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Analysis of Travel Choice Behaviours of Commuters in the Niger Delta Region of Nigeria

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Abstract: This study modelled the travel choice behaviour among commuters in a few selected coastal capital cities in the Niger Delta, reference to road and inland waterways. Multinomial-logit model was used in explaining discrete choiceswhile multiple Regressions was used for the model equation. The following factors that influence the behaviour of commuters such as travel time, cost, and socio-demographic and socio-economic characteristics were investigated. A simple severity index was also used to ascertain the safety level of both ferries and automobiles which could influence commuters' mode choice behaviours. The alternative transport modes available to users were considered and include –private cars, walking, bus service and ferry (boat). From the findings, the use of private cars will be reduced considerably if the public transport sector is given attention in terms of infrastructure/facilities so they can compete. The greater percent that refused to change from private cars to public monorail show that private car users are attached to their cars not just for convenience but for prestige, flexibility, and privacy and finally, it was gathered from the model equation that variables like employment status, distance to work and driver's license had zero effect on the behaviour of people per their choice of transport mode.

Keywords: Travel, choice models, commuters, multi-logit, and transport modes.

I. Introduction

The act of moving people and products from one location to another is referred to as transportation in Webster's comprehensive dictionary. Transport's primary purpose is to transfer people and things over a medium (mode) and to places of greater usefulness while maintaining a level of service quality commensurate with the cost [1]. It is a component of all human endeavours and greatly determines the scope and location of these endeavours as well as the commodities and services that will be offered for purchase. [2] notes that cost and budget are the two most crucial aspects to take into account while delivering goods, and this also applies to commuters as stated in [3]. In today's world, where time is money, choosing the right mode of transportation is essential to getting where you're going or delivering goods efficiently [4]. Public transportation services are essential for getting to work, school, leisure, and travel, especially for those who can't drive, live in low-income households, are elderly or disabled, or do not have a car.

Social and economic connections have a close relationship with people's needs [5]. Because of their biological demands, societal needs, and personal preferences, humans engage in activities in various settings. People choose and decide which transport mode is best appropriate for them to meet these needs when their activities get more complex, and they move about more. The range of available travel modes has likewise expanded.According to [6], different forms of transportation have varied functions when it comes to carrying things; each one has advantages that others might not be able to provide, so it's up to the user to weigh all the options and make an informed choice. Sea transport, for example, is always the best means of transportation when speed is not of the essence, particularly for large or heavy items. In Nigeria, although the road mode (bus, taxi, private automobile) is more common, there are other modes as well, like inland water transport (ferries, speed boats), rail, and air travel (aeroplanes). [7] states that in situations when there are not enough financial resources, favourable conditions, or human effort, transportation can act as an accelerator for both economic growth and decline. Water transport is used in all of the Nigerian states that make up the Niger Delta. This demonstrates how important water travel has become to the country's economy, particularly in light of the difficulties associated with road transit.

With road transport accounting for 1.6% of Nigeria's GDP on average, water transport still trails far behind. With the exception of vacation and tourist traffic, where speed is not of the essence or alternative means are unavailable, such as islands, the mode is slow and unsuitable for passenger movement [8]. By expanding the areas to which commodities may be sent, an efficient transportation system can create place utility as goods are moved through marketplaces. Utility transportation not only creates space but also adds value to products by enabling them to be delivered to clients at the precise time and location they desire. This is especially helpful for products like perishables and seasonal goods that could expire quickly. But goods need to be in the right amount in addition to arriving at the correct location at the appropriate time. Ensuring that the appropriate quantity of merchandise is available and delivered to the correct client is crucial for an effective transportation system [9].

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II. Literatures Review

Many studies have been conducted in the field of travel decision behaviour and mode of transportation selection. Among these foreign researchers, [10] is noteworthy for having used a stated preference to observe tourists' parking choice behaviour at six parking facilities in Beinjing Temple. From this data, a multimodal logit model was created to show the relationship between the decisions made about parking and influential factors. The two most crucial deciding variables were distance and parking costs; during peak hours, some parking lots had 100% usage while others saw 20% of usage. The drivers showed less sensitivity to price and increased sensitivity to walk time. Once more, parking fees were recommended as a means of balancing the use of parking facilities.Another study [11] used a quantitative research approach to survey people in the Colombo Metropolitan region of the Province of Sri Lanka in order to identify the factors that influence the choice of transport modes. The factor analysis's conclusion reveals that, in comparison to other factors, money, car ownership, safety, and comfort are the most significant. [12] investigated the factors influencing the mode of transportation chosen for trips in the Mexican Valley metropolitan area. Multinomial regression was used to estimate the impact of transportation supply spatial characteristics and socioeconomic factors on individual mode choice. The data set came from a 2017 Mexican household travel survey. The results demonstrate that while improved road infrastructure encouraged the usage of Mass Rapid Transit services over driving, improved mass transit infrastructure was not positively correlated with the likelihood of using the service. Walking and bicycling were shown to be negatively correlated, and higher education was found to be favourably correlated with driving, whereas availability was adversely correlated with other forms of transportation.[13] started a study to assess the factors that affect students' decisions about the various university-provided modes of transportation. They used empirical methods to assess students' perceptions of these modes, and they used the analytical hierarchy process (AHP) to determine the relative weights and priorities of criteria.The findings indicate that the most popular criteria for choosing a university's method of transportation are automobile, motorcycle, and e-bike. Students had two options: walking and riding. Walking was an affordable alternative for short distancesbut cycling offered advantages and improved focus on the classroom. While[14] looked into road trip choice behaviour to enhance our basic comprehension of the decision-making process between engaging Drivers used games theory, experimental economics, and discrete choice theory to improve their forecasting for transportation policy decision-making.

The majority of these studies are conducted in industrialised nations, where there is, of course, a well-balanced and organised transportation system (better transportation policies, contemporary infrastructure and facilities, and a multitude of modes, to name but a few).

Experience has also demonstrated that due to infrastructure and other developmental disparities, the suggestions of these works cannot be implemented in underdeveloped nations, including Nigeria. For example, there are many different modes available in the majority of states in the United States of America, including the monorail, trolley buses, light rail transit, tram, rack rail way, heavy rapid transit, bus rapid transit, motorcycles, bicycles, tricycles, water taxis-ferries, and various types of aeroplanes. Modern infrastructure and amenities are included in this mode, including a nice walkway for pedestrians, immaculate 10-lane flyover bridges, traffic lights and impartial law enforcement officers. One of the gaps this research aims to solve is the necessity to localise these studies to fit the developing countries, taking into account their unique characteristics, topography, terrain, and mentality.

Few authors from Africa, especially Nigeria, have dabbled in this field of study. Studies on travel choice behaviour that some Nigerians conducted and that made a valuable contribution include [15], which examined the spatial commuting patterns of the three categories (federal, state, and public) of universities in southwest Nigeria in terms of trip distance and preferred mode of transportation. Distance was shown to be a function of commute pattern; personnel at government-owned and private colleges, respectively, utilised private vehicles 81% and 65% of the time, whereas students primarily used shuttle buses for both short and long-distance travel.
Additionally, unlike the other modes, the shuttle's use was unaffected by the distance travelled. The modes discussed here do not include inland water transport (ferries) [16], which, while using ferries as a mode of transport, focused his research on social costs. Multiple regression analysis and multinomial logit were used to assess the impact of commuters' socioeconomic characteristics on their daily commute time and cost, as well as to examine the impact of commuters' socioeconomic characteristics on their mode of transportation choice. Additionally, he used the concepts of annualised cost of motor vehicle use and divergence between private and social cost of transport to examine the private cost components and external cost of intracity commuting in a metropolitan area (Lagos). The findings demonstrate that socioeconomic factors have a major impact on commuters' costs and journey times. They also demonstrate that, among other modes of transportation, autos account for the largest share of carbon monoxide emissions, while urban buses account for the smallest.[17] modelled undergraduates' modal choices using data from a student travel survey and logistic regression to identify the variables impacting undergraduate modal choices in Obafemi Awolowo, Ile Ife, Nigeria. The findings showed that walking is the most popular mode of transportation for students who are on campus, and commercial buses are the most popular mode of transportation for students who are off campus. A small percentage of the sample uses motorcycles and taxis, and trip-related and socioeconomic characteristics jointly influence mode choices. [18] used a multi-stage sample technique to base their study on walking as an active form of transportation in Illesha, Ondo State.

It was shown that the relative affordability of walking, the absence of a personal vehicle for the traveller, and pleasant weather all had a significant impact on respondents' decisions to walk. However, the biggest obstacles to walking as an active travel mode in the city were vehicle ownership, the mode's relative slowness, and the lack of pedestrian facilities. The steepness of the terrain has

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been demonstrated to impact active transport travel in addition to distance gradient or slope. Steeper terrain typically discourages walking and cycling because most trips aim to minimise the amount of time and energy required.

Additionally, [19] investigated how commuters' socioeconomic status and household characteristics affected their travel habits in Lagos State. The study's findings showed that factors such as age, gender, income level, household size, degree of education attained, distance travelled, and amount of time spent in transit were more predictive of commuters' travel patterns than other variables. He comes to the conclusion that it will be challenging to accurately estimate demand for service planning and policy formulation without a thorough understanding of these patterns.

Another study by [20] used a discrete choice model to estimate the shippers' port utility function and empirically examined the port choice criteria of Nigerian shippers who use the liner services offered at the country's coastal ports. However, the focus was on shippers and importers of goods and their cargo rather than on passengers. The findings indicate that the most crucial variables that shippers of non-oil sea freight take into account when selecting ports for their shipments are crane efficiency (cargo handling speed at the ports), the degree of functionality of port facilities, shipment size, ship call frequency, and shippers warehouse distance from the port.

This study aims to close the gap on the exclusion of ferries as a viable alternative mode of transportation and the necessity of proposing a comprehensive multimodal transport service where each mode is selected based on its relative advantage, particularly in the Niger Delta region.

The bulk of these studies are conducted in industrialised nations, where there is, of course, a well-balanced and organised transportation system (better transportation policies, contemporary facilities and infrastructure, and a multitude of modes, to name but a few). Experience has also demonstrated that due of infrastructural and other developmental disparities, the suggestions of these works cannot be implemented in developing nations, including Nigeria. One of the gaps this research aims to solve is the necessity to localise these studies to the developing countries, taking into account their unique characteristics, topography, terrain, and mentality.

There aren't many African authors that have explored this field of study, especially in Nigeria. Some Nigerians have conducted important research on travel choice behaviour, such as [18], which examined the geographical commuting patterns of federal, state, and public universities in southwest Nigeria with respect to trip distance and preferred mode of transportation. The length of time was discovered to depend on the mode of transportation. Staff members at government-owned and private universities, for example, tended to use shuttle buses for both short and long distances, while private car usage was accepted by 65% and 81% of staff members, respectively.

Moreover, unlike the other modes, the shuttle's use was unaffected by the distance travelled. The modes of transport discussed here do not include inland water transport (ferries). Although ferries were used as a mode of transport, the study focused on social costs; multiple regression analysis and multinomial logit were used to assess the impact of commuters' socioeconomic characteristics on their daily commute time and cost, as well as the impact of those characteristics on their mode of transportation choice [19]. Additionally, he used the concepts of the annualised cost of motor vehicle use and the divergence between the private and social costs of transportation to analyse the private cost components and external cost of intra-city commuting in a metropolitan area (Lagos). The findings demonstrate that commuters' cost and duration of trip are significantly influenced by their socioeconomic status. Among other means of transportation, motor vehicles emitted the most amount of carbon monoxide emissions, while urban buses contributed the least.

In order to identify the factors impacting the modal choice of undergraduates in Obafemi Awolowo Ile Ife, Nigeria, [20] modelled the modal choice of undergraduates using data from student travel surveys and logistic regression. The findings showed that for on-campus students, walking is the most popular mode of transportation, followed by commercial buses for off-campus students. A small percentage of the sample chooses to travel by motorbike or taxi, and their decisions are driven by a mix of trip-related and socioeconomic factors.[21] used a multi-stage sample technique to base their study on walking as an active form of transportation in Ilesha, Ondo State. It was discovered that two main criteria that significantly impact respondents' choice to walk are the relative affordability of the activity, the absence of a personal car owned by the visitor, and pleasant weather. The biggest obstacles to walking as an active travel mode in the city, however, were vehicle ownership, the mode's relative slowness, and the lack of pedestrian facilities. It has been demonstrated that steepness of the terrain influences active transport journey in addition to distance gradient or slope. Steeper terrains generally discourage walking and cycling because most trips aim to minimise the amount of time and energy required.

Additionally, [22] examined how commuters' socioeconomic status and household characteristics affected their travel habits in Lagos State. The findings showed that factors such as age, gender, income level, household size, degree of education attained, distance travelled, and amount of time spent in transit were more predictive of commuters' travel patterns than other variables. He concludes that it will be challenging to create precise demands and projections for service planning and policy creation without a thorough comprehension of these patterns. Another study by [23] used the discrete choice model to estimate the shippers' port utility function and looked empirically into the port choice criteria of Nigerian shippers who use the liner services offered at the country's coastal ports. However, the focus was on shippers and importers of goods and their cargo rather than passengers. This

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIII, Issue IV, April 2024

study aims to close this gap by proposing a comprehensive multimodal transport service where each mode is selected based on its comparative advantage, particularly in the Niger Delta region. Ferries are not included as an alternate mode of transportation.

III. Methodology

Study Area

According to official government definitions, the Niger Delta covers more than 70,000 km and accounts for roughly 7.5% of Nigeria's total area. It is made up of the modern-day Rivers, Delta, and Bayelsa States. The Federal Government encompassed the states of Abia, Akwa Ibom, Cross River, Edo, Imo, and Ondo in 2000. There are about 40 distinct ethnic groups in the area, and their dialects number in the hundreds. Geographically, it is located in southern Nigeria and is bounded by the Atlantic Ocean to the south.

Research Design

This study used both an experiment and a survey as research methods. We looked into the several elements that affect commuter behaviour, especially when it comes to the mode of transportation they choose. These factors included journey time, cost, and sociodemographic and socioeconomic traits. Researchers in the Niger Delta region of Nigeria used a combination of descriptive and correlational research methodologies to examine commuters' mode choice behaviour.

Types of Data Analyzed.

In other to achieve the objectives of the study, the following data types were identified, collected and analyzed.

i. Socio-economic characteristics of households in Niger Delta, such as income, age, accommodation status, employment status, number of household members, travel distance etc

ii. Data on stated preference experiment/theory of planned behaviour aimed at ascertaining the reaction of the commuters in the event of government policy intervention.

Sources and methods of data collection.

The data required for this study were obtained from both primary (obtained through the administration of questionnaires to household heads and interviews of motorists-(civil servants self-employed and other public servants) and secondary data extracted from FRSC, NIWA and national population commission reports /records.

Sampling Design and procedure for primary Data

Four states in the Niger Delta (Akwa-Ibom,Bayelsa, Delta and Rivers) with very similar transportation systems were selected for the survey, questionnaire administration and interviews. A total number of 5,000 pieces questionnaire was distributed proportionately according to the population of these states as shown in the sampling scheme below

Table 1: Sampling scheme. Source: NPC 2006

S/N	State	Population	No. of questionnaire Distributed
1	Akwa-Ibom	3,172,000	1,350
2	Bayelsa	1,900,000	800
3	Delta	3,594,000	1,500
4	Rivers	3,172,000	1,350
Total			5,000

Households were randomly selected from streets and offices in the urban centresand the jetties/ waterfronts (Khaima, Odi, Nembe, Marine Base Abonima wharf) to capture ferry users.

Data Analytical tools

Furthermore, the statistical package for social science (SPSS) software was used to critically analyse the variables relevant to the study. Descriptive statistics and multinomial logit models were employed.In this study, the alternative transport modes available to users were considered and include –private cars, bus service and ferry (boat)

Model Equation relating Travel Mode and the Significant Independent Variables

The first objective is to model travel choice behavior of commuters in Niger DeltaThe model equation was developed using regression analysis in the Excel Data Analysis Tool pak. The result of the analysis is presented in Table 4.25.

Table 2. Regression Analysis Output

Regression Statistics					
Multiple R	1				
R Square	1				

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIII, Issue IV, April 2024

Adjusted R Square	65535				
Standard Error	0				
Observations	7				
	Df	*SS*	*MS*	*F*	*Significance F*
Regression	9	1351.714286	150.1905	0	0
Residual	0	0	65535		
Total	9	1351.714286			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.085423359	0	65535	0	0.085423
Travel time	0.104604735	0	65535	0	0.104605
Employment Status	0	0	65535	0	0
Age	-0.212389454	0	65535	0	-0.21239
Gender	-0.555430464	0	65535	0	-0.55543
Income	1.609515813	0	65535	0	1.609516
Distance to work	0	0	65535	0	0
Family Size	-0.032739096	0	65535	0	-0.03274
Car ownership	0.07280056	0	65535	0	0.072801
driver's license	0	0	65535	0	0

To verify the reliability of the model equation (equation 4.1), the R square, Significance F value, and the P values are assessed. The closer to 1 of the R square value, the better the regression line fits the actual data. If the value of the Significance F is less than 0.05 and most of P-values are below 0.05, then the developed model is also highly reliable.

From Table 4.25, R Square equals 1, which is a perfect fit. This implies that over 100% of the variations in the dependent variable – Travel choice or mode of transport is influenced by the independent parameters: Travel time, Employment Status, Age, Gender, Income, Distance to work, Family Size, Car ownership and driver's license. From Table 4.25 also, the Significance F is 0 and all the P-values are also 0. Therefore, from these three criteria, Equation 4.1 is very reliable for the modelling or predicting the choice of transport mode of the people.

In developing this model equation (i.e. equations 4.1), the values under the 'coefficient' columns in tables 4.25 were utilized. From table 4.25, the intercept value is approximately 0.0854, the coefficients of the independent variables - Travel time, Employment Status, Age, Gender, Income, Distance to work, Family Size, Car ownership and driver's license are 0.1046, 0, -0.2124, -0.5554, 1.6095, 0, -0.0327, 0.0728, and 0 respectively. This means that employment status, distance to work and driver's license had zero effect on the people's choice of transport mode.

Arranging these coefficients and putting them in the form of a linear regression equation

'Y=Ax 1 +Bx 2 +C', resulted to Equation 4.1 below:

$$M\_T = 0.1046T\_t - 0.2124A - 0.554G\_e + 1.6095I\_i - 0.0327F\_s + 0.0728C\_o + 0.0854 \qquad (4.1)$$

Where $M_T$is the choice transport mode, $T_t$is the travel time, A is age, G_e is gender, I_i is income, $F_s$is family size and C_o is car ownership.

In using the equation, after appropriately fitting in the values of the coefficients, if M_T is less than 5, the preferred choice of transport is walking, if the value is more than 5 but less than 8, the preferred choice of transport is ferry, if $M_T$is more than 8 but less than 21, the preferred mode of transport is taxi, if the value is more than 21 but less than 25, the preferred choice of transport is private car, and if $M_T$is more than 25 but less than 41, the preferred choice of transport is bus.

The second objective is to evaluate the effect of socioeconomic characteristics of transport users on their choice of transport mode. Table 3 shows the results of the Multinomial Logit Model on the effect of socio-economic characteristics of transport users on their choice of transport mode.

Table 3: Model Fitting Information. Source; Authors' Field survey (2017)

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	1.036E4			
Final	8.771E3	1.588E3	471	.000

Table 3shows the model fitting information of the model. The presence of a relationship between the dependent variable (mode of

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIII, Issue IV, April 2024

transportation) and the contribution of the independent variable (socio-economic characteristics) is based on the significance of the final chi-square model. In this analysis, the probability of the chi-square is 0.000, which is less than the level of significance, 0.05.

Table 4. Pseudo R-Square. Source; Authors' Field survey (2017)

Cox and Snell	.272
Nagelkerke	.308
McFadden	.147

Table 4 shows the result of Nagelkerke R^2, which reveals that the model accounts for about 31% of the variance of the dependent variable i.e. users' choice of transport mode.

IV. Discussion of Result:

Choice of transport mode

The modes of transport available in the Niger Delta area includes; Private cars, taxi, commercial buses, ferries, tricycle and walking.Over 40% of the Respondents or sampled population make use of the Bus system, 21% use taxis 25% use private cars while only 8% make use of Ferries and 5% walk. This results from a wide range of factors such as transport fare, (public transport users) and operational cost of private cars), travel time, commuters' income, safety/ security, comfort, car ownership and transportation availability, which the commuter consciously considers before a transport mode is endorsed.

Income Level

This is a major deciding factor in transport mode choice since the level of household disposable income determines the amount of money normally allocate to transport and hence predicts the mode of transport affordable for such households or workers. From the survey, over 50% of the sampled household earns N100, 000 and below, this accounts for the high patronage of Buses and Taxis which represents over 60% of the sampled population. Families with an income level of N110, 000-N300, 000 which represents over 22% and 9% of the income bracket of N310, 000 to N500, 000 corresponds to 25% of private car users, while 8% and 5% of the respondents who make use of ferries or walking as a mode of transport represents those whose place of work is accessible only by water or extremely close to their homes.

Distance to work

The distance between a commuter's place of work and his residence can determine to a great extent the mode of transport he will eventually choose. For instance one will not choose walking (which is the slowest mode) for a distance of 10-15 kilometres, the more the distance the more temptation of using a faster mode depending on your disposable income.The highest percentage of the sample population falls between the shorter distance of 1-5 Km and 6-10 Km which represents 47% (31.9% and 15.1% respectively) of the whole sample population. This also corresponds to the high patronage of taxis and Buses which promise to be best for the shorter distance, though walking can become an option for distances that are not more than a Kilometer.

Travel time

Travel or journey time is an important determinant of commuters' mode choice. For trips of 20-30 minutes walking becomes an attractive mode, but from at least 60minutes distance taxis, buses and private cars compete favourably depending on the respondents' income/status. From the survey, 4.7% of the sample population having a trip of fewer than 30 minutes accurately corresponds to 5% of the correspondents who walk to work. Again a greater percentage of commuters fall into the category that expends between 1 hour and 30 minutes to 2 hours accounting for over 80% of the sampled population, this also reflects in the massive use of buses and taxis (over 60%). A variation of 20% is accounted for by some correspondents who may alternate the use of the private car and public transport and part of those who might decide to use a taxi for very short distances say for 45 minutes.

Household car ownership

About 56% of the respondents rely strictly on public transport (Buses and Taxis) corresponding to 60% of correspondence that patronizes buses and taxis. Finding prove that out of the 40% of participants that own at least one car, some use their cars occasionally for pleasure trips, taking children to school, attending churches etc while patronizing public transport to work. 19% of the participants having at least 2 cars normally drive their official cars to work while the private ones are reserved for pleasure trips. The ones with 3 or more cars are those attached to cars and use them for every purpose and hardly make use of public transport. This group usually resists any Government intervention in the areas of improving public transport while discouraging the use of private cars.

Cost of transport

About 52% of the private car owners claim to have a monthly car maintenance cost of N50, 000 while 21% and 27% have a monthly vehicle maintenance cost of N30, 000 and N20, 000 respectively.For the public transport users 67% spend N20, 000 monthly on transport while 20% and 13% expend N30, 000 and N50, 000 monthly on transportation. From the findings those who make use of private cars spend more than the public transport users on transport, this shows that low price is not the sole reason for

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the choice of private cars but the status and flexibility offered it offers. The added advantages of the private car to the users outweigh the high maintenance cost, therefore cost here is a relative term in that the private car owner sees his N50,000 monthly maintenance cost as cheaper than the N20,000 monthly transport cost when he considers the various advantages the private car accords him. However, some middle-class car owners may decide to go to work in public transport while reserving the use of their cars for only pleasure trips in other to save some money from the high daily maintenance costs (especially fuel and parking costs.). Findings also reveal that the use of private cars will be reduced considerably if the public transport sector is given attention in terms of infrastructure /facilities so they can compete with each other favourably.

V.Conclusion

In the strength of the theory of comparative advantage, inland water transport is indispensable to the coastal Niger Delta and should be encouraged and explored to its maximal level, hence this study brings to the fore the enormous advantages of inland water transport in the coastal areas of Niger Delta and so encourages its use while spotlighting ways of minimizing the disadvantages dangers.

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