient maritime transport system can indirectly contribute to improvements in life expectancy, educational attainment, and income levels, which constitute the core dimensions of the Human Development Index (HDI).

The relationship between maritime transportation and human development has become increasingly important within the context of sustainable development. The United Nations Sustainable Development Goals (SDGs) emphasize the need for inclusive economic growth, decent work, poverty reduction, infrastructure development, and reduced inequalities. Shipping operations directly and indirectly contribute to the attainment of several SDGs by promoting trade, creating employment, facilitating industrialization, supporting food security, and enhancing access to essential goods and services. Thus, understanding how shipping activities influence human development represents an important area of inquiry for policymakers, development practitioners, and maritime stakeholders.

In Nigeria, recent policy efforts aimed at promoting the Blue Economy agenda have further highlighted the developmental importance of the maritime sector. The establishment of institutions and reforms targeted at enhancing port efficiency, maritime security, shipping connectivity, and infrastructure development reflects growing recognition of the sector's potential contribution to national development. Nevertheless, despite these initiatives and the increasing volume of shipping activities recorded over the years, substantial development challenges persist. Nigeria continues to face issues relating to poverty, unemployment, inadequate healthcare services, educational deficits, income inequality, and poor infrastructure, factors that have constrained improvements in human development outcomes.

While Nigeria has experienced growth in container handling, crude oil exports, bulk cargo movements, liquefied natural gas shipments, and maritime trade volumes over the past three decades, the extent to which these shipping activities have translated into tangible improvements in human welfare remains unclear. In many instances, increased economic activity does not automatically lead to broad-based development due to structural constraints, weak institutions, infrastructure deficiencies, and unequal distribution of economic gains. Consequently, the existence of shipping growth does not necessarily guarantee corresponding progress in human development indicators.

Furthermore, previous maritime studies have predominantly concentrated on the relationship between shipping activities and macroeconomic indicators such as gross domestic product, trade performance, export growth, port efficiency, and industrial output. Comparatively little attention has been devoted to examining how specific categories of shipping operations influence human development outcomes. Existing studies often aggregate maritime activities into a single variable, thereby overlooking the unique contributions of different shipping segments such as container shipping, bulk cargo shipping, tanker shipping, and liquid cargo shipping.

These shipping categories perform distinct economic functions and may exert varying degrees of influence on human development. Container shipping facilitates the movement of manufactured products and supports commerce and industrialization; bulk cargo shipping enhances agricultural and industrial production through the transportation of raw materials; tanker shipping generates critical export revenues through crude oil transportation; while liquid cargo shipping supports energy security and industrial activities through the

movement of liquefied natural gas and petroleum products. Understanding their individual effects on human development is therefore essential for effective policy formulation and resource allocation.

Additionally, infrastructure development remains a crucial factor influencing the effectiveness of shipping operations and their contribution to development outcomes. Efficient ports, modern terminals, accessible road and rail networks, cargo-handling facilities, logistics infrastructure, and digital maritime systems enhance operational efficiency and amplify the economic benefits derived from shipping activities. In contrast, poor infrastructure may reduce the developmental impact of maritime operations by increasing costs, creating bottlenecks, and limiting market access. As such, infrastructure development may moderate the relationship between shipping operations and human development.

Against this backdrop, there is a compelling need for a comprehensive empirical investigation of the relationship between shipping operations and human development in Nigeria. By examining the effects of container shipping operations, bulk cargo shipping operations, tanker shipping operations, and liquid cargo shipping operations on human development, while incorporating infrastructure development as a moderating variable, this study seeks to provide deeper insights into the developmental significance of the maritime sector. The findings are expected to contribute to the growing body of maritime economics literature and provide evidence-based recommendations for policymakers seeking to leverage shipping activities as a strategic instrument for sustainable human development in Nigeria.

Such an investigation is particularly timely given Nigeria's aspiration to diversify its economy, strengthen its Blue Economy framework, improve social welfare, and achieve sustainable development objectives. Understanding the pathways through which shipping operations influence human development will not only enrich maritime development discourse but also support the formulation of policies capable of transforming maritime activities into a more effective vehicle for inclusive growth and improved quality of life for Nigerians.

1.2 Statement of the Problem

The maritime sector has long been recognized as a critical driver of economic development, international trade, and industrial transformation. In Nigeria, maritime transportation serves as the primary gateway for international commerce, facilitating the movement of crude oil exports, manufactured goods, agricultural commodities, industrial raw materials, petroleum products, and consumer imports. Over the past three decades, the country has recorded considerable growth in shipping activities, reflected in increasing cargo throughput, container traffic, crude oil exports, liquefied natural gas shipments, port modernization initiatives, and maritime investments. These developments have strengthened Nigeria's participation in global trade and reinforced the strategic importance of shipping operations within the national economy.

Despite these advancements, Nigeria continues to face significant human development challenges. The country remains confronted with high levels of poverty, unemployment, income inequality, inadequate healthcare services, educational deficiencies, infrastructural deficits, and declining social welfare indicators. Although maritime activities have generated substantial revenues and contributed to economic growth, the expected improvements in the well-being of the population have not occurred commensurately. This apparent disconnect between the growth of shipping operations and the pace of human development raises critical questions about the developmental effectiveness of the maritime sector.

The paradox is particularly striking because the maritime industry is expected to generate numerous socio-economic benefits through trade expansion, employment creation, industrial stimulation, revenue generation, foreign exchange earnings, and infrastructure development. In theory, these benefits should translate into improved education, healthcare, income levels, and living standards. However, the persistence of socio-economic challenges suggests that the relationship between maritime activities and human development may be more complex than traditionally assumed. It is therefore necessary to determine whether the growth recorded in shipping operations has meaningfully contributed to improvements in human development outcomes in Nigeria.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

A review of existing literature reveals that most empirical studies on maritime transportation in Nigeria and other developing economies have largely concentrated on economic growth, trade facilitation, port efficiency, logistics performance, maritime security, shipping connectivity, and export competitiveness. While these studies provide important insights into the economic significance of shipping activities, they devote limited attention to the broader welfare implications of maritime transportation. Consequently, there remains insufficient empirical evidence on how shipping operations influence dimensions of development captured by the Human Development Index (HDI), including health, education, and income.

Furthermore, previous studies have generally treated maritime transportation as a single aggregate variable, overlooking the fact that shipping operations comprise distinct segments with different economic characteristics and developmental implications. Container shipping operations facilitate the movement of manufactured goods and consumer products, bulk cargo shipping operations support agricultural and industrial production, tanker shipping operations generate export earnings through crude oil transportation, while liquid cargo shipping operations promote energy security and industrial development. The developmental impacts of these shipping segments may differ considerably due to variations in their operational structures, value chains, employment generation capacities, and contributions to economic activities. However, empirical evidence comparing their individual effects on human development remains scarce, particularly within the Nigerian context.

Another significant gap in the literature relates to the role of infrastructure development. Maritime infrastructure such as ports, terminals, transport corridors, logistics facilities, warehousing systems, rail connectivity, and digital shipping platforms plays a crucial role in determining the efficiency and effectiveness of shipping operations. The developmental benefits derived from maritime activities are often influenced by the quality of supporting infrastructure. Weak infrastructure may constrain the positive effects of shipping operations, while modern and efficient infrastructure may amplify their contributions to economic and social development. Despite this reality, relatively few studies have investigated the moderating role of infrastructure development in the relationship between shipping operations and human development.

Additionally, Nigeria's current policy direction towards economic diversification and Blue Economy development has increased the urgency for evidence-based research capable of guiding maritime investment and policy decisions. As policymakers seek to maximize the developmental contributions of maritime activities, there is a growing need for empirical studies that move beyond conventional economic growth indicators and examine how shipping operations affect broader human welfare outcomes. Without such evidence, policy interventions may continue to focus primarily on increasing cargo volumes and trade flows without adequately addressing their implications for societal well-being and sustainable development.

Moreover, the dynamic nature of Nigeria's maritime sector over the period 1990 to 2025 presents an opportunity to investigate long-run relationships between shipping operations and human development. During this period, the country witnessed major transformations in port operations, containerization, crude oil exports, liquefied natural gas production, trade liberalization, infrastructural investments, and maritime reforms. Yet, there is a paucity of comprehensive studies that assess how these developments have collectively influenced human development over time.

The absence of robust empirical evidence on the shipping-human development nexus creates a significant knowledge gap within maritime economics and development literature. Without understanding the specific shipping activities that contribute most effectively to human welfare and the conditions under which these contributions are enhanced, policymakers and stakeholders may be unable to design interventions that maximize the developmental benefits of maritime transport.

It is against this background that this study becomes necessary. Specifically, the study seeks to examine the effects of Container Shipping Operations (CSO), Bulk Cargo Shipping Operations (BCSO), Tanker Shipping Operations (TSO), and Liquid Cargo Shipping Operations (LCSO) on Human Development Index (HDI) in Nigeria from 1990 to 2025. The study further investigates whether infrastructure development moderates the relationship between shipping operations and human development. By addressing these issues, the research fills important theoretical, empirical, and policy gaps in existing literature while providing evidence-based

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

recommendations for leveraging the maritime sector as a catalyst for sustainable human development in Nigeria.

1.3 Aim of the Study

The broad aim of this study is to investigate the impact of shipping operations on human development in Nigeria over the period 1990 to 2025. Specifically, the study seeks to examine how different dimensions of shipping operations contribute to improvements in human welfare, socio-economic development, and quality of life as measured by the Human Development Index (HDI). By analysing the roles of container shipping operations, bulk cargo shipping operations, tanker shipping operations, and liquid cargo shipping operations, the study aims to provide a comprehensive understanding of the contribution of maritime activities to human development outcomes in Nigeria.

The study is premised on the recognition that shipping operations constitute a critical component of the national economy and serve as an important channel for trade facilitation, employment creation, industrial growth, revenue generation, and investment promotion. While these economic benefits are widely acknowledged, there remains limited empirical evidence regarding the extent to which they translate into improvements in education, healthcare, income, and overall living standards. Consequently, this study seeks to bridge the gap between maritime economics and human development by evaluating whether growth in shipping activities has resulted in meaningful improvements in the well-being of the Nigerian population.

The study further aims to move beyond the traditional focus on economic growth by examining development from a human centred perspective. Rather than measuring the contribution of shipping operations solely in terms of output, trade volume, or gross domestic product, the study evaluates their influence on broader development outcomes that directly affect people's lives. This approach is consistent with contemporary development thinking, which emphasizes that economic progress should ultimately translate into enhanced human capabilities, expanded opportunities, and improved quality of life.

In addition, the study seeks to determine the relative contribution of different shipping segments to human development. Shipping operations are diverse in nature and perform different functions within the economy. Container shipping facilitates international trade and commercial activities, bulk cargo shipping supports industrial and agricultural production, tanker shipping drives crude oil exports and foreign exchange earnings, while liquid cargo shipping contributes to energy supply and industrial expansion. By disaggregating shipping operations into these major components, the study aims to identify which segments exert the greatest influence on human development and thereby provide more targeted policy recommendations for maritime sector development.

A further aim of the study is to investigate the moderating role of infrastructure development in the relationship between shipping operations and human development. The effectiveness of maritime transport depends largely on the availability and quality of supporting infrastructure such as ports, terminals, road networks, rail systems, logistics facilities, storage infrastructure, and communication technologies. Consequently, the study seeks to determine whether infrastructure development strengthens, weakens, or otherwise influences the impact of shipping activities on human development outcomes. This dimension of the study recognizes that shipping operations do not occur in isolation but operate within a broader infrastructure ecosystem that shapes their developmental effectiveness.

The study also aims to provide empirical evidence capable of informing policy decisions within Nigeria's maritime sector and the broader Blue Economy framework. As the Federal Government continues to pursue economic diversification and sustainable development, there is a growing need for policies that maximize the social and economic benefits of maritime activities. By identifying the channels through which shipping operations contribute to human development, the study aims to generate evidence-based recommendations that can enhance the developmental impact of investments in maritime transport and related infrastructure.

Furthermore, the study seeks to contribute to existing literature by extending the understanding of maritime transportation beyond conventional economic indicators to include human development outcomes. While

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

numerous studies have examined the relationship between shipping activities and economic growth, relatively few have investigated their effects on welfare indicators such as education, health, and income. This study therefore aims to enrich maritime economics, transport economics, and development studies literature by providing a more holistic assessment of the developmental implications of shipping operations.

Ultimately, the overarching aim of this research is to establish whether shipping operations can serve as a strategic instrument for achieving sustainable human development in Nigeria. Through a comprehensive analysis of the relationship between maritime activities, infrastructure development, and human welfare, the study seeks to demonstrate how an efficient and well-developed shipping sector can contribute not only to economic prosperity but also to the enhancement of human capabilities, social welfare, and national development. In doing so, the research provides a foundation for leveraging Nigeria's maritime resources as a catalyst for inclusive growth, poverty reduction, improved living standards, and long-term sustainable development.

1.4 Objectives of the Study

The broad objective of this study is to examine the impact of shipping operations on human development in Nigeria within the period 1990 to 2025. Specifically, the study seeks to investigate how various dimensions of maritime shipping activities contribute to the improvement of human welfare, living standards, income generation, educational advancement, and overall socio-economic well-being as captured by the Human Development Index (HDI).

To achieve this broad objective, the study is guided by the following specific objectives:

i. To examine the effect of Container Shipping Operations (CSO) on Human Development in Nigeria.

Container shipping has become the dominant mode of international trade due to its efficiency, reliability, and cost-effectiveness. Through the movement of manufactured goods, industrial equipment, consumer products, and commercial commodities, container shipping facilitates trade expansion, industrial growth, employment generation, and market integration. This objective seeks to determine the extent to which growth in container shipping activities contributes to improvements in human development outcomes such as income levels, educational opportunities, and quality of life in Nigeria.

Specifically, the objective aims to establish whether increases in container cargo throughput and related shipping activities translate into meaningful improvements in welfare indicators and contribute to overall human development.

ii. To evaluate the influence of Bulk Cargo Shipping Operations (BCSO) on Human Development in Nigeria.

Bulk cargo shipping plays a critical role in supporting key productive sectors of the economy through the transportation of agricultural products, minerals, fertilizers, cement, grain, iron ore, and other industrial raw materials. These commodities serve as essential inputs for manufacturing, construction, energy production, and agricultural development.

This objective seeks to evaluate the extent to which bulk cargo shipping operations stimulate economic activities that promote employment creation, productivity enhancement, industrial expansion, food security, and income generation. The objective further aims to determine whether improvements in bulk cargo transportation contribute significantly to enhancing human development outcomes in Nigeria.

iii. To assess the impact of Tanker Shipping Operations (TSO) on Human Development in Nigeria.

Tanker shipping operations constitute one of the most important segments of Nigeria's maritime industry due to the country's dependence on crude oil exports as a major source of foreign exchange earnings and government revenue. The petroleum sector continues to play a dominant role in national economic performance and public sector financing.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

This objective seeks to assess the contribution of tanker shipping activities to human development by examining how the transportation of crude oil and petroleum products influences government revenue, national income, employment opportunities, and public investment in social infrastructure. The objective is also intended to determine whether the benefits derived from oil-related maritime activities have translated into improvements in education, healthcare, income levels, and overall welfare.

iv. To determine the effect of Liquid Cargo Shipping Operations (LCSO) on Human Development in Nigeria.

Liquid cargo shipping encompasses the transportation of liquefied natural gas (LNG), refined petroleum products, petrochemicals, chemicals, and other liquid commodities that are essential to industrial and economic development. In recent years, the growing importance of Nigeria's natural gas sector has increased the strategic relevance of liquid cargo shipping within the national economy.

This objective seeks to determine the extent to which liquid cargo shipping operations influence human development through their contribution to energy security, industrialization, export diversification, employment generation, and economic growth. It further aims to ascertain whether increased liquid cargo transportation contributes significantly to improvements in human welfare and living standards.

v. To investigate the moderating role of Infrastructure Development (IND) on the relationship between Shipping Operations and Human Development in Nigeria.

Infrastructure serves as a critical enabling factor in maritime transportation and economic development. The effectiveness of shipping operations is heavily dependent on the availability and quality of supporting infrastructure such as ports, terminals, road networks, rail systems, logistics facilities, warehouses, information technology systems, and inland transport connectivity.

This objective seeks to investigate whether infrastructure development strengthens or moderates the relationship between shipping operations and human development. Specifically, it aims to determine whether investments in maritime and transport infrastructure enhance the developmental impact of container shipping, bulk cargo shipping, tanker shipping, and liquid cargo shipping.

The objective assumes that shipping activities are likely to contribute more effectively to human development when supported by efficient and modern infrastructure systems that reduce logistics costs, improve operational efficiency, facilitate trade, and expand economic opportunities.

Operational Objectives

In line with the overall purpose of the study, the operational objectives can be summarized as follows:

1. To ascertain the long-run and short-run effects of container shipping operations on Human Development Index (HDI) in Nigeria.

2. To determine the long-run and short-run effects of bulk cargo shipping operations on Human Development Index (HDI) in Nigeria.

3. To evaluate the long-run and short-run impacts of tanker shipping operations on Human Development Index (HDI) in Nigeria.

4. To examine the long-run and short-run effects of liquid cargo shipping operations on Human Development Index (HDI) in Nigeria.

5. To assess the extent to which infrastructure development moderates the relationship between shipping operations and human development in Nigeria.

6. To provide empirical evidence that can guide maritime policy formulation, infrastructure investments, and sustainable development planning within Nigeria's maritime and blue economy sectors.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

Collectively, these objectives are designed to provide a comprehensive understanding of how different categories of shipping operations contribute to human development and whether infrastructure development serves as a catalyst for maximizing the socio-economic benefits of maritime activities in Nigeria. The achievement of these objectives will offer valuable insights for policymakers, maritime regulators, development planners, investors, and stakeholders seeking to utilize the maritime sector as a strategic instrument for inclusive growth, poverty reduction, and sustainable human development.

1.5 Research Hypotheses

Research hypotheses provide the empirical framework for testing the relationships between the independent variables and the dependent variable in a study. They are formulated based on the study objectives and existing theoretical and empirical literature. In this study, the hypotheses are stated in their null forms and are subjected to statistical testing using the Autoregressive Distributed Lag (ARDL) estimation technique. The hypotheses are designed to determine whether the various dimensions of shipping operations exert significant effects on human development in Nigeria and whether infrastructure development enhances this relationship.

Given the strategic importance of maritime transportation to trade, industrialization, employment generation, revenue mobilization, and economic development, the study seeks to establish whether these benefits translate into measurable improvements in human welfare. Human development is represented by the Human Development Index (HDI), while shipping operations are disaggregated into container shipping operations, bulk cargo shipping operations, tanker shipping operations, and liquid cargo shipping operations. Infrastructure development is further incorporated as a moderating variable to assess its influence on the shipping-human development nexus.

The following hypotheses are therefore formulated:

H01: Container Shipping Operations and Human Development

Null Hypothesis (H01):

Container shipping operations have no significant effect on human development in Nigeria.

Alternative Hypothesis (H11):

Container shipping operations have a significant effect on human development in Nigeria.

This hypothesis seeks to determine whether increased container shipping activities contribute significantly to improvements in human development outcomes. Container shipping facilitates international trade, enhances market access, promotes industrial production, supports commercial activities, and generates employment opportunities. Consequently, growth in container shipping operations is expected to influence income generation, educational opportunities, and living standards. The hypothesis tests whether these expected benefits translate into statistically significant improvements in the Human Development Index.

H02: Bulk Cargo Shipping Operations and Human Development

Null Hypothesis (H02):

Bulk cargo shipping operations have no significant effect on human development in Nigeria.

Alternative Hypothesis (H12):

Bulk cargo shipping operations have a significant effect on human development in Nigeria.

This hypothesis examines whether the transportation of bulk commodities such as agricultural products, minerals, cement, fertilizers, grains, and industrial raw materials contributes significantly to human development. Bulk cargo shipping supports key sectors including agriculture, manufacturing, construction, and

energy production. Through its influence on productivity, food security, industrial output, and employment generation, bulk cargo shipping is expected to contribute positively to human welfare and socio-economic development.

H03: Tanker Shipping Operations and Human Development

Null Hypothesis (H03):

Tanker shipping operations have no significant effect on human development in Nigeria.

Alternative Hypothesis (H13):

Tanker shipping operations have a significant effect on human development in Nigeria.

This hypothesis assesses whether tanker shipping activities associated with the transportation of crude oil and petroleum products significantly influence human development. Given Nigeria's dependence on crude oil exports as a major source of foreign exchange earnings and public revenue, tanker operations are expected to contribute indirectly to human development by supporting government expenditure on education, healthcare, transportation, and social welfare programmes. The hypothesis therefore tests whether the benefits accruing from tanker shipping activities are reflected in improved human development indicators.

H04: Liquid Cargo Shipping Operations and Human Development

Null Hypothesis (H04):

Liquid cargo shipping operations have no significant effect on human development in Nigeria.

Alternative Hypothesis (H14):

Liquid cargo shipping operations have a significant effect on human development in Nigeria.

This hypothesis investigates whether liquid cargo shipping activities contribute meaningfully to human development. Liquid cargo shipping encompasses the transportation of liquefied natural gas (LNG), refined petroleum products, petrochemicals, chemicals, and other liquid commodities that support industrial production and energy supply. The hypothesis seeks to determine whether growth in this segment of maritime transportation significantly enhances economic opportunities, energy availability, industrial development, and welfare outcomes capable of improving human development.

H05: Infrastructure Development, Shipping Operations, and Human Development

Null Hypothesis (H05):

Infrastructure development does not significantly moderate the relationship between shipping operations and human development in Nigeria.

Alternative Hypothesis (H15):

Infrastructure development significantly moderates the relationship between shipping operations and human development in Nigeria.

This hypothesis evaluates the extent to which infrastructure development influences the effectiveness of shipping operations in promoting human development. Efficient maritime operations are highly dependent on supporting infrastructure such as ports, terminals, transportation corridors, rail networks, warehouses, cargo handling facilities, logistics centres, and information communication technologies.

The hypothesis is based on the premise that improved infrastructure enhances the efficiency, productivity, and competitiveness of shipping operations, thereby strengthening their contribution to socio-economic welfare and human development. Conversely, inadequate infrastructure may constrain the developmental benefits

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

derived from maritime activities. The purpose of this hypothesis is therefore to determine whether infrastructure serves as a significant catalyst in transforming maritime activities into human development gains.

Summary of Research Hypotheses

For ease of reference, the hypotheses are presented as follows:

H01: Container shipping operations have no significant effect on human development in Nigeria.

H02: Bulk cargo shipping operations have no significant effect on human development in Nigeria.

H03: Tanker shipping operations have no significant effect on human development in **Nigeria.**

H04: Liquid cargo shipping operations have no significant effect on human development in Nigeria.

H05: Infrastructure development does not significantly moderate the relationship between shipping operations and human development in Nigeria.

These hypotheses collectively provide the foundation for empirical investigation of the shipping-human development relationship and guide the statistical analysis undertaken in the study. Their testing will provide evidence on the extent to which maritime shipping activities contribute to sustainable human development in Nigeria and whether infrastructure development enhances such contributions.

Infrastructure development does not significantly moderate the relationship between shipping operations and human development in Nigeria.

In addition to the general hypotheses, this study formulates specific hypotheses relating to both the long-run and short-run relationships between shipping operations and human development in Nigeria. The hypotheses are stated in their null forms and are tested using the Autoregressive Distributed Lag (ARDL) model and Error Correction Mechanism (ECM).

Long-Run Hypotheses

The long-run hypotheses examine whether sustained changes in shipping operations produce permanent effects on human development in Nigeria over time.

H01

Container shipping operations have no significant long-run effect on human development in Nigeria.

H02

Bulk cargo shipping operations have no significant long-run effect on human development in Nigeria.

H03

Tanker shipping operations have no significant long-run effect on human development in Nigeria.

H04

Liquid cargo shipping operations have no significant long-run effect on human development in Nigeria.

H05

Infrastructure development does not significantly moderate the long-run relationship between shipping operations and human development in Nigeria.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

Short-Run Hypotheses

The short-run hypotheses examine whether temporary or immediate changes in shipping operations significantly influence human development within a shorter adjustment period.

H06

Container shipping operations have no significant short-run effect on human development in Nigeria.

H07

Bulk cargo shipping operations have no significant short-run effect on human development in Nigeria.

H08

Tanker shipping operations have no significant short-run effect on human development in Nigeria.

H09

Liquid cargo shipping operations have no significant short-run effect on human development in Nigeria.

H10

Infrastructure development does not significantly moderate the short-run relationship between shipping operations and human development in Nigeria.

Error Correction Hypothesis

Since the ARDL approach incorporates an Error Correction Mechanism (ECM), it is also advisable to formulate a hypothesis relating to the speed of adjustment toward long-run equilibrium.

H11

There is no significant long-run equilibrium relationship between shipping operations and human development in Nigeria.

Alternative Hypothesis (H11A):

There exists a significant long-run equilibrium relationship between shipping operations and human development in Nigeria.

Econometric Hypotheses Matrix

Hypothesis	Variable	Relationship Tested
H01	CSO → HDI	Long-run effect
H02	BCSO → HDI	Long-run effect
H03	TSO → HDI	Long-run effect
H04	LCSO → HDI	Long-run effect
H05	IND × Shipping → HDI	Long-run moderation
H06	ΔCSO → HDI	Short-run effect
H07	ΔBCSO → HDI	Short-run effect
H08	ΔTSO → HDI	Short-run effect
H09	ΔLCSO → HDI	Short-run effect

H10	ΔIND × Shipping → HDI	Short-run moderation
H11	ECM(-1)	Long-run equilibrium

Linking the Results

Based on ARDL findings:

- **H01, H02, H03 and H04** would be rejected because CSO, BCSO, TSO and LCSO were all significant in the long run.
- **H06, H07 and H08** would be rejected because CSO, BCSO and TSO were significant in the short run.
- **H09** would be accepted because LCSO was insignificant in the short run.
- **H05** would be partially rejected because infrastructure significantly moderated CSO, BCSO and TSO but not LCSO.
- **H11** would be rejected because the Bounds Test confirmed cointegration and the ECM term was significant.

2.0 LITERATURE REVIEW

2.1 Concept of Shipping Operations

Shipping operations refer to the organized movement of passengers, cargo, and commodities through maritime routes using vessels, ports, terminals, and supporting logistics infrastructure. They encompass all activities associated with the planning, coordination, management, operation, and control of maritime transportation systems. These activities include vessel scheduling, cargo handling, freight forwarding, port operations, terminal management, shipping logistics, customs procedures, maritime safety administration, and ancillary maritime services required for the efficient movement of goods and people across domestic and international waters.

In modern economic systems, shipping operations represent one of the most important components of global transportation networks. They facilitate the movement of raw materials from production centres to manufacturing hubs, transport finished products to consumer markets, and support the exchange of goods and services across national boundaries. Consequently, shipping serves as a critical link between production, distribution, and consumption within the global economy.

According to Stopford (2009), shipping operations constitute an integrated system involving vessels, ports, cargo owners, freight operators, logistics providers, regulatory institutions, and maritime infrastructure that collectively ensure the smooth flow of trade and commerce. The effectiveness of shipping operations is therefore determined not only by the availability of vessels but also by the efficiency of ports, cargo-handling facilities, logistics networks, navigational systems, and supporting transport infrastructure.

The maritime shipping industry has undergone significant transformation over the past few decades due to technological advancements, globalization, containerization, digitization, and increasing international trade. These developments have enhanced operational efficiency, reduced transportation costs, shortened transit times, and expanded trade opportunities across regions and continents. Consequently, shipping operations have become a major enabler of economic integration and sustainable development.

Shipping operations are generally categorized into several segments, each serving distinct economic functions and contributing differently to development outcomes.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

2.1.1 Container Shipping Operations

Container shipping operations involve the transportation of cargo using standardized containers that can be easily transferred between ships, trucks, and rail systems without unloading the contents. The introduction of containerization revolutionized international trade by significantly improving cargo handling efficiency, reducing transportation costs, minimizing cargo losses, and increasing operational speed.

Container shipping is primarily used for the transportation of manufactured goods, machinery, electronics, pharmaceuticals, consumer products, textiles, food products, and industrial equipment. It supports global supply chains by facilitating seamless intermodal transportation and enhancing trade connectivity between countries.

The growth of container shipping is often considered an indicator of economic modernization and trade expansion. Increased container traffic reflects rising commercial activities, growing industrial output, stronger international market integration, and enhanced logistics performance. Through these channels, container shipping contributes to employment creation, income generation, business expansion, and improved living standards.

In Nigeria, container shipping operations are concentrated mainly within ports such as Apapa, Tin Can Island, Onne, and Port Harcourt Ports. These ports serve as major gateways for imports and exports and play a significant role in supporting the country's manufacturing, trade, and commercial sectors.

2.1.2 Bulk Cargo Shipping Operations

Bulk cargo shipping operations involve the transportation of unpackaged commodities in large quantities. These commodities are generally loaded directly into the cargo holds of vessels and transported without the use of containers. Bulk cargo is typically classified into dry bulk and liquid bulk cargoes.

Dry bulk cargoes include:

- Cement
- Coal
- Iron ore
- Fertilizers
- Grains
- Agricultural produce
- Bauxite
- Limestone

Bulk cargo shipping plays a vital role in supporting industrial production, agriculture, infrastructure development, and manufacturing activities. The availability of efficient bulk transportation systems ensures the timely movement of essential raw materials required for production processes.

The economic significance of bulk cargo shipping lies in its ability to facilitate large-scale industrial activities at relatively low transportation costs. Industries such as construction, power generation, steel manufacturing, agriculture, and processing rely heavily on bulk transportation systems to maintain production efficiency. Consequently, improvements in bulk cargo shipping can stimulate industrial productivity, support employment growth, reduce production costs, and enhance economic welfare.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

Within the Nigerian economy, bulk cargo shipping is critical for supporting infrastructure development projects, agricultural supply chains, cement production, and industrial expansion. As such, its contribution extends beyond transportation to include broader socio-economic development outcomes.

2.1.3 Tanker Shipping Operations

Tanker shipping operations involve the transportation of crude oil, petroleum products, and other energy-related commodities through specialized vessels designed to carry liquid cargoes safely and efficiently. Tankers are among the most important classes of commercial vessels due to their strategic role in global energy trade.

For oil-producing countries such as Nigeria, tanker shipping operations are particularly significant because they facilitate the export of crude oil to international markets. Revenue generated from crude oil exports constitutes a major source of foreign exchange earnings and government income. Consequently, tanker operations directly influence macroeconomic stability, fiscal performance, investment capacity, and development financing.

Tanker shipping contributes to economic development through several mechanisms. These include increased export earnings, enhanced government revenue, employment generation, investment stimulation, and industrial development. The sector also supports various auxiliary services such as marine engineering, offshore logistics, ship maintenance, insurance, bunkering, and maritime consultancy.

Given Nigeria's position as a major oil-exporting nation, the efficiency of tanker shipping operations has far-reaching implications for national development. Improvements in tanker operations can strengthen export competitiveness, increase public revenue available for social investments, and create opportunities for human capital development.

2.1.4 Liquid Cargo Shipping Operations

Liquid cargo shipping operations involve the maritime transportation of liquefied natural gas (LNG), liquefied petroleum gas (LPG), refined petroleum products, chemicals, petrochemicals, and other specialized liquid commodities. This segment has gained increasing importance as countries pursue energy diversification, industrial expansion, and cleaner energy alternatives.

The emergence of LNG trade has transformed global energy markets and increased demand for specialized liquid cargo vessels. In Nigeria, the activities of the Nigeria LNG sector have contributed significantly to export diversification, foreign exchange generation, and industrial development.

Liquid cargo shipping supports human development through the provision of energy resources required for industrial production, transportation systems, power generation, and domestic consumption. Reliable energy supply enhances productivity, supports business growth, improves social services, and contributes to higher standards of living.

Furthermore, liquid cargo operations stimulate employment opportunities within maritime transport, logistics, petrochemicals, engineering services, and related industries. These contribute directly and indirectly to income generation and welfare improvement.

2.1.5 Components of Shipping Operations

Shipping operations consist of several interconnected components that collectively determine the efficiency and effectiveness of maritime transportation systems.

a. Port Operations

Port operations include vessel berthing, cargo handling, storage, customs clearance, loading and unloading activities, and terminal management. Efficient port operations reduce vessel turnaround time, minimize

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

congestion, and improve logistics performance.

b. Vessel Management

This involves the administration, maintenance, scheduling, crewing, and operation of vessels to ensure compliance with safety, environmental, and operational standards.

c. Maritime Logistics

Maritime logistics focuses on the planning, coordination, and management of cargo flows from origin to destination. Effective logistics systems enhance efficiency, reduce costs, and improve supply chain performance.

d. Freight Transportation

Freight transportation encompasses the movement of goods through maritime channels and the coordination of multimodal transport systems involving road, rail, and inland waterways.

e. Maritime Support Services

Support services include pilotage, towage, bunkering, dredging, marine insurance, ship repair, maritime security, port agency services, and offshore logistics operations.

2.1.6 Shipping Operations and Economic Development

Shipping operations contribute significantly to national economic development by promoting trade, facilitating industrialization, creating employment opportunities, and generating government revenue. Efficient maritime transportation lowers transaction costs, enhances export competitiveness, expands market access, and attracts foreign direct investment.

The maritime industry generates both direct and indirect economic benefits. Direct benefits arise from shipping services, port operations, maritime employment, and logistics activities. Indirect benefits emerge through linkages with manufacturing, agriculture, construction, energy, finance, insurance, and other sectors that depend on efficient maritime transportation.

For developing countries, shipping operations serve as a catalyst for economic growth by supporting international trade and enabling integration into global value chains. Increased shipping activities promote industrial expansion, encourage entrepreneurship, stimulate investment, and facilitate regional economic integration.

2.1.7 Shipping Operations and Human Development

Beyond economic growth, shipping operations possess significant implications for human development. The benefits generated through maritime activities contribute to higher incomes, improved employment opportunities, enhanced public revenues, and increased access to essential goods and services.

Shipping operations support human development through several channels:

- Creation of direct and indirect employment opportunities.
- Enhancement of household incomes and reduction of poverty.
- Generation of government revenue for education and healthcare investments.
- Facilitation of industrialization and economic diversification.
- Improvement of trade efficiency and market accessibility.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Promotion of infrastructure development and regional connectivity.

Through these mechanisms, shipping operations influence the three core dimensions of the Human Development Index (HDI): income, education, and health. A well-functioning shipping industry therefore serves not only as an economic growth engine but also as an important instrument for improving social welfare, enhancing quality of life, and promoting sustainable development.

In the context of Nigeria, understanding how different categories of shipping operations contribute to human development is particularly important given the country's strategic maritime position, dependence on international trade, and ongoing efforts to promote the Blue Economy as a pathway for inclusive and sustainable development. Consequently, this study conceptualizes shipping operations as a multidimensional maritime activity whose developmental impacts extend beyond trade facilitation to encompass broader improvements in human welfare and societal well-being.

2.2 Human Development

Human development is a multidimensional concept that focuses on enlarging people's choices, expanding their capabilities, and creating opportunities for individuals to live long, healthy, productive, and fulfilling lives. Unlike traditional development paradigms that measure progress primarily through economic growth or increases in Gross Domestic Product (GDP), the human development approach places people at the centre of the development process. It emphasizes that the ultimate objective of development is not merely the accumulation of wealth but the improvement of human well-being and the expansion of freedoms that enable individuals to realize their full potential.

The concept gained international prominence through the pioneering works of Mahbub ul Haq and Amartya Sen, who argued that development should be assessed based on people's capabilities and opportunities rather than solely on income levels. According to this perspective, economic growth is a means to an end rather than an end in itself. A society can experience substantial economic growth without achieving significant improvements in the quality of life of its citizens if the benefits of growth are not translated into better education, healthcare, employment opportunities, and social welfare.

Human development therefore encompasses the process of enhancing human capabilities, increasing choices, reducing deprivation, and creating an enabling environment in which individuals can lead productive and meaningful lives. It seeks to ensure that people have access to the resources, institutions, and opportunities necessary to achieve their aspirations and improve their welfare.

2.2.1 Evolution of the Human Development Concept

Before the introduction of the human development paradigm, national development was commonly measured using economic indicators such as Gross Domestic Product (GDP), Gross National Product (GNP), per capita income, and industrial output. While these indicators provide valuable information about economic performance, they often fail to capture important aspects of human welfare such as health status, literacy levels, quality of education, social inclusion, and access to basic services.

The limitations of purely economic measures of development became increasingly evident in many developing countries where periods of economic growth coexisted with widespread poverty, inequality, poor healthcare, and low educational attainment. As a result, development scholars advocated for broader measures that could better capture the welfare of citizens.

The publication of the first United Nations Development Programme (UNDP) Human Development Report in 1990 marked a major shift in development thinking. The report introduced the Human Development Index (HDI) as a composite measure designed to evaluate development from a people-centred perspective. Since then, human development has become one of the most widely accepted frameworks for assessing national progress and development performance.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

The human development approach recognizes that economic resources are important because they provide the means through which individuals can access education, healthcare, nutrition, housing, and other essentials. However, it also emphasizes that economic prosperity is meaningful only when it contributes to the expansion of human freedoms and improvements in people's quality of life.

2.2.2 Dimensions of Human Development

The Human Development Index (HDI) assesses development through three fundamental dimensions that represent essential aspects of human well-being.

a. Health Dimension

Health is a fundamental component of human development because it determines an individual's ability to participate effectively in social, economic, and political activities. A healthy population is generally more productive, innovative, and capable of contributing to national development.

The health dimension of HDI is measured using life expectancy at birth, which serves as an indicator of overall health outcomes and living conditions. Higher life expectancy reflects better healthcare systems, improved nutrition, enhanced sanitation, lower mortality rates, and greater access to medical services.

In the context of development, improvements in health contribute to:

- Higher labour productivity.
- Reduced disease burden.
- Increased economic participation.
- Lower healthcare costs.
- Enhanced quality of life.
- Greater social welfare.

Maritime activities can influence health outcomes through income generation, increased government revenue, improved access to medical supplies, and enhanced transportation networks that facilitate healthcare delivery.

b. Education Dimension

Education represents one of the most important indicators of human capability and socio-economic advancement. It equips individuals with the knowledge, skills, competencies, and opportunities necessary to improve their lives and contribute to societal development.

Within the HDI framework, education is measured through:

- Mean years of schooling.
- Expected years of schooling.

Education contributes to human development by:

- Enhancing employability.
- Increasing earning potential.
- Promoting innovation and entrepreneurship.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Reducing poverty.
- Improving decision-making abilities.
- Encouraging social mobility.

A well-educated population is better positioned to participate in productive economic activities and adapt to technological and structural changes within the economy.

Shipping operations can contribute to educational advancement by creating employment opportunities, generating tax revenues for educational investment, and stimulating economic activities that increase household incomes and educational expenditures.

c. Income Dimension

Income remains an essential element of human development because it enables individuals to satisfy their basic needs and improve their living standards. Income provides access to food, healthcare, education, housing, transportation, and other necessities required for a decent quality of life.

The income dimension of HDI is measured using Gross National Income (GNI) per capita adjusted for purchasing power parity.

Higher income levels generally contribute to:

- Improved living conditions.
- Increased consumption opportunities.
- Better access to social services.
- Enhanced financial security.
- Reduced poverty.

However, human development theory emphasizes that income should not be viewed as the ultimate objective of development but rather as a means of expanding people's choices and opportunities.

The maritime sector contributes significantly to income generation through trade facilitation, employment creation, business development, foreign exchange earnings, and investment promotion.

2.2.3 Human Development Index (HDI)

The Human Development Index (HDI) is a composite indicator developed by the United Nations Development Programme (UNDP) to measure and compare human development across countries. It provides a broader assessment of development than conventional economic indicators by incorporating social and economic dimensions of welfare.

The HDI combines indicators relating to:

1. Health (Life Expectancy at Birth)
2. Education (Mean Years of Schooling and Expected Years of Schooling)
3. Income (Gross National Income Per Capita)

The index ranges from 0 to 1, with higher values indicating higher levels of human development.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

Countries are generally classified into four categories:

HDI Range	Classification
0.800 and above	Very High Human Development
0.700 - 0.799	High Human Development
0.550 - 0.699	Medium Human Development
Below 0.550	Low Human Development

The HDI has gained widespread acceptance because it provides a more comprehensive assessment of development performance than measures that focus solely on economic growth.

2.2.4 Human Development and Sustainable Development

The concept of human development is closely linked to sustainable development because both emphasize improving present welfare without compromising future opportunities. Sustainable human development seeks to ensure that economic growth, social progress, and environmental sustainability are achieved simultaneously.

According to the United Nations Sustainable Development Goals (SDGs), development should promote:

- Poverty reduction.
- Decent work and economic growth.
- Quality education.
- Good health and well-being.
- Reduced inequalities.
- Sustainable infrastructure.
- Inclusive economic participation.

Human development therefore extends beyond short-term economic gains and seeks long-term improvements in people's capabilities and quality of life.

2.2.5 Determinants of Human Development

Several factors influence human development outcomes, including:

Economic Factors

- Employment opportunities.
- Income levels.
- Productivity growth.
- Investment activities.
- Trade performance.

Social Factors

- Access to quality education.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Healthcare services.
- Social protection programmes.
- Gender equality.
- Community development.

Institutional Factors

- Governance quality.
- Regulatory frameworks.
- Political stability.
- Public service delivery.

Infrastructure Factors

- Transportation systems.
- Communication networks.
- Energy supply.
- Port facilities.
- Water and sanitation infrastructure.

The interaction of these factors determines the extent to which economic activities translate into improvements in human welfare.

2.2.6 Shipping Operations and Human Development Nexus

The relationship between shipping operations and human development can be understood through several interconnected channels.

Trade Facilitation Channel

Efficient shipping operations reduce transportation costs, improve market access, and facilitate international trade. Increased trade stimulates production, investment, and economic activities that generate income and improve living standards.

Employment Generation Channel

Shipping activities create direct employment opportunities within:

- Ports.
- Shipping companies.
- Maritime logistics.
- Marine engineering.
- Customs operations.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Freight forwarding.

Indirectly, shipping supports employment in manufacturing, agriculture, construction, finance, insurance, and other sectors connected to maritime trade.

Government Revenue Channel

The maritime sector generates substantial revenue through:

- Port charges.
- Customs duties.
- Shipping fees.
- Taxes.
- Export earnings.

These revenues enable governments to invest in education, healthcare, social welfare, and infrastructure development, thereby improving human development outcomes.

Infrastructure Development Channel

Shipping activities often stimulate investments in ports, transportation corridors, logistics centres, and communication systems. Such investments enhance productivity, improve connectivity, and increase access to economic opportunities and social services.

Industrial Development Channel

Shipping facilitates the movement of raw materials and finished goods, supporting industrialization and economic diversification. Industrial growth creates jobs, raises incomes, and promotes technological development that contributes to human welfare.

2.2.7 Human Development in Nigeria

Nigeria has recorded gradual improvements in human development over the past decades; however, progress has remained constrained by poverty, unemployment, income inequality, inadequate infrastructure, weak healthcare systems, and educational challenges. Despite being one of Africa's largest economies and a major maritime nation, significant portions of the population continue to experience limited access to opportunities and essential services.

At the same time, Nigeria's maritime sector has expanded considerably through increased container traffic, crude oil exports, LNG shipments, and international trade activities. This raises an important policy question regarding whether growth in shipping operations has translated into measurable improvements in human development outcomes.

Understanding this relationship is particularly important within the context of Nigeria's Blue Economy agenda, economic diversification strategy, and sustainable development objectives. Investigating the contribution of shipping operations to human development provides valuable insights into how maritime resources can be utilized not only as drivers of economic growth but also as instruments for improving welfare, reducing poverty, expanding opportunities, and enhancing the quality of life of the Nigerian population.

Conceptual Link to the Study

This study conceptualizes human development as the ultimate developmental outcome that reflects

improvements in health, education, and income. Shipping operations are viewed as important economic activities capable of influencing these dimensions through trade facilitation, employment creation, revenue generation, industrial expansion, and infrastructure development. Consequently, the Human Development Index (HDI) serves as an appropriate measure for evaluating how shipping operations contribute to broader socio-economic progress in Nigeria between 1990 and 2025.

2.3 Container Shipping Operations and Human Development

Container shipping operations represent one of the most significant innovations in the history of global transportation and international trade. The introduction of containerization in the mid-twentieth century revolutionized the movement of goods across international markets by providing a standardized, efficient, secure, and cost-effective system for cargo transportation. Container shipping involves the movement of goods in standardized steel containers that can be seamlessly transferred between ships, trucks, and rail transport systems without the need to unload and reload individual cargo items. This innovation has significantly enhanced trade efficiency, reduced transportation costs, accelerated cargo handling processes, and expanded global economic integration.

In contemporary international commerce, container shipping accounts for a substantial proportion of global maritime trade and serves as the primary mode of transportation for manufactured goods, machinery, electronics, pharmaceuticals, consumer products, industrial equipment, and processed agricultural products. The rapid growth of container shipping worldwide has transformed production systems, supply chains, and trade patterns by linking producers and consumers across different countries and regions. Consequently, container shipping has become an important driver of economic development and human welfare**.**

2.3.1 Concept of Container Shipping Operations

Container shipping operations encompass all activities associated with the movement, handling, storage, and management of containerized cargo within the maritime transport system. These activities include:

- Container loading and unloading.
- Port and terminal operations.
- Container storage and warehousing.
- Freight forwarding.
- Customs processing and clearance.
- Intermodal transportation.
- Logistics management.
- Shipping line operations.

The efficiency of container shipping operations depends on the availability of modern port facilities, advanced cargo-handling equipment, digital logistics systems, transportation infrastructure, and effective regulatory frameworks. Efficient container shipping systems enhance the speed and reliability of cargo delivery, reduce trade-related costs, and improve connectivity between domestic and international markets.

For developing economies such as Nigeria, container shipping serves as a critical gateway through which imports and exports enter and leave the national economy. The growth of container traffic often reflects increasing economic activities, industrial development, expanding consumer markets, and rising international trade participation.

2.3.2 Theoretical Link Between Container Shipping and Human Development

The relationship between container shipping operations and human development can be explained through several development theories, particularly Human Capital Theory and Transport-Led Development Theory.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

Human Capital Theory suggests that increased economic activities generate resources that can be invested in education, healthcare, and social welfare, thereby improving human capabilities and living standards. Container shipping facilitates these economic activities by promoting trade, investment, industrial production, and employment generation.

Similarly, Transport-Led Development Theory argues that efficient transportation systems reduce transaction costs, improve market accessibility, enhance productivity, and stimulate economic growth. These outcomes ultimately contribute to improvements in human development indicators such as income, education, and health.

Through these theoretical channels, container shipping operations become an important mechanism for transforming economic opportunities into measurable improvements in human welfare.

2.3.3 Channels Through Which Container Shipping Influences Human Development

Trade Facilitation and Market Integration

Container shipping significantly enhances international trade by providing a reliable and efficient means of transporting goods across long distances. Reduced transportation costs and improved logistics performance enable businesses to access larger markets and participate more effectively in global trade.

Increased trade opportunities stimulate economic activities, encourage entrepreneurship, expand business operations, and create wealth. The resulting increase in economic output contributes to higher income levels and improved living standards.

Furthermore, enhanced trade integration increases consumer access to imported goods, educational materials, medicines, technology products, and industrial inputs that improve welfare and productivity.

Industrialization and Economic Diversification

Container shipping plays a crucial role in supporting industrialization by facilitating the importation of raw materials, machinery, production equipment, and intermediate goods required for manufacturing activities.

Efficient container transport systems reduce supply chain disruptions and lower production costs, thereby increasing industrial competitiveness. As industrial output expands, businesses create additional employment opportunities and contribute to economic diversification.

Nigeria's efforts to diversify its economy beyond crude oil exports require efficient container shipping systems capable of supporting manufacturing, agro processing, and export-oriented industries. Consequently, improvements in container shipping can promote broader socio-economic development.

Employment Creation

The growth of container shipping operations generates both direct and indirect employment opportunities throughout the economy.

Direct employment opportunities arise in:

- Port operations.
- Container terminal management.
- Shipping companies.
- Customs administration.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Maritime logistics.
- Cargo handling services.
- Freight forwarding.

Indirect employment opportunities emerge in:

- Manufacturing.
- Warehousing.
- Transportation.
- Distribution.
- Financial services.
- Insurance.
- Information technology.

The expansion of employment opportunities increases household incomes, reduces poverty, and improves standards of living, thereby contributing positively to human development.

Technology Transfer and Knowledge Development

Container shipping facilitates the transfer of technology and knowledge between nations through increased international trade and business interactions. Imported machinery, production technologies, and industrial equipment contribute to improvements in productivity and innovation.

Furthermore, multinational logistics companies and shipping operators often introduce modern management practices, digital systems, and technical expertise that improve operational efficiency within domestic industries.

The diffusion of technology and knowledge enhances human capital development by creating new learning opportunities, improving workforce skills, and increasing productivity.

Government Revenue Generation

Containerized trade contributes to government revenue through customs duties, port charges, value-added taxes, corporate taxes, and shipping levies.

These revenues provide governments with financial resources needed to invest in:

- Education.
- Healthcare.
- Transportation infrastructure.
- Social welfare programmes.
- Skills development initiatives.

Such investments directly contribute to improvements in human development outcomes.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

2.3.4 Container Port Development and Human Development

The developmental benefits of container shipping are closely linked to the performance and efficiency of container ports. Modern container ports serve as economic hubs that attract investments, facilitate trade, create employment, and stimulate regional development.

Efficient container terminals contribute to:

- Faster cargo clearance.
- Reduced vessel turnaround times.
- Lower trade costs.
- Increased cargo throughput.
- Enhanced supply chain performance.

As a result, countries with well-developed container ports generally experience greater economic competitiveness and stronger development outcomes.

In Nigeria, ports such as Apapa, Tin Can Island, Onne, and Port Harcourt play critical roles in handling containerized cargo and supporting economic activities across the country. Improvements in port infrastructure and operational efficiency can therefore have significant implications for human development.

2.3.5 Empirical Evidence on Container Shipping and Human Development

Empirical studies generally support the existence of a positive relationship between container shipping and development outcomes. Research indicates that increased container throughput contributes to economic growth, employment generation, trade expansion, and industrial productivity.

Studies on transport and development suggest that countries with higher levels of container traffic often experience:

- Greater trade competitiveness.
- Higher investment inflows.
- Improved industrial performance.
- Better logistics efficiency.
- Increased income generation.

These outcomes are closely associated with improvements in health, education, and living standards, which are key dimensions of human development.

Although many studies have focused primarily on economic growth effects, the underlying mechanisms indicate that container shipping contributes to human development indirectly through its influence on employment, income generation, public revenue, and industrial expansion.

2.3.6 Container Shipping Operations in Nigeria

Nigeria's container shipping industry has expanded significantly over the past three decades due to increased import demand, trade liberalization, port reforms, and infrastructure investments. Containerized cargo now represents one of the largest segments of maritime trade within the country.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

The growth of container operations has supported:

- Industrial activities.
- Commercial trade.
- Supply chain integration.
- Consumer market expansion.
- Investment inflows.

However, challenges such as port congestion, infrastructure deficiencies, customs delays, inadequate rail connectivity, and high logistics costs continue to limit the full developmental benefits of container shipping.

Addressing these challenges would enhance the contribution of container shipping operations to human development by improving efficiency, reducing costs, increasing productivity, and expanding economic opportunities.

2.3.7 Conceptual Relationship Between Container Shipping Operations and Human Development

The conceptual framework of this study assumes that container shipping operations influence human development through multiple interconnected pathways. Increased container throughput promotes trade facilitation, industrial growth, employment generation, technology transfer, and government revenue mobilization. These outcomes contribute to higher income levels, improved educational opportunities, better healthcare financing, and enhanced living standards.

The relationship can be summarized as follows:

Container Shipping Operations → Trade Expansion → Industrial Growth → Employment Creation → Income Enhancement → Improved Education and Healthcare → Human Development

Thus, container shipping operations are conceptualized not merely as a transportation activity but as a strategic development mechanism capable of enhancing the welfare, capabilities, and quality of life of the population. Within the context of this study, container shipping is expected to exert a positive and significant influence on Nigeria's Human Development Index (HDI), both directly and through its interactions with supporting infrastructure and broader economic activities.

2.4 Bulk Cargo Shipping and Human Development

Bulk cargo shipping represents one of the most important segments of the global maritime transport system and plays a critical role in facilitating economic production, industrial development, food security, and infrastructure expansion. Unlike container shipping, which focuses primarily on manufactured and packaged goods, bulk cargo shipping involves the transportation of large quantities of unpackaged commodities that are loaded directly into a vessel's cargo holds. These commodities constitute essential inputs for industrial production, agricultural development, energy generation, and construction activities, making bulk shipping a fundamental component of national and international economic systems.

Bulk cargo shipping is generally classified into two major categories: dry bulk cargo and liquid bulk cargo. Dry bulk cargoes include commodities such as cement, grains, coal, iron ore, limestone, fertilizer, steel products, bauxite, clinker, gypsum, and agricultural produce, while liquid bulk cargoes consist of petroleum, chemicals, liquefied natural gas, and other fluid commodities. However, within the context of this study, bulk cargo shipping primarily refers to the maritime transportation of dry bulk commodities that serve as critical raw materials and production inputs across various sectors of the economy.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

The significance of bulk cargo shipping stems from its ability to facilitate the movement of large volumes of strategic commodities at relatively low transportation costs. Through economies of scale, bulk carriers can transport vast quantities of raw materials more efficiently than other transportation modes, thereby supporting industrial productivity, agricultural development, trade expansion, and economic growth. Consequently, efficient bulk cargo transportation contributes directly and indirectly to improvements in human welfare and development.

2.4.1 Concept of Bulk Cargo Shipping Operations

Bulk cargo shipping operations encompass all maritime activities associated with the transportation, loading, unloading, storage, handling, and distribution of bulk commodities. These operations involve specialized vessels known as bulk carriers, dedicated cargo terminals, storage facilities, handling equipment, logistics systems, and transportation networks that collectively facilitate the movement of commodities between production and consumption points.

Bulk shipping operations typically involve:

- Cargo aggregation and storage.
- Vessel loading and unloading.
- Port and terminal management.
- Freight and chartering services.
- Maritime logistics coordination.
- Customs and regulatory compliance.
- Inland transportation integration.
- Supply chain management.

The efficiency of these operations significantly influences production costs, supply chain performance, market accessibility, and economic competitiveness. Inefficient bulk shipping systems often result in cargo delays, increased logistics costs, supply shortages, and reduced industrial productivity.

2.4.2 Theoretical Relationship Between Bulk Cargo Shipping and Human Development

The relationship between bulk cargo shipping and human development can be explained through Human Capital Theory, Growth Pole Theory, and Transport-Led Development Theory.

Human Capital Theory posits that economic activities generate resources that can be invested in education, health, and welfare improvements. Bulk cargo transportation enhances economic productivity and income generation, thereby increasing the capacity of governments and households to invest in human development.

Growth Pole Theory argues that strategic sectors of the economy stimulate development through backward and forward linkages. Bulk cargo shipping serves as a catalyst for growth by supporting industries such as agriculture, mining, manufacturing, construction, and energy production. The expansion of these sectors generates employment opportunities, stimulates investment, and contributes to social welfare improvement.

Similarly, Transport-Led Development Theory suggests that efficient transportation systems lower production and transaction costs, increase productivity, expand market access, and foster economic development. Bulk cargo shipping therefore serves as an important vehicle through which economic gains are translated into human development outcomes.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

2.4.3 Channels Through Which Bulk Cargo Shipping Influences Human Development

Industrial Production and Manufacturing Development

One of the most important contributions of bulk cargo shipping is its support for industrial and manufacturing activities. Industries require continuous access to raw materials such as iron ore, coal, limestone, bauxite, gypsum, and other inputs that are often transported through bulk shipping systems.

Efficient movement of these materials ensures uninterrupted production processes and enhances industrial productivity. As industries expand, employment opportunities increase, household incomes rise, and economic activities multiply across supply chains. These developments contribute significantly to improved living standards and human welfare.

Furthermore, increased industrial output generates government revenue through taxes and duties, which can be invested in health, education, and social infrastructure.

Agricultural Development and Food Security

Agriculture remains a major contributor to livelihoods, employment, and poverty reduction in developing economies. Bulk cargo shipping facilitates the movement of agricultural commodities, grains, fertilizers, and farming inputs necessary for increased agricultural productivity.

The transportation of fertilizers and agricultural raw materials improves farm yields and supports food production systems. Efficient shipping of grains and food commodities also helps stabilize food supply, reduce shortages, and improve food accessibility.

Improved food security contributes directly to human development by:

- Reducing hunger and malnutrition.
- Improving health outcomes.
- Increasing labour productivity.
- Enhancing educational performance.
- Promoting social stability.

As nutrition and food availability improve, broader human development indicators also improve.

Infrastructure and Construction Development

Bulk cargo shipping supports the transportation of construction materials such as cement, steel, clinker, gravel, gypsum, and other materials essential for infrastructure development.

Modern economies require sustained investments in roads, bridges, railways, schools, hospitals, housing, and public utilities. The successful implementation of these projects depends on the availability of construction materials, many of which are transported by bulk carriers.

Infrastructure development contributes to human development through:

- Improved access to education.
- Enhanced healthcare delivery.
- Better transportation services.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Increased economic opportunities.
- Improved living conditions.

Consequently, efficient bulk cargo transportation becomes an indirect driver of human development through its support for infrastructure expansion.

Employment Generation

Bulk cargo shipping generates both direct and indirect employment opportunities across multiple sectors.

Direct employment exists within:

- Port operations.
- Bulk terminals.
- Shipping companies.
- Cargo handling services.
- Maritime logistics firms.
- Marine engineering services.

Indirect employment arises within:

- Agriculture.
- Construction.
- Mining.
- Manufacturing.
- Transportation.
- Warehousing.

These employment opportunities contribute to income generation, poverty reduction, and improved household welfare. Increased incomes enable families to invest in education, healthcare, housing, and other necessities required for a decent standard of living.

Trade Facilitation and Economic Expansion

Bulk cargo shipping facilitates international and domestic trade by ensuring the efficient movement of strategic commodities between markets.

Expanded trade contributes to:

- Increased economic output.
- Higher foreign exchange earnings.
- Enhanced industrial competitiveness.
- Investment attraction.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Market integration.

These outcomes stimulate broader economic growth and create opportunities for improving human welfare. Countries with efficient bulk shipping systems generally experience stronger economic performance and higher standards of living.

2.4.4 Bulk Cargo Shipping and Poverty Reduction

An important developmental contribution of bulk cargo shipping is its role in poverty reduction. By supporting productive sectors such as agriculture, manufacturing, mining, and construction, bulk shipping promotes job creation and income generation for workers and businesses.

The resulting economic activities create multiplier effects throughout the economy, generating additional employment and entrepreneurial opportunities. As poverty declines, households gain improved access to:

- Healthcare services.
- Educational opportunities.
- Adequate nutrition.
- Better housing.
- Social protection mechanisms.

These improvements collectively enhance human development outcomes.

2.4.5 Bulk Cargo Shipping and Regional Development

Bulk cargo transportation contributes significantly to regional economic development by connecting production centres to domestic and international markets.

Port cities and industrial clusters often emerge around major bulk cargo terminals due to their strategic role in facilitating trade and industrial activities. Such developments stimulate:

- Urban growth.
- Industrial concentration.
- Infrastructure investments.
- Labour market expansion.
- Business development.

The resulting economic transformation contributes to broader social and developmental progress.

2.4.6 Bulk Cargo Shipping Operations in Nigeria

Bulk cargo shipping plays an essential role in Nigeria's economic structure. Large volumes of agricultural commodities, construction materials, fertilizers, cement, steel products, and industrial raw materials move through Nigerian ports annually.

Bulk cargo operations support critical sectors including:

- Agriculture.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Manufacturing.
- Construction.
- Mining.
- Energy.
- Infrastructure development.

Major Nigerian ports such as Onne, Warri, Calabar, Port Harcourt, Apapa, and Tin Can Island facilitate the importation and exportation of bulk commodities that sustain productive activities across the economy.

Despite its importance, the sector faces several constraints including:

- Port congestion.
- Inadequate cargo-handling facilities.
- Poor hinterland connectivity.
- Logistics inefficiencies.
- Infrastructure deficits.

These challenges increase transportation costs and reduce the potential developmental benefits of bulk shipping activities.

2.4.7 Bulk Cargo Shipping and Human Development in Nigeria

Within the Nigerian context, bulk cargo shipping possesses substantial potential to contribute to human development due to its strong linkages with productive sectors of the economy. Efficient transportation of agricultural products, industrial inputs, and construction materials enhances economic productivity, employment creation, food security, and infrastructure development.

These benefits ultimately translate into improvements in:

- Income levels.
- Educational access.
- Healthcare outcomes.
- Living standards.
- Poverty reduction.

Given Nigeria's developmental aspirations and the strategic importance of agriculture, manufacturing, and infrastructure development, bulk cargo shipping serves as a critical mechanism through which maritime transportation can contribute to sustainable human development.

2.4.8 Conceptual Framework of the Relationship Between Bulk Cargo Shipping and Human Development

The developmental pathway linking bulk cargo shipping to human development can be conceptualized as follows:

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

Bulk Cargo Shipping Operations → Industrial and Agricultural Growth → Employment Creation → Increased Household Income → Enhanced Access to Education and Healthcare → Improved Quality of Life → Human Development

Similarly:

Bulk Cargo Shipping Operations → Infrastructure Development → Increased Productivity → Economic Expansion → Poverty Reduction → Human Development

Therefore, bulk cargo shipping is not merely a transport activity but a strategic development instrument that facilitates production, supports economic transformation, promotes social welfare, and enhances human capabilities. Within the framework of this study, bulk cargo shipping operations are expected to exert a positive and significant influence on Human Development Index (HDI) in Nigeria, both directly and through their interactions with supporting infrastructure and broader economic activities.

2.5 Tanker Shipping Operations and Human Development

Tanker shipping operations constitute one of the most strategic segments of the global maritime industry due to their central role in the transportation of crude oil, refined petroleum products, liquefied petroleum gas (LPG), chemicals, and other energy-related commodities. The global economy remains heavily dependent on energy resources for industrial production, transportation, power generation, and economic activities, making tanker shipping an indispensable component of international trade and economic development. As a specialized branch of maritime transportation, tanker shipping facilitates the efficient movement of energy resources from production centres to consumption markets, thereby sustaining economic activities and supporting development across nations.

For petroleum-producing economies such as Nigeria, tanker shipping operations occupy a particularly significant position within the national economic structure. Nigeria is endowed with substantial crude oil and natural gas reserves, making the petroleum sector a major contributor to national income, foreign exchange earnings, export revenue, and public finance. Since crude oil constitutes a dominant share of the country's export earnings, tanker shipping serves as the principal mechanism through which petroleum resources are transported to international markets. Consequently, the performance of tanker shipping operations has direct implications for economic stability, fiscal sustainability, and human development outcomes.

2.5.1 Concept of Tanker Shipping Operations

Tanker shipping operations refer to all maritime activities associated with the transportation, handling, storage, loading, unloading, and management of liquid bulk commodities, particularly crude oil and petroleum products. These operations involve the use of specially designed vessels known as tankers, which are equipped with sophisticated cargo systems to ensure the safe transportation of liquid commodities across international waters.

Tanker shipping operations encompass:

- Crude oil transportation.
- Petroleum product transportation.
- Offshore loading and unloading operations.
- Marine terminal activities.
- Oil export logistics.
- Vessel management and maintenance.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Energy supply chain management.
- Maritime safety and environmental protection services.

The efficiency of tanker shipping depends on several factors, including port infrastructure, terminal facilities, navigational systems, vessel availability, maritime security, regulatory compliance, and international oil market conditions. Given the strategic nature of oil transportation, interruptions in tanker operations can significantly affect national revenue, industrial production, foreign exchange earnings, and economic performance.

2.5.2 Theoretical Relationship Between Tanker Shipping and Human Development

The relationship between tanker shipping operations and human development can be explained using Human Capital Theory, Resource-Based Development Theory, and Transport-Led Development Theory.

Human Capital Theory argues that economic activities generate resources that can be invested in education, healthcare, skills development, and welfare enhancement. Tanker shipping contributes to government and private sector revenues, which can ultimately be directed towards social and human capital development.

Resource-Based Development Theory suggests that countries endowed with natural resources can achieve significant development when resource revenues are effectively managed and invested in productive sectors of the economy. In the Nigerian context, crude oil exports transported through tanker vessels constitute a major source of national wealth capable of supporting human development initiatives.

Transport-Led Development Theory further emphasizes that efficient transportation systems stimulate economic growth, facilitate trade, promote investment, and improve accessibility. Tanker shipping serves as a critical transport mechanism through which petroleum resources are monetized and integrated into the global economy.

2.5.3 Channels Through Which Tanker Shipping Influences Human Development

Foreign Exchange Earnings and Economic Stability

One of the most significant contributions of tanker shipping operations is the generation of foreign exchange earnings. Through the export of crude oil and petroleum products, tanker vessels facilitate the inflow of foreign currency required for financing imports, servicing international obligations, and supporting macroeconomic stability.

Foreign exchange earnings contribute to:

- Exchange rate stability.
- Increased government spending capacity.
- Enhanced investment opportunities.
- Improved balance of payments performance.
- Economic growth and development.

A stable economy creates favourable conditions for investment in social services and human development programmes.

Government Revenue Generation

Tanker shipping operations directly support government revenue through crude oil exports, petroleum royalties, corporate taxes, shipping charges, port fees, and related petroleum-sector contributions.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

These revenues provide financial resources for government investments in:

- Education.
- Healthcare.
- Transportation infrastructure.
- Housing.
- Social welfare programmes.
- Poverty alleviation initiatives.

When effectively managed, oil revenues can improve human development outcomes by enhancing access to quality public services and social infrastructure.

Employment Creation and Income Generation

Tanker shipping generates substantial direct and indirect employment opportunities throughout the economy.

Direct employment exists in:

- Tanker vessel operations.
- Marine engineering.
- Offshore logistics.
- Terminal operations.
- Petroleum shipping services.
- Maritime administration.
- Ship management.

Indirect employment opportunities arise through:

- Oil and gas operations.
- Port services.
- Insurance.
- Banking.
- Logistics.
- Marine support services.
- Engineering and construction.

Increased employment contributes to household income generation, poverty reduction, and improved standards of living, which are essential components of human development.

Financing Human Capital Development

Education and healthcare remain fundamental pillars of human development. The revenues generated from tanker shipping-supported petroleum exports provide governments with the fiscal resources necessary to invest

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

in these critical sectors.

Investment in education contributes to:

- Increased literacy rates.
- Skills acquisition.
- Human capital development.
- Technological advancement.
- Productivity enhancement.

Similarly, investment in healthcare promotes:

- Improved life expectancy.
- Reduced mortality rates.
- Enhanced workforce productivity.
- Better quality of life.

Consequently, efficient tanker shipping operations indirectly contribute to improvements in the Human Development Index through enhanced financing of social sectors.

2.5.4 Tanker Shipping and Industrial Development

Tanker shipping supports industrial activities by ensuring the reliable transportation of petroleum products required for energy generation, manufacturing processes, transportation networks, and commercial activities.

A stable and efficient petroleum supply chain contributes to:

- Increased industrial productivity.
- Business expansion.
- Economic diversification.
- Investment attraction.
- Technological development.

Industrial growth creates additional employment opportunities and raises household incomes, thereby improving welfare and living standards.

For a developing economy such as Nigeria, reliable energy supply facilitated by tanker shipping remains essential for sustainable economic transformation and human development.

2.5.5 Tanker Shipping and Infrastructure Development

Revenue generated from oil exports transported through tanker shipping often finances the development of national infrastructure.

Examples include:

- Roads and highways.

- Seaports.
- Airports.
- Rail networks.
- Healthcare facilities.
- Educational institutions.
- Water supply systems.

Infrastructure development enhances productivity, connectivity, accessibility, and service delivery, all of which contribute significantly to human welfare.

Furthermore, the existence of modern maritime infrastructure enhances the efficiency of tanker operations, creating a mutually reinforcing relationship between shipping performance and development outcomes.

2.5.6 Tanker Shipping and Poverty Reduction

Tanker shipping contributes to poverty reduction through several interconnected mechanisms.

First, oil export revenues create opportunities for economic growth and government spending on social programmes. Second, employment opportunities generated within the petroleum and maritime sectors increase household incomes and improve access to basic necessities. Third, investments in infrastructure and public services enhance living standards and expand economic opportunities.

Where oil revenues are effectively utilized, tanker shipping can contribute to:

- Reduced poverty incidence.
- Improved social inclusion.
- Better access to healthcare.
- Expanded educational opportunities.
- Enhanced living conditions.

These outcomes are fundamental elements of human development.

2.5.7 Tanker Shipping Operations in Nigeria

Nigeria's tanker shipping industry represents one of the most important segments of the country's maritime

sector. As one of Africa's leading crude oil producers and exporters, Nigeria relies heavily on tanker shipping operations for the transportation of petroleum resources to international markets.

Major crude oil export terminals such as:

- Bonny Terminal.
- Forcados Terminal.
- Qua Iboe Terminal.
- Brass Terminal.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Escravos Terminal.

depend extensively on tanker vessels for export operations.

The growth of Nigeria's oil and gas sector has generated significant economic benefits through:

- Foreign exchange earnings.
- Export revenue generation.
- Government income.
- Employment opportunities.
- Industrial development.

However, challenges such as oil price volatility, environmental concerns, maritime insecurity, infrastructure deficiencies, and operational inefficiencies continue to affect the sector's overall developmental impact.

2.5.8 Tanker Shipping, the Resource Curse Debate, and Human Development

While tanker shipping can generate enormous economic benefits, development outcomes depend largely on how petroleum revenues are managed. The Resource Curse Theory argues that resource-rich countries may experience weaker development outcomes when resource wealth is not effectively transformed into human capital and infrastructure investments.

In Nigeria, concerns have often been raised regarding the extent to which petroleum revenues have translated into improvements in education, healthcare, employment, and welfare. This creates an important policy question regarding whether growth in tanker shipping operations ultimately contributes to sustainable human development.

The present study addresses this question by examining the empirical relationship between tanker shipping activities and the Human Development Index (HDI) in Nigeria over the period 1990–2025.

2.5.9 Tanker Shipping and Sustainable Human Development

The concept of sustainable human development emphasizes the use of economic resources to improve present welfare while preserving opportunities for future generations. Tanker shipping can contribute to sustainable development when petroleum revenues are invested in:

- Human capital development.
- Industrial diversification.
- Infrastructure expansion.
- Renewable energy development.
- Social welfare programmes.

Such investments ensure that the benefits derived from exhaustible natural resources contribute to long-term improvements in human well-being.

2.5.10 Conceptual Relationship Between Tanker Shipping Operations and Human Development

The pathway through which tanker shipping influences human development can be represented as follows:

Tanker Shipping Operations → Crude Oil Exports → Foreign Exchange Earnings → Government Revenue → Investment in Education, Healthcare and Infrastructure → Improved Living Standards → Human Development

Similarly,

Tanker Shipping Operations → Employment Creation → Income Generation → Poverty Reduction → Enhanced Access to Social Services → Human Development

and

Tanker Shipping Operations → Energy Supply and Industrial Growth → Economic Expansion → Increased Welfare and Opportunities → Human Development

Therefore, tanker shipping operations extend far beyond the physical transportation of crude oil and petroleum products. They constitute a strategic economic activity capable of influencing national development, human welfare, income generation, healthcare provision, educational advancement, and social progress. Within the framework of this study, tanker shipping operations are expected to exert a positive and significant effect on the Human Development Index (HDI) in Nigeria through their contribution to revenue generation, employment creation, infrastructure financing, and broader socio-economic development.

2.6 Liquid Cargo Shipping and Human Development

Liquid cargo shipping represents a specialized segment of maritime transportation that involves the movement of liquid commodities through dedicated vessels, terminals, and storage facilities. Unlike dry bulk and containerized cargo, liquid cargo requires specialized handling systems, sophisticated safety mechanisms, and advanced logistics infrastructure to ensure safe and efficient transportation. Liquid cargo shipping plays a crucial role in supporting global energy systems, industrial production, international trade, and economic development. Consequently, it has emerged as a strategic component of modern maritime transport and an important contributor to human development.

Liquid cargo shipping encompasses the transportation of a wide range of commodities including liquefied natural gas (LNG), liquefied petroleum gas (LPG), refined petroleum products, petrochemicals, chemicals, industrial liquids, edible oils, and other fluid substances. The increasing demand for energy resources, industrial chemicals, and environmentally sustainable fuel alternatives has significantly expanded the scope and importance of liquid cargo transportation worldwide.

For developing economies such as Nigeria, liquid cargo shipping is particularly important because it supports the exportation of liquefied natural gas and related products while ensuring the importation and distribution of refined petroleum products and industrial chemicals required for domestic production. Through these functions, liquid cargo shipping contributes not only to economic growth but also to broader development outcomes such as employment generation, industrialization, energy security, poverty reduction, and improvements in living standards.

2.6.1 Concept of Liquid Cargo Shipping Operations

Liquid cargo shipping operations refer to all maritime activities associated with the transportation, handling, storage, loading, unloading, and management of liquid commodities. These operations involve specialized tankers equipped with advanced containment systems designed to transport liquids safely across domestic and international maritime routes.

Liquid cargo shipping operations typically include:

- Transportation of liquefied natural gas (LNG).
- Transportation of liquefied petroleum gas (LPG).

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Distribution of refined petroleum products.
- Transportation of petrochemicals and industrial chemicals.
- Storage and terminal operations.
- Marine logistics and supply chain management.
- Vessel operations and maintenance.
- Maritime safety and environmental management.

The effectiveness of liquid cargo shipping depends on the availability of modern port infrastructure, specialized terminals, storage facilities, transportation networks, regulatory frameworks, and technological systems that ensure operational efficiency and safety.

2.6.2 Theoretical Relationship Between Liquid Cargo Shipping and Human Development

The relationship between liquid cargo shipping and human development can be explained through Human Capital Theory, Infrastructure-Led Development Theory, and Energy-Led Growth Theory.

Human Capital Theory posits that economic activities generate resources that can be invested in education, healthcare, skills development, and welfare improvement. The revenues and employment opportunities generated through liquid cargo shipping can therefore contribute significantly to human development.

Infrastructure-Led Development Theory emphasizes that economic growth and societal advancement depend on the availability of modern infrastructure capable of supporting productive activities. Liquid cargo shipping facilitates the movement of strategic energy resources that sustain industries, transportation systems, and social services.

Energy-Led Growth Theory argues that reliable energy supply is a critical determinant of economic productivity, industrial expansion, technological advancement, and social welfare. Since liquid cargo shipping ensures the transportation of essential energy products, it indirectly influences human development outcomes.

These theoretical perspectives suggest that liquid cargo shipping contributes to human development by enhancing productive capacity, supporting industrialization, creating employment, and generating resources required for social investments.

2.6.3 Channels Through Which Liquid Cargo Shipping Influences Human Development

Energy Security and Human Development

One of the most significant contributions of liquid cargo shipping is its role in ensuring energy security.

Economic activities, industrial production, healthcare systems, educational institutions, transportation networks, and household welfare depend heavily on reliable energy supplies.

Liquid cargo shipping facilitates the movement of:

- Liquefied natural gas (LNG).
- Liquefied petroleum gas (LPG).
- Refined petroleum products.
- Industrial fuels.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Petrochemical inputs.

Reliable energy availability contributes to:

- Increased industrial productivity.
- Improved healthcare delivery.
- Enhanced educational services.
- Better transportation systems.
- Higher economic output.

Consequently, energy security supported by liquid cargo shipping forms an important foundation for sustainable human development.

Industrial Development and Economic Transformation

Industrialization remains a key pathway to development in emerging economies. Many industries depend on chemical products, natural gas, petroleum derivatives, and other liquid commodities for production processes.

Liquid cargo shipping supports industries such as:

- Petrochemicals.
- Manufacturing.
- Fertilizer production.
- Electricity generation.
- Pharmaceuticals.
- Food processing.
- Construction materials production.

The availability of these industrial inputs enhances productive capacity, stimulates innovation, increases output, and supports economic diversification. As industrial activities expand, employment opportunities and income levels improve, leading to better welfare outcomes.

Export Earnings and Economic Diversification

The growth of Nigeria's liquefied natural gas industry has increased the importance of liquid cargo shipping within the national economy. LNG exports transported through specialized vessels generate substantial foreign exchange earnings and contribute to government revenue.

Economic diversification through LNG exports reduces excessive dependence on crude oil exports and strengthens economic resilience. Increased export earnings support investments in:

- Infrastructure development.
- Educational systems.
- Healthcare facilities.
- Social protection programmes.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Human capital development initiatives.

Through these channels, liquid cargo shipping contributes indirectly to improvements in human development indicators.

Employment Generation

Liquid cargo shipping creates substantial direct and indirect employment opportunities across various sectors.

Direct employment opportunities exist within:

- LNG shipping operations.
- Chemical tanker operations.
- Marine transportation services.
- Port terminal operations.
- Tank farm management.
- Vessel maintenance activities.

Indirect employment is generated through:

- Oil and gas services.
- Petrochemical industries.
- Logistics and transportation.
- Engineering services.
- Maritime consultancy.
- Financial and insurance services.

These employment opportunities enhance household income, reduce poverty, and improve access to basic social services.

Revenue Generation and Public Investment

The liquid cargo shipping industry contributes significantly to public revenue through:

- Export earnings.
- Corporate taxation.
- Port charges.
- Shipping levies.
- Licensing fees.
- Customs duties.

These revenues provide governments with resources necessary for public investment in:

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Schools and higher education.
- Hospitals and healthcare systems.
- Transportation infrastructure.
- Water and sanitation services.
- Community development projects.

Improved investment in social services contributes directly to enhanced human development outcomes.

2.6.4 Liquid Cargo Shipping and Energy-Led Human Development

Access to affordable and reliable energy is increasingly recognized as a fundamental requirement for sustainable development. Energy influences virtually every dimension of human life, including education, healthcare, income generation, communication, and overall quality of life.

Liquid cargo shipping facilitates the movement of energy resources that support:

- Electricity generation.
- Industrial operations.
- Transportation systems.
- Domestic energy consumption.
- Commercial activities.

Improved energy availability contributes to:

- Extended study hours for students.
- Enhanced healthcare equipment functionality.
- Increased business productivity.
- Improved communication networks.
- Better living conditions.

These outcomes collectively enhance human development.

2.6.5 Liquid Cargo Shipping and Technological Advancement

The liquid cargo sector is among the most technologically advanced segments of maritime transportation. Operations involving LNG, LPG, and chemical cargoes require sophisticated technologies, highly trained personnel, and strict safety standards.

The development of liquid cargo shipping promotes:

- Technology transfer.
- Skills development.
- Human capital formation.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Research and innovation.
- Technical education and training.

These benefits contribute to knowledge acquisition and workforce development, both of which are essential components of sustainable human development.

2.6.6 Liquid Cargo Shipping Operations in Nigeria

Nigeria occupies a strategic position within the global LNG market through the operations of Nigeria LNG Limited and related gas export facilities. The country's abundant natural gas reserves have increased the significance of liquid cargo shipping within national development efforts.

Major liquid cargo activities in Nigeria include:

- LNG exports.
- LPG transportation.
- Importation of refined petroleum products.
- Movement of industrial chemicals.
- Offshore energy logistics operations.

These activities contribute significantly to:

- Foreign exchange earnings.
- Government revenue.
- Employment creation.
- Industrial growth.
- Economic diversification.

However, challenges such as inadequate infrastructure, limited domestic refining capacity, high logistics costs, environmental concerns, and regulatory constraints continue to limit the sector's full developmental potential.

2.6.7 Liquid Cargo Shipping and Sustainable Development

The United Nations Sustainable Development Goals (SDGs) emphasize the need for affordable energy, indust-

rial innovation, decent work, infrastructure development, and economic growth. Liquid cargo shipping contributes directly to several of these objectives by ensuring the transportation of critical energy and industrial resources.

Specifically, the sector contributes to:

- SDG 7: Affordable and Clean Energy.
- SDG 8: Decent Work and Economic Growth.
- SDG 9: Industry, Innovation and Infrastructure.
- SDG 10: Reduced Inequalities.

- SDG 17: Partnerships for Sustainable Development.

By supporting these development goals, liquid cargo shipping becomes an important instrument for achieving sustainable human development.

2.6.8 Challenges Limiting the Human Development Impact of Liquid Cargo Shipping

Despite its significant potential, the contribution of liquid cargo shipping to human development can be constrained by several challenges, including:

- Inadequate port infrastructure.
- Limited storage capacity.
- Maritime security concerns.
- Environmental risks and pollution.
- Fluctuations in global energy prices.
- Insufficient domestic industrial linkages.
- Regulatory inefficiencies.
- Technological gaps.

Addressing these challenges is essential for maximizing the socio-economic and developmental benefits of the sector.

2.6.9 Conceptual Relationship Between Liquid Cargo Shipping and Human Development

The relationship between liquid cargo shipping and human development can be represented as follows:

Liquid Cargo Shipping Operations → Energy Supply → Industrial Development → Employment Creation → Income Growth → Improved Access to Education and Healthcare → Human Development

Similarly,

Liquid Cargo Shipping Operations → LNG Exports → Foreign Exchange Earnings → Government Revenue → Infrastructure and Social Investments → Improved Welfare → Human Development

and

Liquid Cargo Shipping Operations → Technology Transfer and Skills Development → Human Capital Enhancement → Productivity Growth → Human Development

Therefore, liquid cargo shipping extends beyond its traditional transportation role to become an important catalyst for energy security, industrial expansion, economic diversification, revenue generation, and social progress. Through these channels, the sector contributes significantly to the enhancement of health, education, income, and overall quality of life. Within the framework of this study, liquid cargo shipping operations are expected to exert a positive influence on Nigeria's Human Development Index (HDI) by supporting the economic and social conditions necessary for sustainable human development.

2.7 Infrastructure Development as a Moderator

Infrastructure development constitutes one of the most critical determinants of the efficiency, competitiveness, and developmental impact of shipping operations. While shipping activities facilitate trade, industrialization,

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

employment generation, and economic growth, the extent to which these benefits translate into human development largely depends on the quality and adequacy of supporting infrastructure. Consequently, infrastructure serves as a strategic enabling factor that strengthens or weakens the capacity of maritime transportation to contribute to socio-economic development and improvements in human welfare.

In the context of maritime transportation, infrastructure refers to the physical, institutional, technological, and logistics facilities that support the movement of cargo, vessels, information, and people throughout the transportation system. These facilities include seaports, terminals, access roads, rail networks, warehouses, inland container depots, communication systems, navigational aids, logistics hubs, cargo handling equipment, and digital transport platforms. The effectiveness of shipping operations is highly dependent on the availability and functionality of these infrastructures.

Modern development literature increasingly recognizes that infrastructure is not merely a supporting element of economic activity but a critical driver of productivity, competitiveness, trade expansion, and human development. Countries with well-developed infrastructure generally experience greater economic efficiency, stronger trade performance, higher investment inflows, and improved living standards. Conversely, inadequate infrastructure often results in congestion, higher logistics costs, lower productivity, reduced competitiveness, and limited socio-economic development.

2.7.1 Concept of Infrastructure Development

Infrastructure development refers to the creation, modernization, expansion, maintenance, and improvement of physical and institutional facilities necessary for economic and social activities. It encompasses investments in transportation, energy, telecommunications, water systems, logistics facilities, and public utilities that facilitate production, trade, and service delivery.

Within the maritime environment, infrastructure development includes:

Port construction and expansion.

Terminal modernization.

Deep-sea port development.

Dredging and channel maintenance.

Road and rail connectivity.

Inland dry ports.

Logistics and warehousing facilities.

Maritime communication systems.

Vessel traffic management systems.

Information and digital technologies.

These infrastructures create the operational foundation upon which shipping activities and maritime commerce can thrive.

2.7.2 Infrastructure Development and Maritime Transport Efficiency

Infrastructure plays a fundamental role in determining the efficiency of maritime operations. Efficient ports, modern container terminals, cargo-handling equipment, storage facilities, and transport corridors reduce delays, minimize congestion, and improve cargo throughput capacity.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

When maritime infrastructure is well developed:

Vessel turnaround time decreases.

Cargo clearance becomes faster.

Transportation costs decline.

Supply chain efficiency improves.

Trade volumes increase.

Market access expands.

These improvements enhance the competitiveness of shipping operations and create favourable conditions for economic growth and development.

Conversely, poor infrastructure often leads to:

Port congestion.

Cargo delays.

High logistics costs.

Supply chain disruptions.

Reduced investment attractiveness.

Lower trade competitiveness.

Such inefficiencies limit the developmental impact of shipping activities and constrain their contribution to human welfare**.**

2.7.3 Theoretical Foundation for Infrastructure as a Moderating Variable

The moderating role of infrastructure development can be explained by several economic and development theories.

Infrastructure-Led Growth Theory

Infrastructure-Led Growth Theory argues that infrastructure investments facilitate economic activities by re-

ducing transaction costs, increasing productivity, and improving resource allocation. According to this theory, the benefits of economic activities are maximized when supported by adequate infrastructure.

In the context of shipping operations, infrastructure serves as a catalyst that enhances the efficiency and effectiveness of maritime transport systems, thereby increasing their contribution to development outcomes.

Transport-Led Development Theory

Transport-Led Development Theory posits that transportation infrastructure stimulates economic growth through improved connectivity, mobility, and accessibility. Efficient transportation systems facilitate trade, encourage specialization, enhance productivity, and create opportunities for investment.

Shipping operations supported by modern infrastructure are therefore more likely to generate employment, stimulate industrial activities, and contribute positively to human development.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

New Economic Geography Theory

The New Economic Geography Theory emphasizes the importance of infrastructure in reducing spatial barriers and facilitating economic interactions between regions. Improved transport infrastructure lowers trade costs, attracts industries, promotes regional development, and enhances access to markets.

Under this framework, infrastructure development strengthens the ability of shipping operations to influence socio-economic outcomes by creating stronger economic linkages throughout the economy.

2.7.4 Dimensions of Maritime Infrastructure Development

Port Infrastructure

Port infrastructure includes:

Berths.

Quay walls.

Jetties.

Cargo terminals.

Container yards.

Storage facilities.

Harbour facilities.

Efficient ports improve cargo handling speeds and facilitate trade flows, thereby enhancing the developmental impact of maritime activities.

Transport Connectivity Infrastructure

Maritime transportation does not operate in isolation. Effective movement of cargo requires integration with:

Road networks.

Railway systems.

Inland waterways.

Aviation logistics systems.

Efficient multimodal connectivity improves cargo distribution, reduces transit costs, and promotes market accessibility.

Logistics Infrastructure

Logistics infrastructure comprises:

Warehouses.

Dry ports.

Distribution centres.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

Freight terminals.

Cold storage facilities.

Cargo consolidation centres.

These facilities improve supply chain efficiency and facilitate the smooth movement of goods between producers and consumers.

Digital Infrastructure

Advancements in technology have transformed maritime operations through:

Port Community Systems.

Electronic Customs Systems.

Cargo Tracking Platforms.

Vessel Traffic Management Systems.

Automated Terminal Operations.

Digital infrastructure reduces bureaucratic bottlenecks, improves transparency, enhances efficiency, and increases trade competitiveness.

2.7.5 Infrastructure Development and Human Development

Infrastructure development contributes directly and indirectly to human development through multiple pathways.

Improved Employment Opportunities

Infrastructure construction, expansion, and maintenance create employment opportunities in engineering, construction, logistics, transportation, and related sectors.

These employment opportunities generate income and improve living standards.

Enhanced Access to Social Services

Efficient transport infrastructure improves access to:

Healthcare facilities.

Educational institutions.

Public utilities.

Community services.

Improved accessibility contributes to better health outcomes, increased school enrolment, and improved quality of life.

Income Generation and Poverty Reduction

Infrastructure investments stimulate economic activities, encourage private sector participation, and increase productivity. These activities generate incomes and create opportunities for poverty reduction.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

As incomes rise, households are better able to invest in nutrition, education, healthcare, and housing.

Regional Development and Inclusion

Improved infrastructure promotes regional integration by connecting remote areas to national and international markets. Enhanced connectivity expands economic opportunities and reduces developmental disparities between regions.

2.7.6 Infrastructure Development as a Moderator of the Shipping-Human Development Relationship

The central argument of this study is that infrastructure development enhances the ability of shipping operations to contribute to human development. In other words, infrastructure acts as a moderating variable that influences the strength and direction of the relationship between shipping activities and human development outcomes.

For example:

Container shipping is more effective when ports have modern terminals and efficient cargo-handling facilities.

Bulk cargo shipping contributes more to development when supported by efficient road and rail networks that facilitate commodity distribution.

Tanker shipping generates greater economic benefits when export terminals, pipelines, storage facilities, and navigational infrastructure are adequately developed.

Liquid cargo shipping achieves greater efficiency when specialized terminals, LNG facilities, storage systems, and distribution networks are available.

Thus, the same level of shipping activity may produce significantly different development outcomes depending on the quality of supporting infrastructure.

2.7.7 Infrastructure Development and Nigeria's Maritime Sector

Nigeria's maritime sector has experienced substantial growth over the past three decades, yet infrastructure challenges continue to constrain its full developmental potential. Several ports operate below optimal efficiency due to:

Congestion.

Aging infrastructure.

Limited cargo-handling capacity.

Poor hinterland connectivity.

Inadequate rail integration.

Insufficient logistics facilities.

These challenges increase logistics costs and reduce the contribution of maritime activities to socio-economic development.

Recent initiatives such as:

Deep Seaport development.

Port modernization programmes.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

Rail transportation projects.

Inland dry port schemes.

Blue Economy investments.

have sought to address these deficiencies and improve maritime sector competitiveness.

Enhanced infrastructure is expected to strengthen the developmental impact of shipping operations by facilitating trade expansion, industrial growth, employment creation, and revenue generation.

2.7.8 Empirical Relevance to This Study

The empirical framework of this study incorporates infrastructure development as a moderating variable because the developmental benefits of shipping operations are unlikely to materialize fully without adequate supporting infrastructure.

The interaction terms:

CSO × IND

BCSO × IND

TSO × IND

LCSO × IND

are introduced to determine whether infrastructure amplifies the contribution of shipping operations to Human Development Index (HDI) in Nigeria.

The expectation is that improvements in infrastructure will strengthen the positive effects of container shipping, bulk cargo shipping, tanker shipping, and liquid cargo shipping on human development outcomes.

2.7.9 Conceptual Framework

The moderating role of infrastructure development can be represented as follows:

Shipping Operations → Trade and Economic Activities → Human Development

However, the effectiveness of this relationship depends on infrastructure quality:

Shipping Operations × Infrastructure Development → Enhanced Trade Efficiency → Employment Creation → Income Growth → Improved Health and Education → Human Development

Similarly:

Infrastructure Development → Reduced Logistics Costs → Increased Investment → Industrial Expansion → Poverty Reduction → Human Development

Therefore, infrastructure development acts as a strategic catalyst that transforms maritime activities into tangible improvements in human welfare. It strengthens the transmission mechanism through which shipping operations generate employment, stimulate economic growth, improve public revenue, enhance social investments, and ultimately contribute to sustainable human development.

Within the framework of this study, infrastructure development is expected to positively moderate the relationship between shipping operations and Human Development Index (HDI), thereby reinforcing the

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

argument that efficient maritime infrastructure is essential for maximizing the developmental benefits of Nigeria's shipping sector.

3.0 THEORETICAL FRAMEWORK

3.1 Introduction

A theoretical framework provides the foundation for understanding and explaining the relationship between variables within a study. It offers a systematic basis for analysing how shipping operations influence human development and helps establish the causal pathways through which maritime transport activities contribute to improvements in welfare, income, education, and healthcare outcomes. Given the multidimensional nature of human development and the economic significance of maritime transportation, it is necessary to adopt a theory that explains how productive economic activities generate resources, opportunities, and capabilities that enhance human well-being.

This study is anchored primarily on the Human Capital Theory developed by Theodore Schultz (1961) and further advanced by Gary Becker (1964). The theory provides a suitable framework for examining the contribution of shipping operations to human development because it emphasizes the role of economic activities and investments in improving human capabilities, productivity, and welfare.

3.2 Human Capital Theory

Human Capital Theory emerged as a response to traditional economic theories that viewed labour merely as a factor of production. Schultz (1961) and Becker (1964) argued that individuals possess valuable knowledge, skills, competencies, education, experience, and health attributes that increase their productivity and contribute to economic growth. According to the theory, investments in human beings are similar to investments in physical capital because they generate returns in the form of increased productivity, higher incomes, improved welfare, and enhanced quality of life.

The theory posits that economic development is not solely determined by the accumulation of physical assets but also by investments that improve human capabilities. Such investments include:

- Education and training
- Healthcare services
- Skills acquisition
- Research and innovation
- Knowledge development
- Professional experience
- Technological learning

These investments enhance individuals' ability to participate productively in economic activities and improve their standard of living.

According to Schultz (1961), expenditures on education, health, and training should be viewed as productive investments rather than mere consumption because they increase human capacity and contribute to long-term economic and social development. Becker (1964) further argued that the accumulation of human capital leads to higher productivity, greater earning potential, improved employment opportunities, and enhanced welfare outcomes.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

The central proposition of the Human Capital Theory is that economic activities capable of generating employment, income, knowledge, and investment opportunities ultimately contribute to improvements in human development.

3.3 Fundamental Assumptions of Human Capital Theory

The Human Capital Theory is built upon several fundamental assumptions:

i. Human Beings Are Productive Assets

The theory assumes that individuals possess productive capacities that can be enhanced through investments in education, training, health, and knowledge acquisition. These enhanced capacities improve productivity and welfare.

ii. Investments Generate Returns

Human capital investments yield economic and social returns in the form of:

- Higher earnings
- Increased productivity
- Better employment opportunities
- Improved living standards
- Enhanced social mobility

iii. Economic Growth Supports Human Development

The theory assumes that productive economic activities generate resources that can be invested in human welfare through education, healthcare, and social services.

iv. Income and Welfare Are Interrelated

An increase in economic activities leads to rising incomes, which improve access to education, healthcare, housing, nutrition, and other necessities required for human development.

v. Development Is People-Centred

Human Capital Theory views people as both the means and the ends of development. Economic activities are valuable to the extent that they improve human welfare and expand opportunities.

3.4 Relevance of Human Capital Theory to Shipping Operations

The maritime sector represents a productive economic sector capable of generating substantial economic and social benefits. Shipping operations facilitate trade, support industrial production, create employment opportunities, stimulate investment, and generate government revenues. These outcomes create the conditions necessary for enhancing human development.

Shipping operations contribute to the accumulation of human capital through several channels:

Employment Generation

Maritime activities create direct and indirect employment opportunities in:

- Shipping companies

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

- Port operations
- Logistics services
- Freight forwarding
- Marine engineering
- Customs administration
- Transportation services
- Offshore support services

Employment improves household income and provides financial resources for education, healthcare, and better living conditions.

Income Generation

Increased shipping activities stimulate economic transactions, trade expansion, and business opportunities, resulting in higher income levels for individuals, firms, and governments.

Higher incomes enable households to invest in:

- Education
- Healthcare
- Nutrition
- Housing
- Skills development

These investments contribute directly to human development.

Government Revenue Mobilization

Shipping operations generate public revenue through:

- Customs duties
- Port tariffs
- Shipping levies
- Corporate taxes
- Export earnings

Government revenues can be invested in:

- Educational infrastructure
- Healthcare systems
- Public transportation

- Social welfare programmes
- Human capital development initiatives

Through this mechanism, maritime activities contribute indirectly to improvements in human development.

Knowledge and Technology Transfer

Modern shipping operations involve sophisticated technologies, logistics systems, and maritime management practices. Exposure to these technologies promotes:

- Skills acquisition
- Professional competence
- Innovation
- Technical knowledge development

These outcomes enhance human capital formation and improve development prospects.

3.5 Human Capital Theory and the Study Variables

The Human Capital Theory provides a logical explanation for the relationship between the study variables.

Container Shipping Operations (CSO)

Efficient container shipping promotes trade expansion, industrial growth, and commercial activities. These activities create jobs, increase incomes, and improve welfare, which contribute positively to human development.

Bulk Cargo Shipping Operations (BCSO)

Bulk cargo transportation supports agriculture, construction, manufacturing, and industrial production. These sectors generate employment opportunities and income necessary for enhancing education, healthcare, and living standards.

Tanker Shipping Operations (TSO)

Tanker shipping facilitates crude oil exports, which constitute a major source of government revenue and foreign exchange earnings. These resources can finance social investments that improve human development outcomes.

Liquid Cargo Shipping Operations (LCSO)

Liquid cargo shipping supports energy security, industrial productivity, and export diversification. These activities contribute to economic expansion and create opportunities for human capital development.

Infrastructure Development (IND)

Infrastructure enhances the efficiency of shipping operations and increases their ability to stimulate economic activities. Improved infrastructure strengthens the channels through which shipping operations contribute to human welfare and human development.

3.6 Theoretical Link Between Shipping Operations and Human Development

From the perspective of Human Capital Theory, shipping operations influence human development through a chain of economic and social interactions.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

Pathway 1

Shipping Operations → Trade Expansion → Employment Generation → Increased Household Income → Better Education and Healthcare → Human Development

Pathway 2

Shipping Operations → Government Revenue Generation → Public Investment in Social Services → Improved Welfare → Human Development

Pathway 3

Shipping Operations → Industrial Growth → Skills Development and Productivity → Human Capital Formation → Human Development

Pathway 4

Shipping Operations → Infrastructure Investments → Improved Economic Opportunities → Poverty Reduction → Human Development

These pathways illustrate how economic activities generated by maritime transportation ultimately translate into improvements in human welfare.

3.7 Justification for the Adoption of Human Capital Theory

The Human Capital Theory is considered the most appropriate theoretical foundation for this study for several reasons.

First, the theory directly links economic activities with improvements in human welfare, which is the primary focus of this research.

Second, it explains how income generation, employment creation, and investments resulting from shipping operations can enhance education, healthcare, and living standards.

Third, the theory supports the use of the Human Development Index (HDI) as a measure of development because HDI captures the core dimensions of human capabilities emphasized by the theory.

Fourth, the theory provides a coherent explanation for the moderating role of infrastructure development. Infrastructure increases the productivity of shipping operations and strengthens their contribution to human welfare.

Finally, the theory aligns with the study's argument that shipping operations should not be viewed merely as transportation activities but as strategic economic mechanisms capable of enhancing human capabilities, expanding opportunities, and improving quality of life.

3.8 Theoretical Proposition of the Study

Based on the Human Capital Theory, this study proposes that:

Improvements in shipping operations generate employment opportunities, stimulate trade and investment, increase government revenues, enhance industrial productivity, and promote infrastructure development. These outcomes contribute to higher incomes, better education, improved healthcare, enhanced living standards, and ultimately higher levels of human development in Nigeria.

Therefore, the theory predicts a positive relationship between Container Shipping Operations (CSO), Bulk Cargo Shipping Operations (BCSO), Tanker Shipping Operations (TSO), Liquid Cargo Shipping Operations (LCSO), Infrastructure Development (IND), and Human Development Index (HDI).

3.9 Conceptual Model Derived from Human Capital Theory

Container Shipping Operations (CSO)
↓
Bulk Cargo Shipping Operations (BCSO)
↓
Tanker Shipping Operations (TSO)
↓
Liquid Cargo Shipping Operations (LCSO)
↓
Trade Expansion, Employment, Income Generation, Industrial Growth
↓
Education, Health and Welfare Improvements
↓
Human Development (HDI)

Infrastructure Development (IND) acts as a moderating variable that strengthens the relationship between shipping operations and human development by improving efficiency, connectivity, productivity, and accessibility.

This framework provides the theoretical basis for the empirical examination of the relationship between shipping operations and human development in Nigeria from 1990 to 2025.

4.0 EMPIRICAL REVIEW

4.1 Introduction

Empirical studies have consistently demonstrated that maritime transport plays a vital role in facilitating trade, promoting economic growth, enhancing industrial productivity, and generating employment opportunities. Efficient shipping systems reduce transportation costs, improve market accessibility, support international trade, and stimulate economic development. However, while extensive literature exists on the relationship between maritime activities and economic performance, relatively few studies have examined how shipping operations influence human development outcomes such as income, health, and education.

This section reviews existing studies under the themes of shipping operations and development, container shipping, bulk cargo shipping, tanker shipping, liquid cargo shipping, infrastructure development, and human development.

4.2 Shipping Operations and Economic Development

Several studies have established a positive relationship between shipping activities and economic performance. Stopford (2009) observed that maritime transport supports international trade and industrial development by reducing logistics costs and improving global market access. Similarly, UNCTAD (2023) reported that maritime transport carries over 80 percent of global merchandise trade and remains fundamental to economic growth and competitiveness.

Rodrigue (2020) found that efficient transport systems enhance productivity, investment flows, and regional integration, thereby promoting economic development.

Overall, the literature suggests that shipping operations contribute significantly to economic growth through trade facilitation, investment attraction, and increased productivity.

4.3 Container Shipping Operations and Development

Container shipping has been widely recognized as a catalyst for trade expansion and industrial development. Bernhofen, El-Sahli, and Kneller (2016) found that containerization significantly increased global trade by

reducing transportation costs and improving logistics efficiency.

Notteboom and Rodrigue (2019) reported that increased container throughput stimulates industrial growth, employment creation, and regional economic development. Similarly, Wilmsmeier and Hoffmann (2018) found that improved container shipping connectivity enhances trade competitiveness and export performance.

These studies indicate that container shipping contributes to development through increased trade integration, industrial expansion, and job creation.

4.4 Bulk Cargo Shipping Operations and Development

Bulk cargo shipping supports the transportation of raw materials essential for agriculture, manufacturing, and construction. Lim and Hoffmann (2018) found that efficient bulk transportation improves industrial productivity and economic performance by ensuring the steady supply of production inputs.

Cullinane and Wang (2010) established a positive relationship between bulk cargo throughput and economic growth, while OECD (2019) emphasized its role in supporting food security, infrastructure development, and employment generation.

The literature therefore identifies bulk cargo shipping as a key driver of industrialization and economic transformation.

4.5 Tanker Shipping Operations and Development

Tanker shipping is particularly important in oil-exporting economies due to its role in transporting crude oil and petroleum products. Adeniyi and Olagunju (2022) found that oil export activities significantly contribute to government revenue, foreign exchange earnings, and economic development in Nigeria.

Similarly, Nwokoma and Amadi (2021) reported that tanker shipping positively influences export performance and national income through increased foreign exchange inflows. Stopford (2009) further emphasized that tanker transportation supports energy security and economic stability.

These studies suggest that tanker shipping remains a strategic source of development financing in petroleum-dependent economies.

4.6 Liquid Cargo Shipping Operations and Development

The growing importance of liquefied natural gas (LNG) and other liquid commodities has increased interest in

liquid cargo shipping. UNCTAD (2022) reported that LNG transportation contributes significantly to global energy security and export diversification.

Ibrahim and Yusuf (2020) found that LNG exports enhance Nigeria's foreign exchange earnings and industrial development. Likewise, Eze and Okafor (2021) observed that efficient transportation of liquid energy products supports manufacturing, power generation, and economic growth.

Thus, liquid cargo shipping contributes to industrial expansion, energy security, and economic diversification.

4.7 Infrastructure Development and Maritime Performance

Infrastructure has been identified as a critical determinant of maritime efficiency and development outcomes. Calderón and Servén (2014) found that transport infrastructure improves productivity, lowers logistics costs, and stimulates economic growth.

Button (2017) reported that infrastructure enhances market accessibility and economic opportunities, while Obi, Afolabi, and Eze (2023) identified poor infrastructure as a major constraint to Nigeria's maritime sector performance.

The literature therefore highlights infrastructure as a crucial factor in maximizing the benefits of shipping operations.

4.8 Shipping Operations and Human Development

Although most studies focus on economic growth, emerging evidence suggests that transportation systems also influence human development. UNDP (2022) reported that transport activities improve welfare through employment creation, income generation, and enhanced access to social services.

Similarly, the World Bank (2021) found that efficient transport systems contribute to improved living standards, poverty reduction, and social development. Ahmed and Hassan (2020) further established that transport infrastructure positively affects education, healthcare, and employment outcomes.

These findings suggest that shipping operations may contribute to human development through multiple socio-economic channels.

4.9 Empirical Gap

Despite extensive research on maritime transport and economic growth, several gaps remain:

1. Most studies focus on economic growth rather than human development.
2. Existing studies largely use aggregated measures of maritime transport and do not distinguish between container, bulk cargo, tanker, and liquid cargo shipping.
3. Limited studies assess the moderating role of infrastructure development.
4. Few studies examine both short-run and long-run relationships using ARDL techniques.
5. Empirical evidence linking shipping operations directly to Human Development Index (HDI) in Nigeria remains scarce.

4.10 Contribution of the Present Study

This study addresses these gaps by:

- Using Human Development Index (HDI) as the dependent variable.
- Disaggregating shipping operations into Container Shipping Operations (CSO), Bulk Cargo Shipping Operations (BCSO), Tanker Shipping Operations (TSO), and Liquid Cargo Shipping Operations (LCSO).
- Incorporating Infrastructure Development (IND) as a moderating variable.
- Examining both short-run and long-run effects using the ARDL framework.
- Providing evidence from Nigeria covering the period 1990–2025.

Accordingly, the study contributes to maritime economics and development literature by providing a comprehensive assessment of how shipping operations influence human development in Nigeria**.**

5.0 METHODOLOGY

5.1 Research Design

This study adopts an ex-post facto research design to examine the relationship between shipping operations and human development in Nigeria over the period 1990–2025. The choice of this design is informed by the fact that the study relies on historical and secondary data on shipping activities, infrastructure development, and human development indicators, which are beyond the control or manipulation of the researcher.

The ex-post facto approach is appropriate because it enables the investigation of causal relationships among variables based on existing economic and maritime records. It also provides a robust framework for analysing long-run trends and evaluating how changes in Container Shipping Operations (CSO), Bulk Cargo Shipping Operations (BCSO), Tanker Shipping Operations (TSO), and Liquid Cargo Shipping Operations (LCSO) have influenced Human Development Index (HDI) in Nigeria.

The study utilizes annual time-series data spanning thirty-six (36) years, covering 1990 to 2025. This period was selected to capture major developments in Nigeria's maritime sector, including port reforms, increased containerization, expansion of crude oil and LNG exports, infrastructure investments, and the evolution of the Blue Economy agenda. The extended time horizon also facilitates the assessment of both short-run dynamics and long-run relationships among the variables.

To achieve the study objectives, the Autoregressive Distributed Lag (ARDL) modelling framework is employed because it accommodates variables integrated at different orders, I(0) and I(1), and allows for the estimation of both short-run and **long run** effects within a single model. The ARDL approach further provides a reliable mechanism for testing cointegration and determining the speed of adjustment towards long-run equilibrium through the Error Correction Model (ECM).

Accordingly, the research design provides a suitable empirical foundation for examining how shipping operations contribute to human development and the extent to which infrastructure development moderates this relationship in Nigeria**.**

5.2 Model Specification

The functional relationship is expressed as:

$$HDI = f(C, S, O, B, CSOTSOLCSOIND)$$

Expanded model:

$$HDI_t = \beta_0 + \beta_1 CSO_t + \beta_2 BCSO_t + \beta_3 TSO_t + \beta_4 LCSO_t + \beta_5 IND_t + \mu_t$$

5.3 Estimation Technique

The study employs:

- Unit Root Test
- ARDL Bounds Test
- ARDL Long-Run Estimation
- Error Correction Model (ECM)
- Diagnostic Tests
- Stability Tests

6. RESULTS AND DISCUSSION

6.1 Unit Root Results

The variables exhibited mixed integration orders I(0) and I(1), justifying the use of ARDL methodology.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue XI November 2026

6.2 Bounds Cointegration Test

Table 1: ARDL Bounds Test

Table 1: ARDL Bounds Test

Statistic	Value
F-Statistic	4.9789

The F-statistic exceeds the upper bound critical value, indicating a long-run relationship among the variables.

6.3 Long-Run Results

Table 2: Long-Run ARDL Estimates

Variable	Coefficient	Probability
CSO	0.006996	0.0287
BCSO	0.055806	0.0000
TSO	0.005763	0.0003
LCSO	0.031939	0.0020

Interpretation

Container Shipping Operations

Container shipping positively affects human development. A unit increase in container shipping activities increases HDI by approximately 0.7%.

Bulk Cargo Shipping Operations

Bulk cargo shipping exhibits the largest positive effect on HDI. Increased movement of bulk goods supports industrial production and employment creation.

Tanker Shipping Operations

Tanker operations contribute significantly to human development through revenue generation and economic expansion.

Liquid Cargo Shipping Operations

Liquid cargo shipping promotes energy availability, industrial activities, and welfare improvement.

6.4 Short-Run Results

Table 3: Short-Run Estimates

Variable	Coefficient	P-value
CSO	0.004006	0.0240
BCSO	0.007766	0.0012
TSO	0.003476	0.0105
LCSO	0.006953	0.2110

The results indicate significant short-run effects for CSO, BCSO, and TSO.

6.5 Infrastructure Moderation Analysis

Table 4: Interaction Effects

Interaction Term	Coefficient	P-value
CSO × IND	0.326395	0.0170
BCSO × IND	0.397664	0.0325
TSO × IND	0.091977	0.0349
LCSO × IND	0.090046	0.5349

Interpretation

Infrastructure significantly strengthens the impact of:

- Container shipping
- Bulk cargo shipping
- Tanker shipping

on human development.

This suggests that investments in ports, access roads, logistics facilities, and transportation networks amplify the developmental outcomes of shipping activities.

6.6 Error Correction Mechanism

The error correction coefficient was negative and statistically significant, confirming adjustment toward long-run equilibrium following short-run disturbances.

The result indicates a stable long-run relationship among the variables.

7.0 DISCUSSION OF FINDINGS

The findings reveal that shipping operations are significant drivers of human development in Nigeria, underscoring the strategic role of the maritime sector in promoting socio-economic welfare. The results show that all categories of shipping operations positively influence the Human Development Index (HDI), though with varying degrees of impact.

Among the shipping indicators, Bulk Cargo Shipping Operations (BCSO) emerged as the strongest contributor to human development. This can be attributed to its close linkages with agriculture, manufacturing, construction, and industrial production, sectors that generate employment, support food security, and stimulate income growth.

Container Shipping Operations (CSO) were found to enhance human development through improved trade efficiency, market accessibility, and commercial activities. Increased container traffic facilitates the movement of goods, encourages investment, and creates economic opportunities that translate into higher incomes and improved living standards.

Similarly, Tanker Shipping Operations (TSO) exert a positive influence on human development by generating export earnings, foreign exchange revenues, and government income. These resources provide funding for critical social investments in education, healthcare, infrastructure, and poverty reduction programmes.

Liquid Cargo Shipping Operations (LCSO) also contribute positively to human development, particularly through improved energy security, industrial expansion, export diversification, and employment generation. The sector supports productive economic activities that enhance welfare and overall quality of life.

Furthermore, the results indicate that Infrastructure Development (IND) significantly strengthens the relationship between shipping operations and human development. Efficient ports, transport networks, logistics facilities, and supporting infrastructure enhance operational efficiency, reduce logistics costs, improve trade flows, and amplify the developmental benefits of maritime activities.

Overall, the findings support the Human Capital Theory, which posits that productive economic activities generate income, employment, and investment opportunities that improve human capabilities and welfare. The study therefore confirms that shipping operations contribute not only to economic growth but also to broader human development outcomes through enhanced income, better access to social services, improved living standards, and greater economic opportunities.

8. POLICY IMPLICATIONS

Based on the findings, policymakers should:

1. Modernize seaport infrastructure.
2. Deepen channel capacity for larger vessels.
3. Expand container terminal facilities.
4. Improve intermodal transport connectivity.
5. Strengthen public-private partnerships in maritime infrastructure.
6. Encourage private investments in logistics parks.
7. Support digitization of cargo handling systems.
8. Reduce port congestion through automation.
9. Promote maritime workforce development.
10. Improve regulatory efficiency within the shipping sector.

9. CONTRIBUTION TO KNOWLEDGE

This study contributes to existing literature by:

1. Establishing a direct empirical relationship between shipping operations and human development.
2. Disaggregating shipping operations into container, bulk cargo, tanker, and liquid cargo segments.
3. Introducing infrastructure development as a moderating variable.
4. Demonstrating that bulk cargo shipping has the greatest human development effect among shipping indicators.
5. Providing evidence from Nigeria's maritime industry covering 1990–2025.

10. CONCLUSION

This study examined the effect of shipping operations on human development in Nigeria using ARDL estimation techniques. The findings reveal that container shipping, bulk cargo shipping, tanker shipping, and liquid cargo shipping significantly improve human development in the long run. Bulk cargo shipping exerts the strongest influence on human development outcomes. Infrastructure development significantly enhances the developmental contribution of shipping activities.

The study concludes that effective maritime transportation systems constitute an important mechanism for improving welfare, reducing poverty, creating employment, enhancing income generation, and promoting sustainable human development in Nigeria. Consequently, strategic investments in maritime infrastructure and shipping efficiency should form a central component of Nigeria's development agenda.

REFERENCES

1. Becker, G. S. (1964). *Human Capital: A Theoretical and Empirical Analysis*. University of Chicago Press.
2. Cullinane, K., & Talley, W. K. (2011). Research in Transportation Economics.
3. Nigerian Ports Authority (NPA). Statistical Reports.
4. United Nations Development Programme (UNDP). Human Development Reports.
5. UNCTAD (2024). *Review of Maritime Transport*.
6. Stopford, M. (2009). *Maritime Economics* (3rd Edition).
7. Rodrigue, J. P. (2020). *The Geography of Transport Systems*.
8. World Bank (2024). *World Development Indicators*.
9. Akpan, E. S. (2022). Maritime Transport and Economic Development in Nigeria.
10. NIMASA Annual Statistical Bulletin (Various Years).