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Maritime Transport Accessibility Challenges in Nigeria's Niger Delta Region and the Impact On Socio-Economic Development in the Region

By

[1]Oberhonobe Odjegba Joseph, [1]Obed C. Ndikom, [1]Theophilus C. Nwokedi
[1]Department of Maritime Management Technology, Federal University of Technology, Owerri, Nigeria

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Corresponding author
Oberhonobe Odjegba Joseph

Abstract

This study assesses the challenges facing maritime transport and their socio-economic impact in the Niger Delta region. Utilizing a Principal Component Analysis (PCA) and the willing to Accept (WTA) method of the Contingent valuation Method (CVM), the research identifies four determinant challenges: infrastructural deficiencies, safety and security concerns (maritime insecurity and accidents), hazards of marine environmental pollution, and inadequate implementation of regulatory standards and policies. These factors collectively account for 67.7% of the variance in maritime transport challenges. The study reveals significant economic costs borne by various productive populations due to inefficient maritime transport systems. Crop farmers incur an average economic loss of N2,692,000/capita/year, fishery and aquaculture operators N2,707,000/capita/year, traders N3,229,000/capita/year, and service providers N2,736,000/capita/year, with an overall average loss of N2,841,000/capita/year. The findings underscore the critical need for targeted policy interventions focusing on infrastructure development, strengthening maritime security, environmental protection, and robust regulatory enforcement to enhance maritime transport efficiency and foster socio-economic development in the Niger Delta region.

Keywords: *marine transport, challenges, maritime-safety, security, Niger-delta-region*

1.0 Introduction

Marine transportation plays a crucial role in the economic development and regional integration of coastal and riverine communities. In Nigeria's Niger Delta region, where vast waterways intersect numerous remote settlements, marine transport is not just a mode of movement—it is a lifeline for trade, mobility, access to basic services, and socio-economic growth. Despite its strategic importance, the sector faces significant challenges ranging from poor infrastructure and safety concerns to governance, policy, and environmental degradation.

The greatest problem of mankind has been how to bridge the gap that existed between points of origin and destination as relative products availability and scarcity are concerned. Transport investment link factors of production together in a web of relationship between producers and consumers to create a more efficient system of production and distribution. It is known to leverage geographical comparative advantage and provide the means to expand economies of scale and scope (Amewero, 2005). The contributions of transportation system to socio-economic development of a nation include the following:

- Network- Effect-Linking more locations exponentially as it increase the value and effectiveness of the locations and their products.
- Performance improvement by reducing cost and time for existing passengers and freight movement as they increase the contributions to economic growth
- Reliability: Transportation improves times performance and reduces loss and damage, thus reducing economic wastes (Ndikom, 2006).
- Transportation increase the market size of products as it leads to access to wider market, add to economic of scale in product distribution and consumption thereby increasing economic growth.
- Productivity: Transport increase productivity gained from access to a large and more diverse base of inputs

such as raw materials, parts energy and labour and broader market for more diverse outputs (Amewero, 2005).

Transport has affected economic development from the beginning of human civilization. Economic development flourished at the confluence of transport system especially rivers. Early cities grew up on natural bags, port, and lakes where transport was available (Amewero, 2005). The Romans built road to unify and provide access to their far-flung empires. Geographic characteristics such as proximity to oceans, seas and waterways, plains, mountains and the location of Oasis defined early transport system e.g, the "skill road" went from Oasis to Oasis and city top City where there were no reliable water n road routes. The industrial revolution generated new transport demands, which required higher volumes of coal, iron, ore and other materials. This led to canal connection that extended water transport and to early railways development. Transport has been the sector that, has successfully provided a meaningful solution to the problem through its numerous roles.

About eighty percent (80%) of the earth surface is covered by water. The movement of goods and passengers by water dates back into history over the centuries, the discovery of new lands by sea-going adventures and the continuing exploitation of technology by shipping industry has steadily exalted the role of maritime transportation in the growth of international trade and global economy (Rodrigue, 2017).

The marine transportation is indispensable if people and nations are to be empowered. Transport is to the Nigerian economic as artery is to the blood circulatory system. Without maritime transportation, Nigeria would have been land-locked and its economy would have not move forward but remains stagnant in different area (Adams, 2002).

Marine transport is a mode of transport developed to bridge the gap created by the inabilities of land transport to cope with the unfolding trends of the industrial revolution of the 18th century. In other words, other modes of transport has limitation in coping with the movement of large or bulks of goods from where they were produced and where not immediately needed to where their relative importance and value are greater. Maritime transport is an essential tool for the growing and development of all activities in space particularly when natural and human resources are definitely deployed. According-6 Ndikom (2011). Maritime transport is an activity that serves as the driving force for the bulk movement of people, information, raw materials and maintains a society. Nigerian involvement in importation and exportation of goods depended largely on maritime transport, because other modes were either non-existent, undeveloped or very expensive (Ndikom, 2006).

Many Niger Delta coastal communities and LGAs like Burutu Local Government Area (LGA) in Delta State are emblematic of these realities. With its location along the Forcados River and its historical significance as a trading and maritime hub, Burutu for example has enormous untapped potential. However, persistent challenges in marine transportation have contributed to its underdevelopment and social marginalization. Limited investment in port infrastructure, inadequate vessels, lack of regulatory oversight, and environmental issues such as oil spills and flooding continue to impede progress. Several studies highlight the importance of marine transport in facilitating trade, employment, and regional connectivity. According to Oni (2018), efficient water transport systems enhance access to markets, reduce transportation costs, and stimulate local economies. In the Niger Delta, marine transport is vital due to the region's extensive waterways, which serve as primary routes for goods and passengers (Ebeku, 2020). However, inefficiencies in this sector can hinder economic progress, particularly in areas like Burutu, where alternative transport modes are limited. However, there exist critical challenges that limited the efficiency of use of marine transport in Burutu LGA and negatively impacted on socioeconomic development of the region. Available empirical studies identify multiple challenges affecting marine transport in the Niger Delta. Some of these include:

(i). Poor and inadequate Infrastructure and Navigational Hazards

Studies by Nwilo et al. (2019) reveal that inadequate port facilities, dilapidated jetties, and siltation of waterways impede smooth marine operations. In Burutu, navigational hazards such as submerged wrecks and lack of dredging contribute to frequent boat accidents, disrupting transport services (Okonkwo & Eze, 2021).

(ii). Safety and Security Concerns

Piracy and waterway insecurity are major concerns in the Niger Delta. Research by Osinowo (2020) indicates that attacks on vessels and passengers discourage investment in water transport, reducing economic activities in riverine communities. Burutu, being a transit point for oil and goods, faces similar security threats, affecting trade and mobility.

(iii). Environmental Degradation and Climate Change

Oil spills and erosion exacerbate marine transport challenges in the Niger Delta. A study by Kadafa et al. (2021) found that pollution from oil exploration damages boats and clogs waterways, increasing transport costs. Additionally, climate-induced flooding worsens navigational difficulties, as seen in Burutu's recurring flood disasters (Amadi & Igwe, 2022).

(iv). Weak Regulatory Frameworks and Underinvestment

Empirical evidence suggests that poor policy implementation and underfunding hinder marine transport development. According to Igbokwe et al. (2020), government neglect of inland waterway management leads to inefficiencies. Burutu's reliance on federal interventions for waterway maintenance aligns with this finding, as local authorities lack the resources to sustain transport infrastructure.

(v) Inadequate or Limited Volumes of Trade and Commerce:

Ebeku (2020) found that poor marine connectivity reduces market access for fishermen and traders, lowering income levels in riverine communities.

(vi) High/Increased Transportation Costs

A study by Adeleke (2021) in the Niger Delta showed that transport fare hikes due to boat breakdowns and fuel scarcity disproportionately affect low-income residents.

(vii) Social Exclusion and Migration: Communities cut off by transport inefficiencies face marginalization, leading to rural-urban migration (Udoh & Ekpenyong, 2023).

These have impacts and implications on the socio-economic development of the region. For example, the Niger Delta region and Burutu consist majorly of inhabitants engaged in fishing, farming, trading, traditional community-based service providers (e,g transporters, herbalists, skilled-workmen and women, etc.), educationists, etc. The lack of access and immobility to transport experienced by these groups as a result of challenges in access to and use of marine transportation which constitute the most singular dominant transportation mode in the communities will have negatively consequences on the productivity. The need to process empirically the extent of these challenges to accessing marine transportation and understanding the impacts on the productivity of the various components of the population in the region is important.

This research seeks to critically assess the extent to which these specific challenges affect marine transportation in the region and analyze how these obstacles hinder productivity of the components of the population and facilitation of socio-economic development in the area. The study will provide evidence-based recommendations aimed at improving marine transport systems to boost local livelihoods, encourage economic activities, and foster regional development. By focusing on a localized case study, the research also aims to inform broader policy decisions for the sustainable development of similar riverine communities in the Niger Delta and beyond.

The proplems addressed in the study include the fact that marine transportation remains a vital component of mobility, trade, and socio-economic survival in the Niger Delta region, particularly in riverine communities like Burutu Local Government Area (LGA), Delta State' yet residents in the region faces accessibility challenges. In these areas, where road infrastructure is limited or non-existent, water transport serves as the primary means of accessing markets, healthcare, education, and administrative services. Despite its importance, marine transport in the region is severely constrained by a myriad of challenges that continue to undermine its efficiency, safety, and contribution to local development.

Persistent issues such as poor and inadequate infrastructure, navigational hazards, insecurity on waterways, environmental degradation, weak policy implementation, underinvestment, and high transport costs have significantly impacted the livelihoods of residents. These challenges restrict access to markets for traders and fishermen, increase the cost of doing business, and exacerbate social exclusion by limiting mobility for low-income and vulnerable groups. Moreover, environmental factors such as oil spills and climate-induced flooding further deteriorate the transport system, leading to increased economic vulnerability and reduced productivity among the population.

Existing empirical studies on marine transport challenges in the Niger Delta have largely been generalized and lack localized insights specific to coastal communities in the Niger Delta like Burutu LGA. There is a critical research gap in identifying and categorizing the determinant challenges affecting marine transport in the area, evaluating the associated economic costs on productivity, analyzing the trends in safety and security risks, and ranking these challenges in terms of their overall influence on socio-economic development. These gaps hinder the formulation of targeted, evidence-based policy responses and infrastructural interventions necessary for improving marine transportation and fostering inclusive regional development.

Therefore, this study seeks to identify the determinant challenges facing marine transport in the wider Niger Delta and evaluate the economic costs of these challenges on productivity within key socio-economic groups;

1.2. Aims and Objectives

The main aim of the study is to assess the maritime transport challenges and their impact on socio-economic development, Niger delta region. The specific objectives of the study are to:

(i) Identify the determinant challenges facing maritime transportation in the Nigeria delta region and communities

(ii) Evaluate the economic cost of challenges to access of maritime transport on productivity of the various components of the region's population.

1.3 The Research Questions

The research questions of the study hover around the challenges of maritime transport relative to their socio-economic impact on the Niger Delta region.

(i) What is the determinant challenges facing maritime transportation in the Nigeria delta region and communities?

(ii) What is the economic cost of challenges to access of maritime transport on productivity of the various components of the region's population?

2.0 Literature Review

Empirical studies such as Oni and Okanlawon (2015) and Akinyemi et al. (2018) have established a direct relationship between transportation infrastructure and regional development in riverine areas. Using econometric models, they demonstrated that improved access to water-based transport leads to increased economic activity, better market linkages, and reduced cost of goods in remote communities. However, they also identified that poor government funding and inadequate maintenance of jetties and vessels hinder sustained growth.

In a related study, Ezenwaji et al. (2020) used GIS mapping and socio-economic surveys in Delta and Bayelsa States to show that marine transport remains the most accessible mode of transportation in at least 60% of the rural coastal settlements. The study emphasized the urgency of policy intervention to address recurring issues of navigational hazards, boat mishaps, and poor safety regulations.

Olagunju and Adeyemo (2016) conducted a field survey in coastal communities across Lagos and Delta States and found that the lack of standardized boat engines, inadequate docking facilities, and inconsistent fuel supply are among the main operational constraints affecting marine transportation. Their study concluded that these constraints are not only technical but also institutional—reflecting poor regulatory enforcement and limited public-private partnership in the sector.

Similarly, Okon and Udoh (2017), in their case study of Cross River State, reported that delays in policy implementation and limited maritime education among local transport operators contribute to inefficiency and accidents. Their findings were based on interviews with 150 marine transport users and operators.

Several studies, including Nwilo and Badejo (2006), have explored the impact of environmental degradation on marine transport in the Niger Delta. Their work, based on satellite imagery and incident reports, identified that oil spills, siltation, and water hyacinth proliferation severely disrupt water routes, reduce navigability, and increase risks for both passengers and cargo. Ugochukwu and Ertel (2008) also provided empirical data linking oil exploration activities to increased sedimentation and erosion along navigable channels, thereby affecting transport reliability and safety in riverine communities.

Studies such as Ighodaro (2019) and Olomola (2020) evaluated how transport inefficiencies translate into higher transaction costs, reduced market access, and income inequality in riverine communities. Using household surveys and statistical analysis, these researchers showed that residents in poorly connected areas earn significantly less and face more difficulties accessing health and educational services compared to those in better-connected urban coastal areas. In particular, Ighodaro's logistic regression model demonstrated that households relying primarily on marine transport are 35% less likely to have access to essential services due to seasonal disruptions and poor scheduling.

Empirical research by Amadi and Kene (2021) focused on participatory governance and found that community involvement in transport planning significantly improves infrastructure sustainability. Their study, using qualitative interviews across three LGAs in Delta State, highlighted the success of local transport cooperatives in managing boat operations and maintaining docks when supported by local councils.

Similarly, Ekong (2018) emphasized the importance of integrating traditional knowledge systems and community feedback into marine transport policymaking to ensure culturally relevant and practical solutions in riverine environments.

3.0 Data and Methods

3.1 The Study Area

The study area of the research is the Nigerian maritime industry with particular emphasis on the coastal and inland water transport sub-sector in the Niger Delta region of Nigeria. The study areas covered include most coastal communities in the Niger Delta region that experience challenges in the access to and use of marine transport. For example, Burutu LGA in Warri Delta state in the Niger Delta, Okrika in Rivers State, Opobo, etc., are typical coastal communities in the region that must use marine transport system before they can access major markets and towns for economic and other transactions.

3.2 Research Design

The study employed survey research design. It employed both primary obtained from surveys The investigation is to reveal the determinant challenges facing maritime transportation in the Nigeria delta region and communities, evaluate the economic cost of challenges to access of maritime transport on productivity of the various components of the region's population, determine the trends of safety and security challenges to maritime transportation in the Niger Delta Communities and rank the challenges facing maritime transport development in the Niger delta communities in decreasing order of influence

3.3 Sources of Data

Primary data used in the study was sourced from respondents who are individual engaged in various forms of economic activities in Niger Delta coastal communities and who face inefficiencies in their operations as a result of the challenges encountered in the maritime transport systems in the region. The primary data were collected through the use of questionnaire as survey instruments. The questionnaire elicited the responses of the respondents on the on the extent to which each of the identified challenges constitute barriers and constraints to the development of the marine transportation systems and the economic development of the region. The identified challenges of maritime transport in the region hindering socio-economic development include:

i. Infrastructural and Navigational Challenges.
ii. Safety and Security Challenges.
iii. Environmental hazards and Climate-Related Challenges.
iv. Institutional and Policy-Related Challenges.
v. High transport (fare or freight) cost
vi. Poor standards and policy/regulatory inefficiency
vii. Low volume of trade and passenger traffic

These are already discussed in the section on literature review. The questionnaire was designed and administered to the coastal communities in the Niger Delta region to elicit their responses as to what extent these factor constitute serious maritime transport challenges that hinder their productivity in the region. Also respondent perceptions of the impacts/cost of challenges of maritime Transport challenges on their output and productivity levels were obtained by the use of questionnaire calibrated to elicit the responses using the Willingness to Acept (WTA) approach of the contingent valuation method. Primary data on the respondent's

perceptions of the extent of impacts of challenges of inadequacy of marine transportation systems on the productivity of the fishery and aquaculture operators, farmers and clusters of traders and service providers in the coastal communities was also obtained using the contingent valuation approach.

3.3.1 Population of the Study and Sampling Technique

The population of interest of the research from which primary data was sourced consisted of population living in the coastal communities engaged in one form of economic activity or the other that demands the use of marine transport services. The population of interest consists of residents in core coastal communities of the Niger delta region as earlier identified in Rivers, Bayelsa, Delta, Akwa-ibom and Cross-River States, that are engaged in one form of economic activity (fishing, trading, crop farming, other service providers, etc.) for which they demand and use marine transport services. These form the groups that face the challenges identified and their productive ventures are impacted most by these challenges. Since the actual population of these groups across the coastal communities sampled is not known with certainty, the study used the Z score formula for unknown population to determine the sample size while adopting a purposive random sampling method in which the individuals in the coastal communities engaged in any of the identified economic activities for which they use maritime transport were randomly sampled in the survey, interviewed, with copies of the questionnaire administered.

The determination of sample of unknown population using Z score is given as:

$$N = \frac{Z^2(P)(1-P)}{C^2} \qquad (3.1)$$

Where Z = standard normal deviation set at 95% confidence interval =1.96

P = percentage picking a choice or response =50%

C = confidence interval =0.05

Therefore $N = \frac{(1.96)^2(0.5)(1-0.5)}{(0.05)^2}$

$$N = \frac{0.9604}{0.0025}$$

$$N = 384.16$$

About 384 copies of the questionnaire were distributed to respondents in th coastal communities sampled in the study. Recall that the questionnaire was distributed to elicit the responses of the extent to which the identified constraints constitute challenges to the use of maritime transport and development in the region. It also elicited the perceptions on the economic cost of the underdevelopment of maritime transport systems in the region which has impacted their productivity. However, only 278 respondents representing about 72%were able to correctly fill and return their questionnaire.

3.3.2 Validity Test

Validity test ensures that the survey instrument (questionnaire) measures basically what is intended to be measured and is of various types (Field, 2005). The study tested the face and content validity of the survey instrument defined by Straub, Boudreau and Grefen (2004) as the degree to which the questions in a survey instrument reflect the content universe to which the instrument will be generalized. Thus, content validity test evaluates content of questionnaires (survey instruments) to ensure that only questions (items) that are essential are allowed while undesirable questions and items are struck out. The study adopted a quantitative approach to test the validity of the survey instrument in which content validity questionnaires were sent out to professionals in the same field of research for responses (Hamed, 2016). Each item in the questionnaire was assessed based on a three-point scale: not necessary, useful but not essential, and essential.

The content validity ratio (CVR) was determined by using Lawshe's (1975) method:

$$CVR = \frac{ne-(N/2)}{N/2} \qquad (3.2)$$

Where CVR = content validity ratio, n_e = number of experts or panel members indicating essential, N is the total number of experts or panel members. Note items in the survey instrument that are non-significant at critical level were eliminated.

However, to retain an item in the survey instrument based on the CVR is dependent on the population and/or size of the panel of experts sampled. Lawshe (1975) provided a guide for valid value of the CVR for retaining the evaluated questions (items) which were used in the study. The study used an expert population between 5 and 10 to validate the content of the survey instrument.

3.3.3 Testing Reliability of the Instrument

Reliability assesses repeatability and consistency of the responses to the survey instrument (Oladimeji, 2013). Testing for reliability is important as it refers to the consistency across the parts of a measuring instrument. Huck, (2007) writes that a measurement has high internal consistency and reliability if the items of the measurement "hang together" and measure the same construct. To measure the reliability and internal consistency of the survey instrument, we used the Cronbach Alpha coefficient.

It was determined after administering the survey instrument once to overcome the problems associated with testing over multiple time periods. Reliability was thus determined using the slit-half reliability index and the Cronbach Alpha index. The split-half estimate was done by dividing up the test into two parts first half of the items/second half of the items), administering the two forms to the same group of individuals in the population and correlating the responses. The coefficient alpha is the mean (average) of all possible split-half estimates while the existence of differences between the two was used to assess reliability.

To estimate coefficient alpha (a), we use:

$a = n/(n-1)\,[1 - \text{Sum Var}\,(Y_i)/\text{Var}\,(X)]$ (3.3)

Where n = Number of items

Sum Var (Y_i) = Sum of item variances

Var(X) = Composite variance.

Since many respondents, about 384 raters rated their perceptions of the extent to which the identified factors constitute challenges to marine transport system development in the region and the economic impacts, the inter-rater-reliability was also measured by using the correlation method to compare the correlation between the different responses of the raters (respondents) as with test-retest reliability method.

For decision purposes, the higher the reliability value, the more reliable the measure. Reliability values of 0.70 or higher is most acceptable (Nunnally and Bernstein; 1994). The result showed a correlation coefficient of 0.85 indicating that the responses are about 85% reliable.

3.4 Method of Data Analysis

3.4.1 Principal Component Factor Analysis (PCA)

The study used the PCA to provide answers to research question-1 which seeks to ascertain the determinant challenges facing maritime transportation development in the Niger delta region and the coastal communities. The principal component factor analysis (PCA) statistical method was used to analyze the data obtained from field survey in order to determine the determinant/significant challenges to marine transportation that operators significantly impede marine transportation development in the region. It reveals in empirical literature, the identified the challenges to marine transportation in the region to include:

i. Infrastructural and Navigational Challenges. (INFR)
ii. Safety and Security Challenges (SAFS).
iii. Environmental hazards and Climate-Related Challenges (ENHAZ).
iv. Institutional and Policy-Related Challenges (INSTP).
v. High transport (fare or freight) cost (COST)
vi. Poor standards and policy/regulatory inefficiency (STD)
vii. Low volume of trade and passenger traffic (TRDVOL)

The determinant challenges to marine transportation in the region was determined by subjecting the data obtained to principal Component Analysis using SPSS version21 analytical software.

3.4.2 Contingent Valuation Model (CVM)

The contingent valuation model (CVM) follows the stated preference (SP) approach to generate value for non-market goods such as environmental goods (impacts of challenges to transportation development on productivity of communities) in terms of willingness to pay for protection (WTP) or willingness to accept (WTA) compensation by the sample population in a survey. CVM as a survey research technique determine the benefits and costs implications of regulations, impacts of pollution or challenges on ecosystem and public policies by eliciting information directly from the sampled population about their preferences of values for a given policy, programme or regulation. Questions about how much they value the goods and services posed to the respondents enables responses to be gathered on the value the society places on such goods, policies and programmes. It is termed contingent because, the respondent's assignment of values to the goods or services is 'hypothetical' as the researcher will not necessarily provide the goods or services to the respondents in real terms. Thus, economic value for public goods and policy preferences such as environment benefits of addressing challenges to marine transportation system preservation, impacts/cost of marine transport system inefficiencies productivity of individuals in a coastal community, improvements in water or air quality, reductions in risks of death, etc., for which conventional markets does not exist can be determined by the use of CVM. While the willingness to pay (WTP) approach of CVM asks the sampled population questions on their willingness to pay to access and/or obtain a good such as improved marine transport system of a given community based on the value they place on the improved or developed transport system and the benefits expected; the willingness to accept (WTA) approach asks questions on the amount of fiscal value and/or compensation they can accept in order to give up the good.

$$V(y + WTA, p, q_0) = V(y, p, q_{1;}) \quad (3.5)$$

The both equations, the utility derivable from the policy or programme is dependent on the vector of individual characteristics affecting the trade-offs that they are willing to make between income and environmental quality.

The study will use the willing to accept approach of the CVM to determine the economic cost of marine transport system challenges cum inefficiencies to affecting the productivity of the various components of the region's population ranging from fishing and aquaculture groups, the crop farmers, traders and clusters of service providers in the coastal communities in the Niger Delta regions. The mean WTA/ WTP will be estimated based on responses gathered from the identified groups of respondents. The mean WTA will be multiplied by N, the aggregate size of the fishing population, crop farmers, traders and service providers for provides information on the economic cost of challenges to marine transport systems development to the productivity of the component of the coastal population and the amount which marine underwriters should provide as compensation benefits. It can equally serve as basis for assessing the performance of maritime transportation system efficiency in serving the needs of the coastal communities and determining allocation of economic resources for investment marine transport development programmes and policies. With open-ended questions, WTA/ WTP amounts reported the sampled population is simply averaged and a WTA/WTP estimate obtained:

$$MWTA = \frac{1}{n}\sum_{i=1}^{n}(y_i) \quad (3.5)$$

$$MWTP = \frac{1}{n}\sum_{i=1}^{n}(y_i) \quad (3.6)$$

Where: n = sample size,
y = reported WTA/WTP amount.

Sometimes the mean WTP could deceivingly high in situations where few respondents record abnormally too high WTP amounts.

Such few very large or very low WTP are normally recommended to be identified in order to reduce their influence on the mean. Carson (1991) suggests that, the use a-trimmed sampled mean in which a is set at predetermined percentage or a weighted average in which a weight of zero is attached to the highest and lowest (i.e a x 100) of the observations to effectively discharge them. If the WTP/WTA distribution is normal, the mean of the sample is the best (i.e. lowest-variance) estimator of the true population mean. It is however, common to assume that, the mean of CVM is not normal; where this happens that the distribution of population is not a normal, Using the willingness to accept (WTA) CVM approach discussed above, the study evaluated the economic cost of productivity losses affecting the component populations of the coastal communities in the Niger Delta as a result of the challenges to maritime transport development in the region, providing the basis for its adequate compensation and/or investment in marine transport systems in the region to improve the performance.

4.0 Results and Discussion

Table-4.1: Determinant Maritime Transport Challenges in Niger Delta Coastal Communities Nigerian frontline

	Mean	Std. Deviation	Analysis N
INFR	27.08633	9.060552	278
SAFS	18.66906	9.074015	278
ENHAZ	27.8777	7.019273	278
TRDVOL	13.34532	4.726776	276
INSTP	13.77698	4.856858	278
COST	13.09353	4.630603	278

Communalities

	Initial	Extraction
INFR	1.000	.521
INSTP	1.000	.913
COST	1.000	.654
TRDVOL	1.000	.792
SAFSD	1.000	.491
ENHAZ	1.000	.520

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.009	22.317	22.317	2.009	22.317	22.317
2	1.556	17.294	39.611	1.556	17.294	39.611
3	1.441	16.006	55.616	1.441	16.006	55.616
4	1.088	12.083	67.700	1.088	12.083	67.700
5	.410	4.555	100.000			
6	3.394E-017	3.771E-016	100.000			

a. 4 components extracted. Source: Author

Table4.1 above is the result of the Principal Component factor Analysis (PCA) conducted to determine the determinant challenges to maritime transport systems development and efficiency in the coastal communities of the Niger Delta region. This becomes necessary since some of the identified challenges to maritime transport system's efficiency in the Niger Delta region may be positively correlated such that they increase or decrease in the same direction. As a result, the PCA will reduce the number challenges or barriers to only significant challenges/factors in order that the maritime transport planning and administration authorities can prioritize the elimination of the determinant/significant challenges to maritime transport system development and efficiency in the Niger Delta region of Nigeria.

The mean values of the challenges range from 13.0935 (COST) to 27.8777 (ENHAZ), indicating that some variables have higher central tendencies. The standard deviations are relatively close across variables, suggesting moderate dispersion around the means. The result indicate that while infrastructural challenges (INFR) which has to do with the lack of and inadequate investment in maritime infrastructure such as river ports, piers, navigational channels, etc., has a mean score of 27.0864 with standard deviation of 0.061,safety and security challenges (SAFS) which has to do with the prevalence of maritime insecurity and maritime accident in the waters of the region has mean score of 18.669 with standard deviation of 9.0740 and prevalence of hazards of environmental pollution (ENHAZ) in the waters of the Niger Delta has mean score of 27.877 and standard deviation of 7.01927.

Similarly, low trade volumes (TRADVOL), and poor institutional and regulator policy standards (INSTP) each have respective mean scores of 13.345 and 13.7769 with standard deviations of 4.72678 and 4.8569 respectively. High transportation cost as a challenge to maritime transport development and efficiency in the Niger Delta region has a mean score of 13.094 with standard deviation of 4.6306.

The correlation matrix reveals the relationships between the variables while the communalities which represent the proportion of variance in each variable that is accounted for by the extracted factors indicate that the highest communalities are for SAFS (0.93), TRDVOL (0.792), INSTP (0.759). These high communalities suggest that these variables contribute significantly to the extracted principal components.

The Eigen values indicate that only four principal components with Eigen values that are each greater than one (Eigen >1) are extracted as the determinant factors. That is, principal components with the Eigen values 2.01, 1.56, 1.44 and 1.09 are extracted.

Table4 shows the factor loadings for each factor/challenge (variable) across the four extracted principal components.

Variables with higher absolute values (≥ 0.5|) are more strongly associated with a given component.

The PCA result identified 4 principal component factors considered the determinant challenges to maritime transport operations in the Niger Delta region to include: infrastructural challenges (INFR) with Eigen value of 2.009, safety and security challenges (SAFS) with Eigen value of 1.556, hazards of marine environmental pollution with Eigen value of 1.441 and poor cum inadequate implementation of regulatory standards and policies with Eigen value of 1.088. The first four components are responsible for 67.7% of the variances. The figure-6 below shows the screen plot of the extracted principal components based on Eigen values.

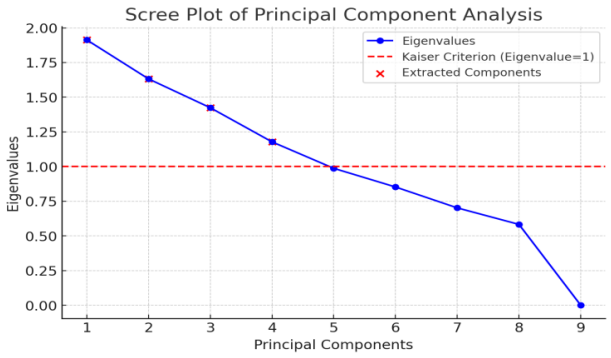

Figure-1: screen plot of the extracted principal components based on Eigen values. Source: Prepared by the author

However, from the factor loadings table, we can determine which variables contribute most too each principal component (PC) and that form the determinant factors that constitute challenges to marine transport development in the Niger Delta region of Nigeria.

The implication is that in order to improve access to maritime transport operations and productivity maritime administrators should focus on improving the four principal component challenges which include factors related infrastructural challenges (INFR) with Eigen value of 2.009, safety and security challenges (SAFS) with Eigen value of 1.556, hazards of marine environmental pollution with Eigen value of 1.441 and poor cum inadequate implementation of regulatory standards and policies with Eigen value of 1.088.

Table4.2: Economic Cost of Productivity Loses to the Component of the Productive Population in the Niger Delta Regions Occasioned by Maritime Transport Challenges and Inefficiency

Components of the population	WTA /capita/year ₦000
Crop farmers	2,692,000
Fishery & Aquaculture Farmers	2,707,000
Traders	3229000
Clusters of service providers	2736000
Overall Average WTA /capita/year ₦000	2841000

Source: Author's calculation

The result on Table4.2 above provides evidence of the level of output losses associated with challenges to maritime transport development, affecting the productivity of components of the productive population in the Niger Delta communities. Using the Willing to Accept (WTA) approach of the Contingent Valuation method (CVM), the study findings indicate that crop farmers in the Niger Delta communities affecting by inefficient maritime transport system suffer an average economic cost of ₦2692000/capita/year. The implication is that as a result of the challenges to the development and use of effective maritime transport systems in the coastal communities, the perception of crop farmers in the region is that each crop farmer lost an average of ₦2692000/year.

Similarly, fishery and aquaculture operators in the Niger Delta coastal communities have a willingness to accept (WTA) score of ₦2707000/capita/year. This implies that the each fishery and aquaculture farmer in the Niger delta region suffer and average economic cost of ₦2707000/capita/year as a result of the challenges associated with accessibility and use of maritime transport systems and infrastructure in the region.

Traders and clusters of service providers in Niger Delta region each have respective WTA scores of ₦3229000/capita/year and ₦2736000/capita/year respectively. The implications is that while each trader loses and average ₦3229000/capita/year to the challenges and inefficiency of maritime transport system in the coastal communities; each service provider in the coastal communities loses an average of ₦2736000/capita/year as a result of the challenges faced in the access and use of maritime transport services in the region.

The findings of the study indicate that traders in the coastal communities of the Niger Delta region suffer the worst economic impacts of challenged and inefficient maritime transport systems and services in the Niger Delta communities. The overall average WTA score for all components of the productive population in the coastal communities of the Niger Delta is ₦2841000/capita/year.

4.3. Policy Implications

Based on the study's findings, several policy implications emerge for improving maritime transport operations and socio-economic development in the Niger Delta region:

1. **Prioritization of Determinant Challenges:** Maritime transport planning and administration authorities should prioritize addressing the four principal determinant challenges identified by the PCA: infrastructural challenges, safety and security challenges, hazards of marine environmental pollution, and poor/inadequate implementation of regulatory standards and policies. Focused interventions in these areas are crucial for improving access and productivity in maritime transport operations.
2. **Investment in Maritime Infrastructure:** Given that infrastructural challenges have a high mean score and are a determinant factor, there is a clear need for increased and adequate investment in critical maritime infrastructure such as river ports, piers, and navigational channels. This will directly address a significant barrier to efficient maritime transport.
3. **Enhanced Maritime Security Measures:** The prevalence of safety and security challenges, particularly pirate attacks and vandalism of offshore infrastructure, necessitates enhanced maritime security measures. This includes strengthening naval patrols, improving surveillance, and implementing effective anti-piracy strategies to protect vessels and infrastructure. The non-significant trends in these incidents highlight the ongoing need for robust security interventions.
4. **Environmental Protection and Pollution Control:** The significant impact of marine environmental pollution hazards underscores the importance of stringent environmental regulations and effective pollution control measures. Policies should aim to prevent and mitigate pollution to ensure the sustainability of marine ecosystems and safeguard maritime operations.
5. **Strengthening Regulatory Frameworks and Implementation:** The study identified poor and inadequate implementation of regulatory standards and policies as a key challenge. Policy efforts should focus on reviewing, strengthening, and effectively enforcing existing maritime transport regulations to ensure compliance and improve operational efficiency.
6. **Mitigating Economic Losses for Stakeholders:** The substantial economic costs borne by various productive population segments, particularly traders, due to inefficient maritime transport systems, call for targeted interventions. Policies aimed at improving maritime transport efficiency will directly alleviate these economic burdens, thereby enhancing the livelihoods and productivity of crop farmers, fishery and aquaculture operators, traders, and service providers in the region. This could include subsidies for transport, improved logistics networks, or direct support for affected communities.
7. **Data-Driven Decision Making:** The study's use of statistical analysis, including PCA and trend analysis, provides a strong foundation for data-driven policy decisions. Future policy development and evaluation should continue to rely on robust data collection and analysis to ensure effective allocation of resources and measurable outcomes

5.0 Conclusion

This study thoroughly assessed the challenges impacting maritime transport and their ripple effects on the socio-economic development of the Niger Delta region. The study conclusively identified four primary determinant challenges to maritime

transport operations in the Niger Delta: inadequate infrastructure, pervasive safety and security threats, prevalent marine environmental pollution hazards, and significant shortcomings in the implementation of regulatory standards and policies. These factors are interconnected and collectively impede the efficiency and development of the maritime sector in the region.

The economic burden of inefficient maritime transport is substantial and directly impacts various components of the productive population. Traders experience the highest economic losses, followed by service providers, fishery and aquaculture operators, and crop farmers, indicating a widespread negative impact on livelihoods and regional productivity.

6.0. Recommendations

Based on the study's conclusions, the following recommendations are put forth to address the challenges in maritime transport and foster socio-economic development in the Niger Delta region:

- **Strategic Investment in Maritime Infrastructure:** Given the significant impact of infrastructural challenges, there is an urgent need for increased and sustained investment in developing and upgrading critical maritime infrastructure. This includes the construction and maintenance of modern river ports, piers, navigational channels, and associated facilities to enhance connectivity and operational efficiency.

- **Strengthening Maritime Security Architecture:** To mitigate the pervasive safety and security challenges, a robust and comprehensive maritime security architecture should be implemented. This should involve enhanced patrolling of waterways, improved intelligence gathering and sharing, deployment of advanced surveillance technologies, and increased collaboration among security agencies to combat piracy, vandalism, and other forms of maritime insecurity.

- **Effective Environmental Protection and Pollution Control Measures:** Addressing the hazards of marine environmental pollution requires the strict enforcement of environmental regulations and the implementation of proactive measures for pollution prevention, control, and remediation. This includes regular monitoring of water quality, prosecuting polluters, and promoting environmentally sustainable maritime practices.

- **Reform and Rigorous Implementation of Regulatory Standards:** To tackle the challenge of poor and inadequate implementation of regulatory standards and policies, a thorough review and reform of existing maritime transport policies are necessary. This should be followed by rigorous enforcement mechanisms, capacity building for regulatory bodies, and promotion of transparency and accountability in maritime governance.

- **Targeted Economic Support and Logistics Improvement:** To alleviate the substantial economic losses faced by various productive sectors, policies aimed at improving the efficiency and accessibility of maritime transport are crucial. This could include developing efficient logistics networks, providing support or incentives for businesses utilizing maritime transport, and exploring mechanisms to reduce transportation costs for goods and services in the region.

- **Promoting Public-Private Partnerships:** To ensure sustainable development and effective implementation of the above recommendations, encouraging public-private partnerships (PPPs) in maritime infrastructure development, security initiatives, and environmental management can leverage resources, expertise, and innovation from both sectors.

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