A REVIEW OF ECONOMIC POTENTIALS OF THE RIVER PORT OF ONITSHA

BY

OKONKWO, CHUKWUKA (B.Tech)

(REG. NO: 20104769488)

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CERTIFICATION

This is to certify that this Thesis "Analysis of Port Activities at the River Port of Onitsha" was carried out by **OKONKWO CHUKWUKA** (PGS/M.Sc/20104769488) in the Department of Maritime Management Technology, School of Management Technology, Federal University of Technology Owerri, for the award of Master of Science (M.Sc) in Transport Management Technology.

.... 19/07/21 ....
PROF. K.U. NNADI **DATE**
(Supervisor)

.... 26/07/21 ....
DR. D.E. ONWUEGBUCHULAM **DATE**
(Head of Department)

.... 05/11/21 ....
PROF. O.T. EBIRINGA **DATE**
(Dean, School of Management Technology)

....
PROF. CHIEDOZIE. C. EZE **DATE**
(Dean, Postgraduate School)

.... 26/07/21 ....
External Examiner **DATE**
Prof Osi Akpoghomeh

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ABSTRACT

Inland waterways are one sector of transportation that has been grossly underutilized the world over, despite being one of the earliest form of transportation and facilitator of trade between people. This study aims to review the economic potentials of the Onitsha inland river port. The study adopted a mixed method research design as data were sourced from the secondary source (NIWA, NPA statistical bulletins & journals) and primary source using a well-structured likert modelled questionnaires administered to about 50 respondents. The data gathered were subjected to analysis using tools such as Analytical hierarchy process (AHP), Time series modeller and Trend analysis with the aid of AHP calculator and IBM Statistics Package for Social Scientists (SPSS V21) computer software. The findings depicts that the volume of import cargos from seaports destined for the southeast states which forms the hinterland for the river port shows a significant positive trend estimated by the linear regression line Y = 14075X – 18057. The time series modeller used to analyse the cargo trend series shows an acceptable value of R-squared and stationary R-squared of 72.3% and a mean average percentage error of 50.066%, indicating that the present are approximately 50% short of predicted volume by trend. The AHP results indicate that inland waterways (0.5276), road (trucking) (0.2527) and air (0.2197) in that order are the preferred mode of freight movement for logistics operators in the south east if presented with alternatives. The following factors in descending order forms the basis of their choice of freight means; safety (0.6026), timeliness (0.1822), costs (0.1174), efficiency (0.0691) and carrying capacity (0.0286). In conclusion, the southeast bound import cargoes from the seaports can well serve the Onitsha river port and are even short of their projected volume for the time period under study. It was recommended that the government should ensure continuous dredging of inland waterways and river banks to ensure all round navigability of the waterways. Government or future concessionaires of Onitsha river port should ensure installation of handling and storage facilities for bulk agricultural products like grain storage silos, pumps and tanks for vegetable oil, etc. to ensure the river port is capable of handling shipments of bulk agricultural products.

Keywords: Safety, inland waterways, river port, trend analysis, time series modeller,

hinterland

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Transportation ensures the existence of inter-modal connectivity between sectors, cultures, production and consumption, and as such forms the pivot of people's economic life. The importance of transport in the development of any modern state cannot be over emphasized. Transportation is the bedrock of any society as it cuts across social, economic, cultural and political concerns of any society. Transportation is an essential part of human activity and in many ways forms the basis of all socio-economic interaction. Indeed no two locations will interact effectively without a viable means of movement. Transportation thus is both as a result, and cause of an advancing society.

Transportation plays a key role in the economic and social development of any nation. A well-functioning and integrated transportation system amongst other things:

I. Stimulates national development and enhances the quality of life for all.
II. Allows markets to operate by enabling seamless movement of goods, services and people.
III. Provides vital links between spatially separated facilities and enables social contact and interaction.
IV. Provides access to employment, health, education and services.
V. Alleviates regional inequality and fosters national integration.
VI. Increases access to markets and links local, regional, national and international markets.

VII. Promotes economic development by increasing access to labour and physical resources thereby facilitating the realization of a country's comparative advantage.

The different transportation modes have specific features and advantages, and the overall efficiency and effectiveness of the transport system depends on the development of these modes and their interfacing/ integration, hence intermodalism in transport. In modern times, integrated transportation system reflects the level of advancement of a country. However in many developing economies Nigeria inclusive, inadequate transport facilities are often the norm rather than the exception (Rodrigue et al, 2009). The problems of Nigerian transportation system include bad roads; inadequate fleets of buses or trucks; irregular, inadequate, out-dated and overcrowded trains and airplanes and congested ports. These are common features of the developing world. In line with these are physical problems such as dearth of suitably-trained transport managers and planners, capital restructuring bottlenecks, serious issues of institutional reforms and ineffective traffic regulations. An effective and efficient transport system is characterized by: physical integration of networks; integrated inter-modal operability; smooth service provider-user interface; joint planning and development of transport facilities and systems; harmonized standards; cross-border investments; and accession to relevant international treaties and conventions (Okello, 2010). The share of transport in the Gross Domestic Product [GDP] of Nigeria is in the neighbourhood of 3 per cent, and as such important to the economy of the nation. The transport sector is an important component of the economy impacting on development and the people’s welfare. There apparently exists an relationship between the quantity and quality of transport infrastructure and the level of economic development , thus an efficient transport system provides economic and social opportunities and benefits which in turn results in multiplier effects such as better accessibility to markets, employment and additional investments, an inefficient transport system on the other hand can result in economic costs such as reduced or missed opportunities and lower quality of life. A good transport system thus is essential to support economic growth and development.

Around the world, multi-modal systems have become an intrinsic part of the transport system, particularly in gateway regions having a high reliance on trade. Transport development thus is gradually shifting inland, after a phase that focused on development of port terminals and maritime shipping networks. The complexity of modern freight distribution, the increased focus on multi-modal transport solutions and capacity issues appears to be the main drivers behind a renewed focus on hinterland logistics and inland ports (Rodrigue, et al, 2009).

Nigeria looks to become one of the world's twenty largest economies by the year 2020. Transportation will surely play a very vital role if this goal is to be achieved and timely too. There exists a strong relationship between infrastructure (transport) and economic growth, although the direction of causality may still be debatable; good infrastructure spurs economic growth and conversely, increased growth results in greater demand for infrastructure (Eustace and Fay, 2007). Good infrastructure affects economic development in intertwined ways; both as intermediate and final consumption goods. As an intermediate good, good transport infrastructure facilitates mobility of factors of production (labour, goods and finance) thus improving productivity and reducing costs which are key factors in competitiveness; and increases information flow, opening new opportunities and reducing asymmetries and other market imperfections. As a final good, consumption of infrastructures services improves quality of life, easy access to energy for industries and domestic use, fast and safe transportation of goods and travel, good and reliable communication and good health (Okello, 2010). In most advanced economies of the world, transportation accounts for approximately 6 to 12% of their GDP at the macroeconomic level, between 10 to 15% of household expenditures at the microeconomic level and around 4% of the cost of each unit of output in manufacturing (WTO, 2012). In these advanced economies which Nigeria is striving to be among, a modern integrated transport system is a consistent feature. It is very important to note that modern transport system goes beyond well paved road networks, functional and efficient seaports, effective air transport, and a working rail system. An effective and efficient transport system is characterized by physical integration of networks, smooth service provider – user interface, joint planning and development of transport facilities and systems, and integrated inter-modal operability. A modern transport system must among other things be systematically interchangeable. By this, intermodal through transport must be highly effective and efficient hence, a combination of two or more transport modes with the purposes of optimizing cost, time, energy and above all making it as flexible as possible for the end transport user. In other words, a containerized cargo should be able to be transferred from a vessel unto a rail car, unto a trailer or a barge seamlessly without much constraint(s). In order to achieve this desired level of advancement in our transport system, Nigeria must look inwards towards its huge inland water resources and be able to fully explore the huge potentials which abounds there and fully co-opt it into its transport system in order to achieve a very versatile transport system.

The Nigerian inland waterways are a major natural resource, traversing twenty (20) out of the thirty-six (36) states (DNTP, 2010). The areas adjacent to the major rivers represent the nation's important agricultural wetlands. For a country with the second longest length of inland waterways in Africa, with 8,575km (5,329miles) of inland waterways and about 3,000km of navigable waterways in its natural form, and an extensive coastline of about 850km, the potentials it possesses are in large bounds.

The importance of inland waterways ranges from resource to economic development and defence, as well as commercial transportation. As a result, inland waterways are generally viewed as something more than a part of the transportation system (Ibeawuchi, 2013). Inland waterways provide a diverse range of benefits such as transport, recreation opportunities, tourism, flood protection, regeneration benefits and non-use values. Non-use values are values that are not associated with actual use or even the option to use a good or service. They are made up of;

a) Altruistic value- derived from the knowledge that something exists for others to use.

b) Existence value- derived from knowing that something exists.

c) Bequest value- knowing that future generation will have the option to enjoy something (DEFRA, 2009).

A river port is a port situated at the estuaries in the riverbanks, sometimes called inland port. This type of port possesses all the attributes of a deep sea port in terms of infrastructures and super structures, human resources and other physical attributes of a seaport. The only difference being that most river ports are restricted to the kind of vessels they can handle, as a result of the depths of their channel ways and navigational restrictions (as not all lengths of the inland waterways may be navigable all year round). In most cases thus, it is more of a barge calling port than ocean going vessels of deep draft requirements. Some river ports however are not hampered by such restriction, noteworthy is the world's largest inland port; the port of Montreal, Canada. Despite being a river port (located on the St Lawrence River), it can arguably boast of volume of cargo throughput common to sea ports. Some quick statistics of this river port are; annual total of 2,039 vessel calls, annual container volume of 1,331,351(TEUs), annual cargo throughput of 25, 999,667tons of cargo and a cruise passenger traffic of 40,142 (Port of Montreal, 2010). A further examination of the economic impact analysis of this river port reveals a provision of eighteen thousand, two hundred and eighty (18,280) direct and indirect jobs, out of which three hundred and twenty (320) direct employees accounts for thirty-three (33) million dollars in salaries and employee benefits (Port of Montreal, 2008). An inland port has a level of integration with the maritime terminal and supports a more efficient access to the inland market both for inbound and outbound traffic. This implies an array of related logistical activities linked with the port, such as distribution centres, container depots, warehouses and logistics providers. A river port is in essence, an extension of sea port activities inland. River ports will greatly partake in the on-going inter modal integration between ports and their hinterland through long distance inland waterways corridors.

1.2 Problem Statement

Nigeria has the second longest inland waterways in Africa, second only to the democratic republic of Congo. Despite having an extensive length of inland waterways which strategically runs through the heart of the country with rivers Niger and Benue dividing the country into east, west and north, and having Lokoja as their confluent point, Nigeria does not have a functional inland waterway port. Almost all inland waterways activities of present are limited to passenger ferrying. The Onitsha inland river port particularly, despite having a hinterland that boasts of one of the biggest commercial and industrial activities in West Africa, does not boast of TEUs of cargo being transported through it. The potential economic gains of the South East through the Onitsha river port seems to be eroded in capital flight in terms of cargo traffic and value to ports located in other geopolitical zones. The Federal government has expressed clear lack of political will to operationalize the port as she is still in court with some of the private operators bidding to operate the port.

A functioning Onitsha River port would boost economic activities in the Southeast and ultimately create employment opportunities and wealth for the region. It will also relieve the exporters and importers the stress and costs of transporting containers by road from different ports to the Southeast.

Despite all these pointers in favour of inland waterways transportation, the Onitsha River port is still dying from neglect, low level of patronization and almost non-existent government policy measures aimed at operationalizing this port. Where such government policies exist, they are grossly not enforced or even abused, hence the aim of this study.

1.3 Aim and Objectives of the Study

The aim of this research work is to analyse port activities at the river port of Onitsha, other specific objectives are as follows:

1. To analyse the share of Onitsha river port bound import cargoes to the total national volume of import cargo.
2. To examine the traffic and evaluate the shipping impact of port activities at the river port of Onitsha.
3. To analyse the choice of Onitsha River port to importers and logistics managers as a preferred alternative route to other transport modes.
4. To estimate the trend of flow of import cargoes to the southeast and the capacity of Onitsha River port to accommodate them.

1.4 Relevant Research Questions

In the course of this research, it is the intention of the researcher that this research work will be able to address some very relevant questions that are pivotal to the research subject. This research will strive to provide conclusive answers to the following research questions:

1. What is the share of Onitsha River port bound import cargoes to the total national volume of import cargo?
2. What is the traffic and shipping impact of port activities at the river port of Onitsha?
3. What motivates the choice of Onitsha River port to importers and logistics managers as a preferred alternative route to the other transport modes?
4. What is the trend of flow of import cargoes destined to the Onitsha River port?

1.5 Research Hypotheses

To provide answers to the various research questions earlier raised, the following hypotheses are thus formulated;

1. **H_{01}** The share of Onitsha river port bound import cargoes to the national import volume is not statistically significant.
2. **H_{02}** The river port at Onitsha will not have a significant traffic and shipping impact.
3. **H_{03}** The choice of Onitsha river port by importers and logistics managers as a preferred alternative route to other transport modes is not statistically significant
4. **H_{04}** There is no positive trend in the flow of import cargoes bound for the Onitsha river port.

1.6 Justification of the Study

This research work is an extensive study into the state of Nigeria's inland waterways with special interest on the river port of Onitsha and also a highlighter to the countless bounds of opportunities and potentials which the inland waterways network of Nigeria provides. This research work will prove invaluable to government agents/agencies, policy makers and other relevant government maritime establishments and representatives, particularly the agents of the national inland waterways authority (NIWA). This work will also be treasured by indigenous shipping companies, agents and practitioners, commercial entities and even financial bodies who might be looking at financing any deal involving inland waterways operations. This work will also form an exposé to foreigners who might be interested in investments into Nigeria's inland waterways sector through partnerships with local companies.

1.7 Scope and Limitations of Study

This research work just like any other has its scope and limitations. The study area was strictly Nigeria's inland waterways, that is, all part of the rivers, lakes and channels that falls within the territorial area of Nigeria. The absence of enough data will not allow for a meaningful statistical projection into the future activities of this sector and as such no accurate trend can be projected. The clearing and forwarding agents that were sampled are assumed to be representatives of importers and exporters in Nigeria and as such their opinions are assumed to be same as their principals. In assessing the potentially available cargoes for the Onitsha river port, the import cargo destination data for the south-eastern states were all assumed to be cargoes that will be transported all through the waterways. Also, this research work is based on the assumption that all import cargoes destined to the south-eastern states will be routed through the Onitsha river port.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 Historical Overview of Inland Water Way Transport in Nigeria

The river Niger is the longest river in West Africa and third longest in Africa. The river Niger is the chief source of water forming majority of Nigeria's inland waterways, augmented from the Northeast by the river Benue. 26.6% of the river Niger's 4,200km length falls within Nigeria's territorial area (CIA world fact book, 2014). Indeed, the name Nigeria is derived from the river Niger. Long before the Europeans penetrated the river Niger and their onward colonization of these areas, the nations of those days were actively using the inland waterways in communication, transportation and trade.

The need for transportation is prompted by distance between location of goods and where they are required or between where an individual finds himself and where he wants to be. Travel by water is very ancient and it predates the wheel and remains a vital part of the transport mix for millions of people in rural and urban areas, yet in a world which associates roads and motor vehicles with progress and development, water transport is neglected and undervalued. The invention of the wheel became the basis of modern transportation however, waterways transportation has had very considerable influence on many phases of human activities as indicated by geographical and historic facts.

The Nupe people from Rabba (present day Niger state) and the Hausa people from Kano used the river Niger as an important mode of trade and transportation to the Southern part of Nigeria. Rabba was an important river town where caravans from Kano or any other part of the North crosses to the South in Yoruba land and as such was the Northern terminus for an all-water route on the Niger (Ogunremi, 1982). Slave trading also flourished among the towns along the waterways as it provided these towns with an easy route to evacuate their slaves with reduced risk of attack. Towns like Onitsha, Lokoja, and Bonny were notable slave posts of those days. Majority of the other rivers that forms part of Nigeria’s inland waterways are distributaries of the river Niger. These rivers are collectively often referred to as the lower Niger area. The European merchants popularized the lower Niger from the second half of the nineteenth century from their economic activities along these waterways (Ali, 2012). Following the discovery by John and Richard Lander (Lander brothers) in 1830 that the lower Niger was a suitable mode of transport, Macgregor Laird, a Liverpool merchant, in 1832 obtained financial and material assistance from the British government to visit the lower Niger and thereafter, trading stations were subsequently established on riverside towns and a resident consul was stationed at Lokoja (Flint, 1960). In the year 1877, Sir George Goldie visited the lower Niger area and thereafter, persuaded the British firms then trading in the lower Niger region to amalgamate. The result was the formation of the United African Company (U.A.C) in 1879(Ali, 2012). Other European companies that were involved in these early trades along the inland waterways includes; John Holt, Niger river transport (NRT) company, Paterson Zochonis (PZ), Societe commercial de Ovest African, G.Goltshalkand co., London Africa and overseas Ltd, JF Sick and co., co-operative wholesale society, Union Trading Company (U.T.C), K. Chellarams and sons and J.T. Chanrai and co.(Ali, 2012). Others where Elder Dempster and company Ltd (a shipping company and one of the prominent transnational enterprises of that era), Compagnie de Transport et commerce (CTC), Socony Vacuum Company (S.V.O.C), and Du Compagnie Francaise were other companies actively involved in the area and had few vessels plying the lower Niger area for trade and transport (Ali, 2012). Before the 1960s hundreds of canoes, tugs, barges, and ships owned by expatriates and indigenous merchants and traders plied the lower Niger (NIWA, 2011). The lower Niger was thus the busiest waterway in West Africa during that era (Ali, 2012). Burutu (in the present-day Delta state) was the depot for all trading firms in the lower Niger (asides John Holt and the African Eastern Trade Corporation). This was because Burutu was navigable all year round. Also, the wharves and warehouses at Burutu offered spacious accommodation and facilities for loading and unloading the largest vessels. As many as five ocean steamers could be berthed at the same time at Burutu (Hopkins, 1973). With the increasing economic activities in the late 19th and early 20th century along the lower Niger area, the multiplier economic effects on the major towns along the major inland waterways' corridor were much too obvious. Towns like Escravos, Burutu, and Warri were all hosting ocean-going vessels at all time of the year as their portions of the inland waterway corridor was navigable all through the year. Thus, with those frequent ships call came their attendant activity that arises from loading and unloading of ships and also increased trading activities witnessed in these areas. Warri was then the center for the distribution of inbound European Manufactured goods (Ali, 2012). Onitsha on the other hand owes its growth and development to its role in the transportation and commercial activities of the inland waterways of the Niger River. Despite the global economic depression of the 1930s, trade boomed in Onitsha to the extent that the market began to witness traffic congestion due to an increase in the number of Lorries that came to load and unload at Onitsha market (NAI, 1938). Other river towns that benefited from the economic activities along the inland waterways of these early years were Ajaokuta, Idah, and Lokoja. The European merchants operating in the inland waterways acquired landed properties from these towns along the riverside on which they built wharves and storage accommodation on a very extensive scale, and established cotton ginnery, inland water transportation was thus very vital to the economic activities of those years. However, the fortunes of the inland waterways were adversely affected with the construction of roads and railway lines across Nigeria which began in 1922 (Ali, 2012). With the increasing road networks and extension of railway lines, came a faster transport alternative which despite being more expensive, was generally accepted owing to the fact that they are a faster means of transportation. However, the Nigerian civil war was the final blow that plunged the inland waterways operations to its present almost comatose state in which its activities (where existent) has being curtailed to only passenger ferrying services.

A river port is a port situated at the estuaries in the riverbanks. This type of port possesses all the attributes of a sea port in terms of infrastructures and superstructures, personnel and other attributes of a port. The only difference being that most river ports are restricted to the kind of vessel they can handle, as a result of the depths of their channel ways and navigational restrictions (as not all lengths of inland waterways may be navigable). In most cases however, it is more of a barge calling port than ocean going vessels of deep draft requirements. Some river ports however do not come with such restrictions. An inland port has a level of integration with the maritime terminal and supports a more efficient access to the inland market both for inbound and outbound traffic. This implies an array of related logistical activities linked with the port, such as distribution centers, container depots, warehouses and logistics providers. A river port is in essence, an extension of port activities inland. River ports will partake in the ongoing inter-modal integration between ports and their hinterland through long distance inland waterway corridors. River ports are poised to play a huge role in cargo logistics and mostly because by their default plan, they are connected with other transport modes hence the reason why they are sometimes referred to as intermodal hubs. An inland port is a location where the processing of trade can be shifted from the national borders and where multiple modes of transportation and a wide variety of services are offered at a common location. International operations are supported at an inland port when customs clearance and Foreign-Trade Zone capabilities are available. Inland ports that provide value-added services in addition to trade processing will support industry efforts to create more efficient supply chains. Transportation planners and policy makers now concentrate on multimodal corridors as part of their investment strategies. Inland ports provide an opportunity to enhance corridor investments because of the capability to balance truckloads on highway, air, rail, or water modes. Ultimately, inland ports have the capability to create local employment, enhance corridor efficiencies, and reduce costs at border points of entry. A complete range of services can be provided at an inland port, typically in one location. These services can range from all modes of transportation (highways, rail, air, water, and pipelines), distribution, warehousing, manufacturing and logistics-management services (Gooley, 1998). This consolidation of services at one location makes an inland port more attractive to shippers and logistics managers concerned with promoting efficient supply chains. In addition to providing an atmosphere where international trade can be facilitated, an inland port can and do promote local and regional development.

Inland ports can be classified into various categories according to the kind of activities carried out within and the level of interconnectivity with other transport modes. The two categories of inland port as it concerns this study are: inland waterways port and maritime feeder inland port (Leitner and Harrison, 2001).

- **Inland waterway ports**

They are more involved and focused on domestic freight movement. Today's major inland waterway ports deal in specific bulk commodities like grain, coal, petroleum, and chemicals in addition to general cargo and containerized cargo and are typically transported by barges. It provides one of the most efficient means for the transport of bulk cargo. In terms of energy efficiency, one ton of cargo travels 59 miles by truck, 202 miles by rail, or 514 miles by barge per gallon of fuel.

- **Maritime feeder inland ports**

A maritime feeder inland port is most closely related to traditional maritime ports. This class provides relief at overcrowded maritime seaports. The concept of this class is to provide a consolidation or deconsolidation point for goods being shipped in or out of a congested maritime seaport. Typically, maritime feeder inland ports are located 50 to 250 miles away from the port (Harrington 1991). This distance will allow for fast delivery to the maritime port and has potentially shifted away enough from the highways serving the maritime port to be effective at relieving congestion (Leitner and Harrison, 2001).

Table 2.1: Approved Annual Tonnage Handled in Nigerian Inland Waterways Ports (Nearest Thousand)

Ports	Approved Annual Tonnage Handled	Coverage Storage Facilities	Available Facilities	Remarks
BURUTU	350,000	40,000	OTM	B= BERTH
ONITSHA	80,000	25,000	QTLM	T= TANKER PETROLEUM FOR PRODUCT
IDAH	20,000	6,000	L	L= MAN HANDLING
LOKOJA	10,00	8,000	TL	M= MECHANIZED HANDLING
WARRI	100,00	12,000	QBLM	O= QUAY
BARU	75,000	10,000	LR	R= RAILWAY CONNECTION
MAKURDI	12,000	10,000	LR	
IBI	3,000	4,000	L	
NUMAN	7,000	8,000	L	
YOLA	8,000	9,000	L	
GARUA	35,000	17,000	OTLM	

Source: NEDECO (1954:57)

2.1.2 Potential Economic Analysis of Inland Port Development: The Cost Benefit Analysis (CBA) Model An Overview

In the transport sector projects are valued in terms of their net worth, the difference between the value of their benefits and their costs, both measured so far as is possible in terms of monetary units (World Bank, 2005).

Some of the key questions which economic evaluation of the Onitsha river port seeks to address is: -

- Is the project worthwhile from an overall social point of view?

Other important questions which the project appraisal should inform are;

- What is the pattern of gains and losses? Do the benefits and costs accrue to the rich or the poor? What is the impact on identified social groups?
- Is the project financially sustainable? Is there a revenue stream to maintain the asset? How will the project actually be funded and how will the debt be repaid?
- Is the project practicable? Are there social or technical barriers to implementation? "Are there any fatal flaws in the project"?

The concept of CBA dates back to an 1848 article by Dupuit and was formalized in subsequent works by Alfred Marshall. The practical application of CBA was initiated in the U.S by the corps of engineers, after the Federal Navigation Act of 1936 effectively required cost-benefit analysis for proposed federal waterway infrastructure. The flood control act of 1939 was instrumental in establishing CBA as federal policy. It specified the standard that "the benefits to whomever they accrue (be) in excess of the estimated costs (Marshall, 1939). Relating it to inland waterways operations, empirical evidence from other countries shows that inland waterways construction follows the course of natural rivers because of the high cost of building man-made canals. The cost of dredging, deepening the channels and eliminating sharp curves are normally much more cost effective than building an integrated rail road or road network to move the same amount of cargo (Nzewi et al., 2013). But there are other benefits when waterways are constructed or dredged, such as expansion of electricity, irrigation for farming and increased sea foods for consumption. Therefore, the cost benefit of dredging the waterways to be operated can be estimated in order to assess how it can positively affect the nation's economy.

Cost-benefit analysis is used mainly to assess the monetary values of very large private and public sector projects. This is because such projects tend to include costs and benefits that are less amenable to being expressed in financial or monetary terms (e.g. environmental damage), as well as those that can be expressed in monetary terms, private sector organizations tend to make much more use of other project appraisal techniques, such as rate of return, where feasible. The practice of cost-benefit analysis differs between countries and between sectors (e.g., transport, health) within appraisals, the extent to which impacts are expressed in monetary terms, and differences in the discount rate between countries (Frank, 2000).

World Bank (2005) noted that in the economic impact evaluation of transport projects the “primary” impacts incurred by transport users, operators and governments are calculated as follows;

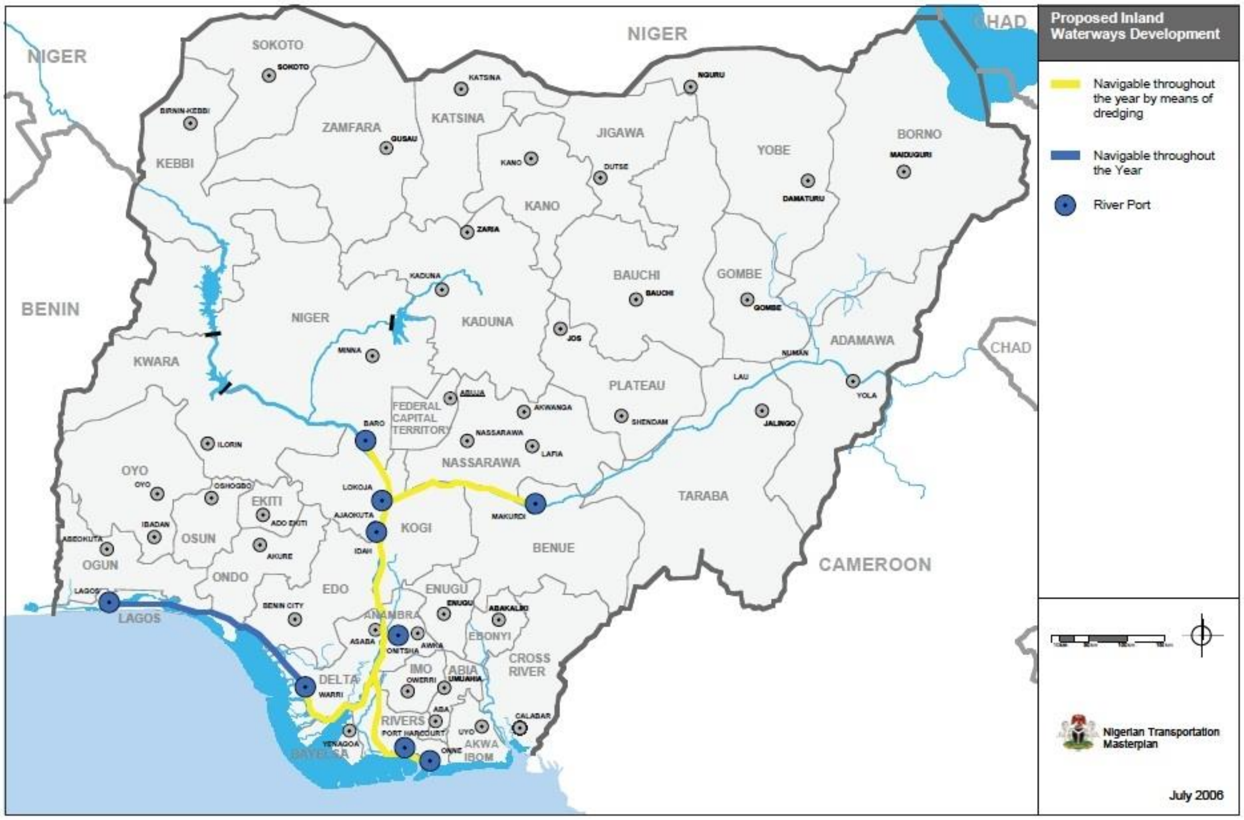
Overall Economic Impact = Change in transport user benefits (Consumer Surplus) + Change in system operating costs and revenues (Producer Surplus and Government impacts) + Change in costs of externalities (Environmental costs, accidents, etc.) - Investment costs (including mitigation measures).

2.1.3 Barges and Barge operations for Inland Water ways

The Federal government have issued operating licenses to about eight barge operators to move containers from Lagos ports to Onitsha River port and other inland ports through the country’s inland waterways.

A barge is a flat-bottomed watercraft with shallow draft predominantly used to service the inland waterways and canals transport sectors and also in water areas where draft requirements are low. Most barges are non-motorized, that is, they rely on the motor power of tug or towboats to be propelled (some barges are self-propelled too). One tug/towboat can tow as much as 40 barges latched together; this however is a function of the power rating of the barge. Barges are of various types;

- **Open hopper barge** – This type of barge is used to freight dry bulk cargoes that do not need any form of protection from the weather. Sands, chippings, scrap metals, etc are some of the cargoes usually carried in this barge type.
- **Covered hopper barge** – This type of barge has watertight covers for its cargo holds and is used to freight cargoes that need protection from weather conditions. They commonly transport grains, chemicals, fertilizers, cement, etc.
- **Deck barge** – This barge type does not have cargo hold, rather the cargoes are loaded onto the deck of the barge. They are commonly used to transport machinery, construction materials, very large fabricated items, etc.
- **Tank barge** – This type of barge is used in transporting bulk liquid cargoes. Crude oil and petroleum products are examples of liquids carried with this barge type



Map 2.1: Nigeria's inland waterways showing the existing and proposed river ports

Source: Draft National Transport policy, Ministry of Transport.

2.1.4 The Dredging of the Onitsha River Port

In 2013, the federal government after dredging the waterways went on to refurbish the Onitsha river port terminal, renovating the warehouses, extending the storage space, and purchase of two new Liebherr LHM 180 cranes. The LHM 180 crane has a lifting capacity of 64 tonnes and a maximum outreach of 35metres and can handle a wide variety of break bulk cargoes including containers. The workability of the Lagos to Onitsha river port after being dredged was tested with a barge operation from Onne to Onitsha and was confirmed successful.

The area of the transit shed of Onitsha river port is 900, 000m^2 and has a stacking area of 1,200,000m^2 for storage of transit cargoes. The river port also has two ridge stackers for container stacking. The river port has a multi-level pier that caters for its ferry services passengers while remaining functional all year round from seasonal variations in water level.

Onitsha river port is bordered by important and economically strategic towns and locations. The Onitsha main market is in itself, one of the largest in West Africa as it hosts merchants from all over the country and some neighbouring African countries as well. The volume of trade in this market is estimated to be in the excess of $2 billion annually. Virtually all items of trade are traded in this town, from the heavy building materials market to the agricultural products and textile, etc. 18km away from Onitsha, is the industrial town of Nnewi hosting quite a good number of industries (both heavy and light industries). Amongst the industries in this town are the Innoson vehicle Manufacturing, the Afro Asia motorcycle and plastics industry, Life vegetable oil manufacturing industry, Kotec industries, etc. These industries are importers of heavy raw materials for their manufacturing concerns. Orient Petroleum and refinery is less than 10km away from Onitsha and looks to handle up to 55,000 barrels of petroleum products per day at the start of operations.

Plate 2.0: Pictorial Representation of the Completed Onitsha River Port

Source: NIWA

2.1.5 The Potentials of the Nigerian Inland Water Way Transport

The Nigerian inland water ways have great potentials and is a major natural resource, traversing 20 out of the 36 states of the country. The areas adjacent to the major rivers represent the nation’s important agricultural wetlands. Agricultural products from the middle belt and particularly from Makurdi, and Lafia areas can be transported to Onitsha and Port Harcourt through the waterways. The Ajaokuta Steel Complex and Aladja steel rolling mill which are fed with coal and scrap metals, which can be imported through Warri and Onitsha, will both benefit from waterways, for movement of bulk cargo (DNTP, 2010). Despite the overwhelming potentials and physical attributes of the Nigerian inland waterways, the Nigerian inland waterways are under-prioritized, underutilized and highly underdeveloped (Ndikom, 2013), resulting in the sector’s contribution of a mere 1.6% share in the transport sub sector's contribution to the GDP (with road transport having the lion share of 95%) (NBS, 2001).

Nigeria with its 8,600km (NIWA, 2006) inland waterways length, cannot boast of a single TEU of cargo-throughput transported through its inland waterways, while inland regional river Nile transport volumes among Egypt, Sudan, Uganda and Kenya amounts to 1.6 million TEUs per year (Ghazy, 2010). Notwithstanding, the Anther Ennaby river port Cairo, is currently being developed to help boost Egypt's container throughput to 350million tons by 2020, the length of Egypt's inland waterways is 3500km.

The enormous potentials possessed by Nigeria's inland waterways had been envisioned as far back as 1877 by the early European merchants have discovered how important the lower Niger river was to their commerce, and thus the real opening up of the area to European commerce and amongst others, culminating in the birth of the present geographical entity called Nigeria (Flint and Goldie, 1960).

The United Nations Economic Commission for Africa in its 1966 survey of development prospects for water transport in west Africa, gave Nigeria the country with the greatest prospects in inland waterways cargo throughput growth, projecting as much as 425,000 to 630,000 tonnes of cargo within 1975 to the 1980-year period (from the 250,000 tonnes of 1958/1959 year). Nigeria's inland waterways instead of developing and improving on the gains and achievements of the pre-colonial and colonial era is actually receding and losing out. This inadequacy partly is responsible for the slow pace at which Nigeria's economy is developing. The first stages of the industrial revolution of the late 18th and 19th centuries are linked to the development of the canal systems in Western Europe and North America. This relationship is still evident today as is demonstrated in present-day China as the Yangtze River or ‘the golden waterway’ as it is known in China, is a major driving force behind the fast economic growth being witnessed in China.

The increased reliance on international trade has created significant demand for port facilities to process containerized consumer goods and as such, there is an increased concern on the heightened pressure being exerted on the road highways through which trucks transport these cargoes. 2012 annual cargo throughput at Nigeria’s various seaports is 77, 092,625 million tonnes out of which at least 4, 961,188 tonnes of containerized cargoes were surely transported through roads by trucks, none by rail or inland waterways. This contributes greatly to the fast rate of highway decays in Nigeria as it has been documented that a truck axle has the same destructive impact on the road structure of about 10,000 car axles (Mercedes Benz, 2001). On the other hand, Inland water transport is an environmentally friendly means of transporting goods, both in terms of energy consumption and exhaust gas emissions. It is estimated that its energy consumption per km/ton of transported goods is approximately 17 per cent of that of rail transport and 50 percent of road transport (UNCTAD, 2011). Inland water transport operation is advantageous in terms of costs of moving heavy traffic; especially where speed is not put into consideration than cost, for instance, a single 15-barge tow is equivalent to about 225 railroad cars or 870 tractor-trailer trucks (Ndikom, 2013).

The intermodal implications of barge operations relative to other modes is illustrated in the following table

Table 2.2: comparative illustration of carrying capacity of a barge against other means of carriage

Equivalent units	One barge	15 Jumbo rail-road hopper cars	58 large trailer trucks
Cargo carrying capacity	One barge 1,500 tonnes 52,500 bushels 1,717,063 litres	Jumbo rail-road hopper car 100 tonnes 3,500 bushels 114, 471 litres	Large trailer trucks 25 tonnes 910 bushels 29,772 litres
Equivalent lengths	One barge 0.0268km	15 Jumbo rail road hopper cars 0.2951km	58 large trailer trucks 1.234km (bumper to bumper)

Source: Iowa Department of Transportation

The implications of table 2.1 is that a barge can safely transport the total volume of cargoes carried by 58 trailer trucks or 15 jumbo rail road hopper cars, despite having a length of 0.0268km, as compared with the length of 15 jumbo rail road cars of 0.2951km, and 58 trailer trucks (bumper to bumper parking) of 1.234km. In terms of freight costs, water transportation is approximately five times cheaper than rail transport, twenty-five times cheaper than road transport and fifty times cheaper than air transportation (Ali, 2012). Water transportation also is the most efficient means of transportation in terms of fuel consumption and the resulting propulsion/movement produced, as its medium of movement is devoid of opposing friction forces that consumes energy.

Previous studies elsewhere have all reached the same consensus that inland waterways transportation is a more suitable cargo transport alternative. The UK's

Department for the environment, rural affairs and agriculture (DEFRA) (2009), in its commissioned report on 'benefits of inland waterways transport', went on to highlight the huge benefits the inland waterways have on the greater economy of the UK especially the rural areas. Glaves et al (2007) in their review of the economic and other benefits of inland waterways, being a research report for the Inland Waterways Advisory Council (IWAC) of the UK, portrayed the state of the inland waterways' operations in the UK. Showing how much, it contributes to the economy, how much has been invested by the government in recent times, and the implications of failure to fund. Ghazy (2010) in his work; River transport and reshaping Africa, he highlighted the large potentials of the river Nile to the Nile basin economies and especially to Egypt and how governments across Africa can utilize the various inland waterways across Africa to speed up economic development and regional integration. The Nile Basin Initiative (NBI) in its 2012 report; 'the state of the Nile basin', discussed the role of Inland water transport in support of further regional Integration.

To better appreciate the essence of Nigeria's inland waterways and also get a better picture of the potentials inherent, some select countries are sampled here and the state of their inland waterways highlighted.

- **BRAZIL**

Brazil has the largest reserves of fresh water and some of the largest hydrographic basins in the world. Within this immense water resource, it is estimated that Brazil has 60,000km of rivers of which 42,000km are navigable. Out of this navigable 42,000km, about 10,000km are exploited commercially (Rivers of the World Atlas, 2010). Though the participation of inland waterways transportation in the carriage of Brazil's inland cargoes is still slight due to its limitation to the market of Ore and agricultural bulk, it accounts for 7% of the inland cargo.

Map 2.2: Main Inland Waterways in Brazil

Source: Ministry of Transport Brazil

The government intends to gradually increase the participation of navigable waterways in the domestic transport of cargo, thus contributing to the sustainable development of the Brazilian economy. To attain this, the Government has established a global long-term strategy for the transportation sector – the National Logistics and Transport Plan (Plano Nacional de Logística Transportes – PNLT), which includes the main investments in inland waterways. The government's Program for the Acceleration of Growth (PAC) stimulates a multimodal transport system. The PAC is investing R$ 1.5 billion in the construction of locks for the Tucurui complex, for dredging and rock clearing in the Parana- Paraguai, Sao Francisco, and Tocantins waterways, as well as in building 39 river terminals in the Amazon region. It plans to invest up to $2.7 billion in its inland waterways transport system between the years 2011 – 2014 (Ministry of Transport, Brazil, 2010).

- **RUSSIA**

The navigable waterways of the Russian federation extend along some 101.8 thousand KM and are indeed second only to that of China globally even though they are not used on a full scale. The main water arteries of this system are Rivers Volga, Kama, Don, and Neva, as well as the Volga – Don, Volga – Baltic, and Moscow Canals. Inland shipping accounts for approximately 3% of domestic inland freight movement.

Map 2.3: Main Inland Waterways of the Russian Federation

Source: Rivers of the World Atlas, 2010.

Russia's inland waterways network has 131 river ports (15 of international importance), 1500 companies involved in freight and passengers transportation along the inland waterways, and a total of 30,000 vessels of various capacities involved in inland waterways activities, handling 225 million tonnes of cargo in river ports and 20million passengers (Ministry of Transport, Russian Federation, 2010).

- **INDIA**

India has a substantial network of navigable waterways with still largely untapped potential. Although India has inland waterways with a navigable length of 15,544km, only 37% of this length (5,700km) is used for navigation.

Map 2.4: Main inland waterways of India

Source: Inland Waterways Authority of India (IWAI)

Among these navigable waterways, three have been declared national waterways; the Ganges River (from Haldia to Allahabad (1,620km)); the Brahmaputra River (from Dhubri to Sadiya (891km)), and the west coast canal (from Kottapuram to Kollam) including the Chamakara and Udyogmandal canals(205km) (IWAI). In 2001 – 2002, the inland waterways of India were responsible for 17.3million tonnes of inland cargo which represents a mere 0.1% of India's inland cargo.

- **CHINA**

With a navigable length of 123,495 km, China's inland water transport network is the largest in the world in length and volume of cargo. It consists of more than 5,000 rivers, of which the 6,300-km Yangtze and its tributaries are the longest.

Map 2.5: Main inland waterways of People's Republic of China

Source: *Rivers of the World Atlas*

Apart from Russia, the navigable length of the Yangtze and its tributaries alone is greater than the total length of inland waterways in any other country.

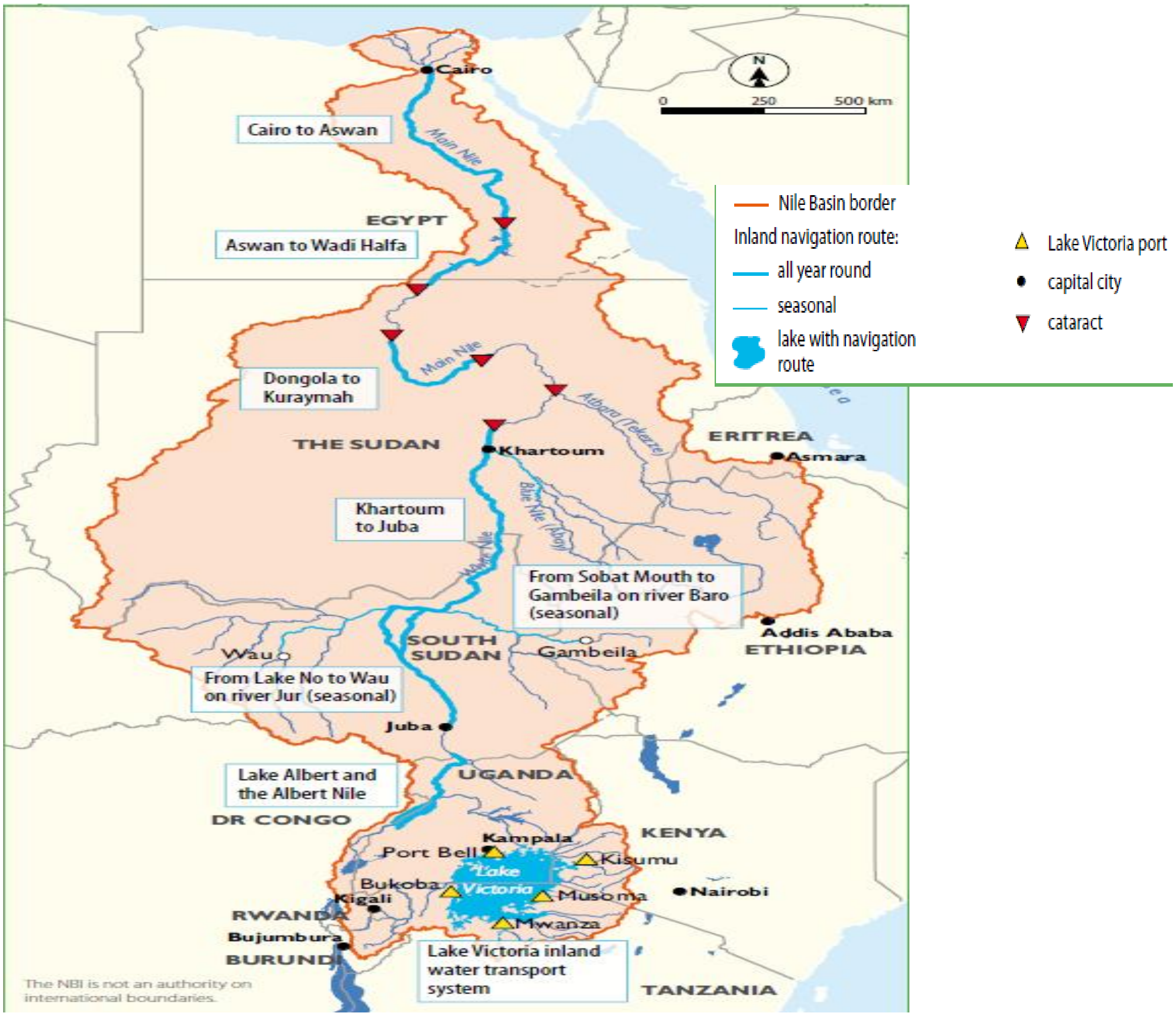
Apart from the Yangtze, the two other major waterways are the Pearl River waterway and the Hangzhou-Beijing waterway (also known as the Grand Canal). The Pearl River waterway, which encompasses 10,000 km of the Pearl River and its tributaries as far west as Nanning is an important transport link between Hong Kong and the manufacturing areas of Guangdong. The Hangzhou-Beijing waterway (the Grand Canal), extends 1,743 km, from Tianjin in the north to Hangzhou in the south. This is the world's longest man-made waterway. Silting made it impassable for more than a century, but Beijing has recently

Initiated a dredging programme, and its navigable length has been extended to 1,100 km during the flood season and 400km year-round. The Yangtze River – or the 'Golden Waterway' as it is also known in China – is the logistics backbone of Shanghai. On its banks, such cities as Wuhan and Chongqing are rapidly increasing their industrial output. The Yangtze River is China's longest and largest river and in the Yangtze River Basin, 35% of China's GDP is generated. 80% of all inland shipping in China is related to the Yangtze River. The total volume of cargo transported on the river is estimated to be more than 1 billion tons annually, and the Yangtze River carries 80% of the iron ore, 72% of crude oil, and 83% of coal transport along the inland waters. The container throughput of the Yangtze River ports is increasing fast and is at present more than 7 million TEU. Large inland ports such as Chongqing and Wuhan have reached the volume of half a million TEU, and impressive total cargo throughput in 2008 of 56 million tons (Wuhan) and 15 million tons (Chongqing) (rivers of the world atlas, 2010). A port like Nanjing is still classified as a river port, although it handles also seagoing vessels, and this port has reached an astonishing volume of 111 million tons and 1.3 million TEU in 2008. The Chinese government adopted a strong inland shipping policy, and set up support programmes, at first mainly focusing on the capacity increase in handling and vessel capacities. Also, other waterways such as the Grand Canal and the tributaries of the Yangtze River are being (re)developed, and the construction of barrages and ship-locks, improve the sailing conditions and make the waterways accessible to larger vessels all year round. Due to the fast increase in volumes, more and more attention is given to the sustainability of inland shipping development and an increase in the efficiency of the use of the waterway system. In the fields of transport safety and securing the environmental risks of increasing inland shipping, the achievements are significant, but still, further improvements are targeted, to develop inland waterways transport as the safest and cleanest mode of transport. New projects are launched concerning better monitoring systems for vessel movements, emergency response systems, the introduction of River Information Services, and the management of waste collection related to inland shipping. Continuously the Chinese central and provincial governments are announcing new investment plans to improve and increase the inland waterways system, thereby placing it at the heart of Chinese transport policies.

There exist very few geographical regions with a well-developed inland waterways network. The few organized ones and the impacts of these networks in the constituent countries of these regions are portrayed here.

2.1.6 The Nile River Basin Countries

The Nile region is endowed with many rivers and lakes that have great potential to support inland water transport. Nine of the 11 Nile riparian countries have navigable water bodies, and a total of 72 inland water ports between them, with Egypt and Uganda having the highest number.



Map 2.6 Map of the Nile River Basin

Source: Sudan Ministry of Transport

The main areas important for inland water transport are Lake Victoria, sections of the White Nile in South Sudan, and the Main Nile in The Sudan and Egypt. The land-locked economies of the upper Nile region are hampered by expensive road transportation and logistics that have generally reduced their economic opportunities. Economic development in the Nile countries combined with prospective mineral resources, fossil fuels, and agricultural potentials, justify investment in inland waterways transportation. Several reaches of the Nile could form elements of a comprehensive bulk cargo transportation system that could provide cost-effective access to internal and external markets.

Table 2.3: countries of the Nile basin and their number of River ports

Country	Number of river ports
Uganda	18
Egypt	18
DR Congo	13
Sudan	8
South Sudan	6
Tanzania	4
Rwanda	3
Kenya	1
Burundi	1

Source: Nile Basin Initiative 2012

Egypt has the most developed inland water transport system on the Nile River. This comprises the Ashwan – Cairo waterway (960km), the Cairo – Alexandria waterway (220km), and the Cairo – Damietta waterway (225km). The Egyptian network is linked to Sudan and other upstream countries through the Aswan – Wadi Halfa waterway (350km). All the waterways have been equipped with hydraulic structures and navigation facilities to allow for 24-hour all-year traffic (Ghazy, 2010).

Table 2.4: 2009 exports of Nile countries.

Country	Export Volume (USD)	Remarks
Egypt	$23 billion	3.6% of these exports went to fellow Nile basin countries. More than two – thirds of Egypt's Nile basin exports go to Sudan and South Sudan, with the remaining upstream riparians receiving a little above 1% of Egypt's total exports
Sudan†	$6.9 billion	2.2% of these exports went to fellow Nile basin countries.
Kenya	$4.5 billion	31% of these exports went to fellow Nile basin countries.
DR Congo	$2.5 billion	0.8% of these exports went to Nile basin countries.
Tanzania	$1.890 billion	10% of these exports went to Nile basin countries.
Uganda	$1.490 billion	44% of these exports went to Nile basin countries. South Sudan and Kenya are Uganda's top export recipients.
Ethiopia	$1.480 billion	5.2% of these exports went to Nile basin countries.
Rwanda	$335 million	39% of these exports went to Nile basin countries. Kenya alone receives 33% of Rwanda's total exports.
Burundi	$88 million	8% of these exports went to Nile basin countries.

Source: IMF DOT, 2011.

†Figures are those of old Sudan before the split.

Subsequently, this trade amongst the Nile basin countries is still visible in their import trade pattern as demonstrated in the table below

Table 2.5: 2009 import charts of Nile basin countries.

Country	**Import Volume (USD)**	**Remarks**
Egypt	$45.250 billion	0.6% of their total imports are from fellow Nile basin countries.
Kenya	$11.9 billion	4% of their total imports are from fellow Nile basin countries
Sudan†	$8.5 billion	12% of their total imports are from fellow Nile basin countries
Ethiopia	$6.95 billion	3% of their total imports are from Nile basin countries. Their trades with other Nile basin countries are limited because it is landlocked and has no navigable river.
Tanzania	$6.5 billion	7.5% of their total imports are from Nile basin countries.
DR Congo	$3.6 billion	12% of their total imports are from Nile basin countries.
Uganda	$2.8 billion	19% of their total imports are from Nile basin countries.
Rwanda	$1.2 billion	32% of their total imports are from Nile basin countries. Kenya and Uganda are top import suppliers to Rwanda.
Burundi	$380 million	23% of their total imports are from Nile basin countries.

Source: IMF DOT, 2011.

Figures are for old Sudan before the split

The high volume of trade between the Nile basin countries of Kenya, Rwanda, Burundi, Uganda, and Tanzania are attributable to the interconnection of waterways between them, particularly Lake Victoria which is bordered by Uganda, Kenya, and Tanzania. Inland Regional Nile transport volumes among Egypt, Sudan, Uganda, and Kenya, amount to 1.6 million TEUs annually (Ghazy, 2010).

2.1.7 European waterways corridor

Waterways flow through Europe's enlarging market and benefit the economies of countries, regions, and cities. They are the only highways that still have plenty of capacity. Four main corridors form a unique European network: North-south Corridor – accounting for 9.7% of inland cargo transportation, Rhine Corridor – accounting for 14.3% of inland cargo transportation, East-west Corridor – accounting for 1.2% of inland cargo transportation, Southeast Corridor – accounting for 7.2% of inland cargo transportation (NAIDES, 2013).

The Danube River accounts for a large portion of the European transport ring as it passed through more countries than others.

A feeding network of smaller waterways compliments the catchment area of the main network. The importance of waterway transportation to the competitiveness of some major seaports in Northern Europe cannot be underestimated. Ports rely on a modern river network for important and seamless export to and from their hinterland. Inland navigation is their main partner. In Rotterdam and Antwerp, more than 50% of the sea tonnage is carried by inland shipping.

Map 2.7: European waterways transport ring

Source: ministry of transport, Russian Federation

The European Commission issued at the start of 2006 the first comprehensive development program for inland waterway transport, to promote better use of rivers and canals for freight transport across Europe. Baptized “Naia- des” after the river nymphs of ancient Greece, the program aims at setting positive incentives and scrapping barriers for the development of inland waterway transport. By linking navigable waterways to the road, rail, and short-sea networks, the EU wants to contribute to relieving traffic congestion, mastering energy use, and sustainable distribution solutions.

2.2 Theoretical Framework

Although a few studies have considered inland waterways transportation within the country, they have all but focused on the different aspects of inland waterways transportation rather than on the economic potentials, on which this research work is premised on.

Over the years cargo traffic through the Nigerian ports is increasing along with the economic development of the country. The theoretical analysis of the port activities at the inland river port of Onitsha lies at the root of growth theory.

2.2.1 Theory of unbalanced growth- Alder. O Hirschman

Hirschman's theory of unbalanced growth maintains that; investments in strategically selected industries or sectors of the economy will lead to new investment opportunities and so pave the way to further economic development. Thus, growth is unbalanced as it does not occur everywhere, only in certain sectors, which then pull others along (Krishna and Pérez, 2004).

The Nigerian government must also encourage private/ public sector investment in the development of maritime infrastructures, such as ports, inland waterways and intermodal connections, vital links to the multi-modal transport network, and reliable and cost-effective coastal feeder services, to improve inland waterways transport development, enhance productivity, competitiveness and operational performance (Emenyonu, et al., 2015; Nwachukwu, 2017). This was buttressed by the work of Njoku and Ikeji, (2012), who was of the view that adequate investment in transport infrastructure (inland waterways infrastructure) is a catalyst to the economic growth of Nigeria.

2.3 Empirical Framework

Onyema et al. (2017) analysed the effects of underutilization of inland waterway transport on the Nigerian economy. They also critically examined the challenges negating the utilization of the Nigerian inland waterway transport. They conducted the research using data obtained through the primary source. The data received from 60 respondents identified constraining variables were subjected to factor analysis using the principal component and orthogonal varimax rotation. Their findings show that factors such as human capital development, inadequate government transport policy, private sector investment apathy and poor implementation of the Cabotage Act are the major components facilitating the underutilization of the Nigerian inland waterway transport.

Etus (2016) appraised the impacts of inland waterways operations on Nigeria's economic growth using a time series secondary data. The data were subjected to Simple regression analysis and paired-sampled t-tests. Her findings indicate that the value of GDP generated in the Nigerian economy will increase by 27.3% for every one percent increase in revenue generated from inland waterway transport and decrease by 3.5% for every one percent increase in piracy and kidnap incidents on Nigerian waterways, also increase by 16.0% for every one percent increase in the number of private investors registered with NIWA.

Ibeawuchi (2013) focused on safety records of inland waterways activities, analysing the fatality rates of boats and ferry incidents on the inland waterways in Nigeria. Within a survey period of 2004 - 2009, the fatality rate of ferry services in the inland waterways was approximately 6% (which is comparatively low and in essence should result in a positive effect on their economic development). In a more comprehensive approach, Ndikom (2013) undertook a critical assessment of the inland waterways operations and management on the development of the Nigerian maritime industry. His work was, however, focused on the inland coastal shipping (Cabotage) act of 2003; its implementation, and its effect on inland waterways transportation in Nigeria. In his work, Dogorawa (2012) tried to highlight investment opportunities and trade patterns existing among West African countries and some select Islamic countries and non-Islamic countries, equating these trade patterns as maritime opportunities and shipping patterns. In their work; 'analysis of the factors limiting performance in the lower river Niger dredging project, Nigeria', Obeta, Ubuoh, & Akande (2011) analysed inland water transportation in Nigeria and the factors militating against the dredging project of the lower Niger. Ekpo (2012) highlighted the huge impact of shipping on Nigeria's economy and the huge existing potentials that exists in the domestic shipping industry. Ali (2013) carried out extensive work on the history of trade and transportation in the lower Niger. His work, 'trade and transport in the lower Niger 1830 – 2011' dealt with the history of transportation and trade along the lower Niger River.

AHP has had some wide applications to maritime transport and logistics, few recognizable studies are Frankel (1992) on shipping policy decision making, Kumar (2002) on debates over liner shipping competition. However, most of these studies are limited only to its analytical and conceptual discussion on the respective issues. Haralambides and Yang (2003) did apply a fuzzy set theory (an advanced version of AHP) to international ship registry, especially to flag choice. Another important consideration in the AHP is the notion of consistency. Consistency is the degree to which the perceived relationship between elements in the pairwise comparison is maintained, Ugboma et al (2006). This is very important because comparisons lacking consistency may indicate that the respondents did not understand the differences in the choices presented or were unable to assess accurately the relative importance of the elements compared (lack of adequate information about the criteria being compared or a lack of concentration during the judgment process can also cause inconsistency, Ugboma et al (2006)). As an initiative for empirical applications of the AHP framework to the research subject, this study will conduct a step-by-step process under the framework.

2.4 Summary of Reviewed Literature and Research Gap

Onyema et al. (2017) analysed the effects of utilization of inland waterway transport on the Nigerian economy using a Principal Component Analysis (PCA) model, Etus (2016) studied the appraisal of the impacts of inland waterway transport operations on Nigerian economic growth using the Ordinary Least Square (OLS) multiregression model, Ibeawuchi (2013) focused his study on safety records of inland waterways operations, Ndikom (2013) critically assessed inland waterways operations and management on the development of the Nigerian maritime industry with a focus on the Cabotage regime, This study reviewed the economic potentials of the Onitsha river port using the time series modeller, trend analysis, and Analytical Hierarchy Process (AHP) to model the choice of inland waterway transport rather than the air and road modes for the transport of south-eastern bound cargoes considering, costs, efficiency, safety, timeliness and carrying capacity of choosing either of the modes.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study Area

Onitsha owes its growth and development to its role in the transportation and commercial activities of the inland waterways of the Niger River. Despite the global economic depression of the 1930s, trade boomed in Onitsha to the extent that the market began to witness traffic congestion due to an increase in the number of Lorries that came to load and unload at Onitsha market (NAI, 1938). Other river towns that benefited from the economic activities along the inland waterways of these early years were Ajaokuta, Idah, and Lokoja. However, the fortunes of the inland waterways were adversely affected with the construction of roads and railway lines across Nigeria which began in 1922 (Ali, 2012).

Onitsha is one of the ancient cities in Nigeria today whose origin, growth, and probably continuous existence today can safely be attributed to the River Niger. Historically the initial settlers migrated to the present Onitsha because of the river and the attendant economic values that it presents to its immediate environment. Onitsha went on to become a very important slave post as the waterway provided a safer alternative for the slave traders to evacuate their slaves to the coastal towns where they trade with the Europeans. After the abolition of the slave trade, palm oil, and cash crop trade boomed, and in 1857, the Royal Niger Company established a permanent trade post at Onitsha, and with the development of steam engines, they were able to safely navigate to Onitsha. In the early 20th century, economic activities were at its peak at Onitsha river port, such that goods remained at Burutu warehouse awaiting transport to Onitsha and may not be cleared for as long as six months, prompting the establishment of a customs station at Onitsha river port in 1917 (Ali, 2012). Onitsha lies at a very strategic East–West crossing point of the River Niger and also occupies the northernmost point of the river regularly navigable by large vessels all year round. It was indeed the major link of other neighbouring south eastern states (Igbo ethnic nationals) to the rest of the nation in terms of economic activities. These contributive factors helped propel Onitsha to the present stage of trade and economic vibrancy. The modern Onitsha river port was commissioned in 1983 but following complacency on the part of government regulators and other factors, the port was soon abandoned and left to decay. Onitsha River port falls under lot 2 of the recently concluded dredging of the river Niger (from Bayelsa to Patani is lot 1; Patani to Onitsha is lot 2; Onitsha to Agenobode is lot 3; Agenobode to Jameta bridge is lot 4; Jameta bridge to Baro is lot 5).

3.2 Research Design

Research design provides the glue that holds the research project together. It is used to structure the research to show how all of the major parts of the research work together to try to address the central questions. This study adopted the mixed method research methodology to give a better treatise to the aim and objectives of the study. This is achieved by scientifically analyzing the data sourced with the aid of relevant statistical models.

3.3 Method of Data Collection

This section explains the ways through which this research study was carried out. It plays an important role in every research study as it provides in-depth knowledge about the basic framework on which the research was premised, and the answers to the research study questions emerge. Further details of this chapter rest on the research design, the research population and population size, instruments of the research study, sources of data, and the procedures employed in obtaining and analysing these data.

The source of data used in the course of this research study falls under two categories; primary data and secondary data.

3.3.1 Secondary Data

The secondary category of data used for this research study includes data obtained from publications and articles, maritime magazines, journals of relevance, library, textbooks, internet, publications and bulletins of the Nigerian Inland Waterways Authority (NIWA), Nigeria Ports Authority (NPA), and other forms of catalogued data. These categories of data as employed in the course of this research study helped throw light on the research subject. It however helped provide resources on past research studies carried out on the research subject area for review and also provides links for further studies and research for those who would want to venture into future research on the research subject. Note that the cargo traffic to south-eastern hinterlands will be used as proxy to cargo traffic to Onitsha river port.

3.3.2 Primary Data

The primary data category includes data obtained from such sources as oral interviews with relevant persons, questionnaires, statistical surveys, opinion polls, observations e.t.c. The main instrument of data collection here is the questionnaire which is designed to obtain data from the responses of the target audience to a specific set of structured questions, solely designed for this research work.

One of the methods used in gathering data used for this research study is through the use of questionnaires. The questionnaires contained a set of structured questions aimed at obtaining relevant data from the sampled population as regards the research topic (see appendix II for a sample of the distributed questionnaire). These questionnaires were distributed to randomly selected persons whose contributions and businesses are hugely dependent on the outcome of the research work. A total of fifty valid questionnaires were administered and validly filled and collected. This 100% success in return is pointed to the fact that the researcher sat through with the respondents explaining every aspect of the questionnaire where and when required to the sampled respondents. The target audiences of this research whom the copies of the questionnaire were distributed to are senior logistics managers of some logistics firms, clearing and forwarding agents, procurement and logistics managers of some manufacturing industries within the catchment area of the river port of interest (Onitsha river port), project managers of major construction companies operating within the same area. The research study uses a non-probability sampling method through convenience sampling to arrive at a sample size of fifty respondents.

3.3.3 Determining the Sample Size.

In knowing the real sample size to use in the study the researcher used Yaroyamen formula. This method is adopted when one is having a finite population, which can be utilized in computing the sample size.

Thus, $$n = \frac{N}{1 + N(e)^2}$$

Where, N = population

e = sample error/ tolerance error level

n = sample size

Based on this;

So, N = 80

e= 3% $(0.03)^2 = 0.0009$

n = ?

Applying the formular,

$$n = \frac{N}{1 + N(e)^2}$$

$$= \frac{80}{1 + 80(0.0009)}$$

$$= \frac{80}{0.0729}$$

$$= 74$$

Therefore, the sample size of the study is 74 questionnaires were distributed as per the study.

3.3.4 Method of Data Instrument Administration

The researcher personally visited these ports and distributed the questionnaire to the target respondents who filled and returned the questionnaire to the researcher. He also used a lot of secondary data from relevant government agencies and various published materials and text books.

3.3.5 Validity and Reliability of the Measuring Instrument

The measuring instrument (questionnaire) was first administered to staff of NIWA, two different ports within Lagos (Apapa and Tincan Port) and Onitsha and Lokoja river ports for responses. The summary of their responses was collected and analyzed using the Spearman Correlation method and a coefficient of 0.95 degree of significance was obtained, indicating a strong relationship in the likelihood of future responses. This shows that the measuring instrument is reliable. The validity adopted is the content validity.

3.4 Models for Analysis and Analytical Procedure

3.4.1 Time Series Modeller for Testing Objective One and Two

A time series is a set of observations obtained by measuring a single variable regularly over a period of time. Thus, the form of the data for a typical time series is a single sequence or list of observations representing measurements taken at regular intervals. One of the most important reasons for doing time series analysis is to try to forecast future values of the series. A model of the series that explained the past values may also predict whether and how much the next few values will increase or decrease. The ability to make such predictions successfully is important. The Time Series Modeler procedure estimates exponential smoothing, univariate Autoregressive Integrated Moving Average (ARIMA), and multivariate ARIMA (or transfer function models) models for time series, and produces forecasts. The procedure includes an Expert Modeler that automatically identifies and estimates the best-fitting ARIMA or exponential smoothing model for one or more dependent variable series, thus eliminating the need to identify an appropriate model through trial-and-error Statistics. Goodness-of-fit measures include stationary R-square, R-square (R^2), root mean square error (RMSE), mean absolute error (MAE), mean absolute percentage error (MAPE), maximum absolute error (MaxAE), maximum absolute percentage error (MaxAPE), and normalized Bayesian information criterion (BIC). This tool will be used to analyse data to address research objective two. The IBM statistics package for social scientists (SPSS) 21 was used in modelling the time series data.

3.4.2 Analytic Hierarchy Process (AHP) for Testing Objective Three

To analyse data obtained from respondents for research objective four, AHP will be used. Analytic Hierarchy Process is a comprehensive framework that is designed to cope with the intuitive, the rational, and the irrational when we make multi-objective, multi-criterion, and multifactor decisions with and without certainty for any number of alternatives (Harker and Vargas, 1987). The Analytic Hierarchy Process is a very reliable technique that is employed in Multi-Criterion Decision Analysis (MCDA). The Analytic Hierarchy Process (AHP) is an established methodology in decision making and ranking priorities, with quantifiable and or intangible criteria (Song and Yeo, 2004). It is a veritable tool for choice modelling based on a number of criteria for decision making. The concept of AHP was introduced by Saaty (1980), who defined it as combining both subjective and objective assessments and perceptions into an integrative framework based on ratio scales from simple pairwise comparisons. The technique associated with AHP requires three major steps:

i. Structuring a hierarchy
ii. Making pairwise comparisons to yield priorities

iii. Synthesizing the priorities into composite measures of the decision alternatives or options (Wedley et al, 2001).

AHP has a wide range of applicability which includes business decision making, resource allocation, priority rating, and (or) performance evaluation problems and in a variety of industries. In particular, a very useful feature of AHP is its applicability to the measurement of intangible criteria along with the tangible, through ratio scales (Badri, 1999). Also, by breaking problems into their constituent parts and logically relating them (i.e. from the larger scales – descending in a gradual step – to the smaller ones), an analyst can connect the small ones to the large through the use of paired comparison (Vargas, 1990), which is a useful background for this research study.

3.4.2.1 Analytic Hierarchy Process Stages

The Analytic Hierarchy Process is a multi-leveled process of analysis that must be taken in such progressive order to achieve the end goal. The following represents descriptive explanations of the various AHP stages in the order through which they are applied to the ultimate goal/decision.

First stage: Establishing decision-making hierarchy

The starting point for the AHP analysis is to establish the hierarchy of associated decision making choices in the form of a network structure. This can be done by putting an ultimate goal of such a decision and /or assignment on the top of the hierarchy, locating critical criteria for achieving the goal in the middle of the hierarchy and finally listing identified alternatives on the bottom, which are linked with those criteria and the ultimate goal of this decision making. As for this research study, the ultimate goal is ‘freight transportation’, which is situated at the top of the hierarchy. Critical criteria or elements that constitute the freight transportation, which were identified from the review of relevant literatures, are in the middle of the structure. Finally, the alternatives (the sampled options) will be listed at the bottom of the hierarchy.

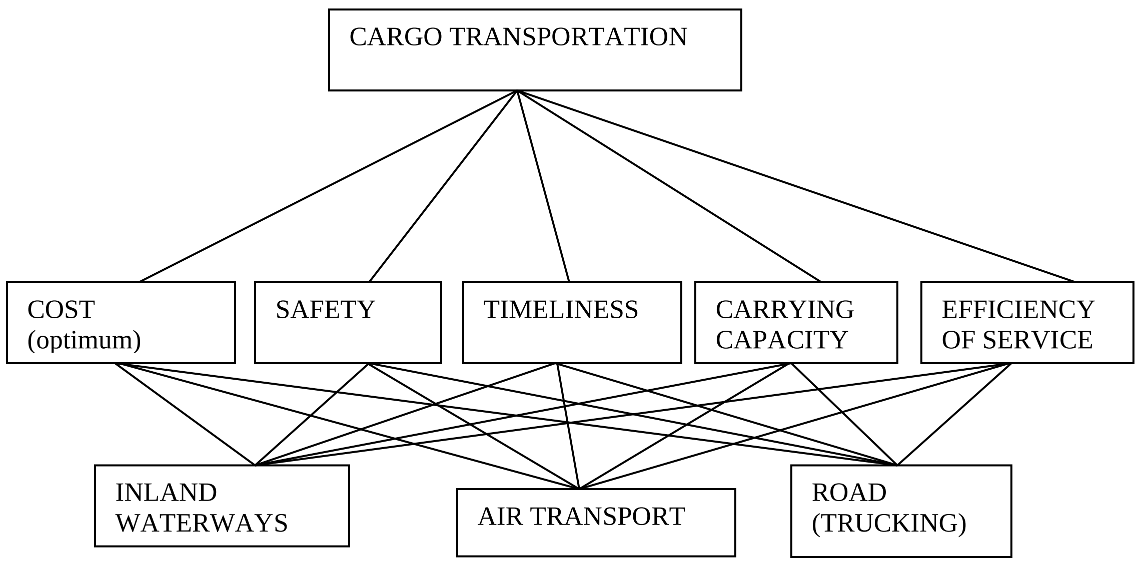


Figure 3.1: A hierarchical structure for cargo transportation decision

Second stage: Determining weights on criteria and alternatives

In this stage, pairwise comparisons are made in order to determine relative weights on the identified criteria and sampled alternatives. The logic behind this process is that the more important factors (attributive factors and elements in terms of AHP) should have higher weights or values thus being given more attention in making a decision or assessment. This process is based on the procedures suggested by Saaty (1980, 1984). Pairwise comparisons are used to determine the relative importance of each alternative in terms of each criterion. In this approach the decision-maker has to express his opinion about the value of one single pairwise comparison at a time. The pairwise comparisons from each branch at each level of the hierarchy are entered into a matrix and used to determine a vector of priority weights. Only those elements that pertain to a common objective are compared against one another.

In making pairwise comparisons, combination of comparisons can only be done in

$\frac{n(n-1)}{2}$ Times, where **n** – is the number of criteria to be considered.

Table 3.1: The fundamental scale for AHP

Intensity of importance on an absolute scale	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one over another	Experience and judgment strongly favour one activity over another
5	Essential or strong importance	Experience and judgment strongly favour one activity over another
7	Very strong importance	An activity is strongly favoured and its dominance demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When compromise is needed
Reciprocals	If activity ***i*** has one of the above numbers assigned to it when compared with activity ***j***, then ***j*** has the reciprocal value when compared with ***i***.	

Source: Saaty (1990)

The pairwise comparisons from each branch at each level of the hierarchy are entered into a matrix and used to determine a vector of priority weights. Only those elements that pertain to a common objective are compared against one another. We use the following notation:

w_i = weight for attribute i, I = 1,..,n where n = number of attributes;

$a_{ij} = w_i / w_j$ = the result of a pairwise comparison between attribute i as compared to attribute j;

A = matrix of pairwise comparison values, a_{ij}

A set of pairwise comparisons can be represented as:

$$\boldsymbol{A} = \begin{pmatrix} W_1/W_1 & W_1/W_2 & \cdots & W_1/W_n \\ W_2/W_1 & W_2/W_2 & \cdots & W_2/W_n \\ \vdots & \vdots & \ddots & \vdots \\ W_n/W_1 & W_n/W_2 & \cdots & W_n/W_n \end{pmatrix} \qquad (1)$$

Where w_1/w_2 is the importance of attribute 1 as compared to attribute 2. Since the

direct result of a pairwise comparison is a_{ij}, where a_{12} is equal to w_1/w_2, matrix ***A*** becomes:

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix} \qquad (2)$$

The goal of AHP is to uncover the underlying scale of priority values w_i. In other words, given α_{ij}, find the "true" values of w_i and w_j. This **A** matrix has some special properties; first, ***A*** is of rank one. If we look at each column of ***A***, we have:

$$A = \left\{ w_1^{-1}\begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_n \end{bmatrix}, w_2^{-1}\begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_n \end{bmatrix}, \cdots, w_n^{-1}\begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_n \end{bmatrix} \right\} \quad \ldots\ldots (3)$$

Each column of ***A*** differs only by a multiplicative constant, w_i^{-1}. If the ***A*** matrix is consistent only one column is required to determine the underlying scale ($w_1, \ldots, w_n$). The same evaluation could be undertaken in a row-wise fashion with the same result.

Second, if B is x times more important than C, then it follows that C is 1/x times as important as B. In other words, α_{ji} is the reciprocal of α_{ij} such that $\alpha_{ij} = 1/\alpha_{ji}$. This assumes the decision maker is consistent with respect to individual pairwise comparisons and is a fundamental assumption made by the AHP. With this assumption, matrix ***A*** is reduced to:

$$A = \begin{pmatrix} 1 & \alpha_{12} & \alpha_{13} & \cdots & \alpha_{1n} \\ 1/\alpha_{12} & 1 & \alpha_{23} & \cdots & \alpha_{2n} \\ 1/\alpha_{13} & 1/\alpha_{23} & 1 & \cdots & \alpha_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1/\alpha_{1n} & 1/\alpha_{2n} & 1/\alpha_{3n} & \cdots & 1 \end{pmatrix} \quad \ldots\ldots (4)$$

As seen in equation (4), the diagonals are equal to unity (i.e. $w_1/w_1 = 1$). The above reduction means that only n (n - 1)/2 pairwise comparisons need to be solicited from decision makers as compared with n^2 total entries in the completed ***A*** matrix. If the assumption that the decision maker is consistent with respect to individual pairwise comparisons does not hold, in other words if α_{ij} … $1/\alpha_{ji}$, then $(n^2 - n)$ pairwise comparisons would be required.

Third stage: Evaluating overall ranking of alternatives

Priorities derivation once the comparisons matrices are filled (and is perfectly consistent), priorities can be calculated.

To compute the priority vector (which is the normalized Eigen vector of the matrix) each column of the matrix is first normalized – sum each column of the reciprocal matrix and divide the individual elements with the sum of its column, thus we have a normalized relative weight, and the sum of each column is 1. The normalized principal Eigen vector also called the priority vector can be obtained by averaging across the rows. The priority vector shows the relative weights among the elements compare. The traditional AHP uses the Eigen value method. The principal Eigen value is the Eigen vector with the highest value. The principal Eigen value can however be obtained through mathematical manipulations, from summation of products between each element of Eigen vector and the sum of columns of the reciprocal matrix. To obtain the importance of each sub-criterion, relative to the overall goal, the local priorities are weighted (multiplied) by the priority of the parent criterion to obtain their global priorities with respect to the goal.

3.4.2.2 Consistency measure

Deviations from both ordinal and cardinal consistency are considered, and to a certain extent allowed, within AHP. Ordinal consistency requires that if x is greater than y and y is greater than z, then x should be greater than z. Cardinal consistency is a stronger requirement stipulating that if x is 2 times more important than y and y is 3 times more important than z, then x must be 6 times more important than z. If ***A*** is cardinally consistent, then $\alpha_{ij}\alpha_{jk} = \alpha_{ik}$. Using the previous definition of α_{ij} we can see that this is true:

$$\alpha_{ij}\alpha_{jk} = \frac{W_i}{W_j}\,\frac{W_j}{W_k} = \frac{W_i}{W_k} \qquad \text{.............................. (5)}$$

If the relationship $\alpha_{ij}\alpha_{jk} = \alpha_{ik}$ does not hold then ***A*** is said to be cardinally inconsistent. AHP has been designed to deal with inconsistent matrices (both cardinal and ordinal inconsistency), thus the problem becomes:

$$\frac{W_i}{W_j}\,\varepsilon_{ij} \bullet \frac{W_j}{W_k}\,\varepsilon_{jk} = \frac{W_i}{W_k}\,\varepsilon_{ik} \qquad \text{.. (6)}$$

Where $\varepsilon_{ij} > 0$ and represents some perturbation causing ***A*** to be inconsistent, producing An ***A*** matrix that looks like the following:

$$A = \begin{pmatrix} 1 & \varepsilon_{12}\alpha_{12} & \varepsilon_{13}\alpha_{13} & \cdots & \varepsilon_{1n}\alpha_{1n} \\ 1/\varepsilon_{12}\alpha_{12} & 1 & \varepsilon_{23}\alpha_{23} & \cdots & \varepsilon_{2n}\alpha_{2n} \\ 1/\varepsilon_{13}\alpha_{13} & 1/\varepsilon_{23}\alpha_{23} & 1 & \cdots & \varepsilon_{3n}\alpha_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1/\varepsilon_{1n}\alpha_{1n} & 1/\varepsilon_{2n}\alpha_{2n} & 1/\varepsilon_{3n}\alpha_{3n} & \cdots & 1 \end{pmatrix} \qquad \text{.................. (7)}$$

Various methods have been devised to deal with inconsistency. Saaty (1990) suggests using the following consistency index (**CI**):

$$CI = \frac{\lambda_{max} - n}{n - 1} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (8)$$

Where λ_{max} is the largest Eigen value of ***A*** and n is the number of elements within a branch being compared. If ***A*** is perfectly consistent (cardinally) than λ_{max} will be at a minimum and equal to n, producing a **CI** equal to zero. As inconsistency increases, λ_{max} increases, producing a larger value of **CI.** This consistency index can also be expressed as a consistency ratio:

$$CR = \frac{CI}{CI_R} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where; CI_R is the consistency index for a random square matrix of the same size.

Table 3.2: Random consistency Index table for various values of *n*

n	1	2	3	4	5	6	7	8	9
RCI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Source: Saaty, (1980)

Saaty suggests that **CR** should be less than or equal to 0.1. If after completion of a pairwise comparison matrix **CR** exceeds this threshold value then the user is instructed to go back and revise comparisons until the value of **CR** is acceptable. Several methods for revising matrices to achieve an acceptable **CR** have been developed. The simplest method for identifying pairwise comparisons that are the most inconsistent is to compare the response from the pairwise comparison process (α_{ij}) with a ratio derived from the calculated weights (w_i / w_j). Those values of α_{ij} that are the most different from w_i / w_j are the pairwise comparisons that, if changed in the direction of w_i / w_j, will most improve consistency.

3.4.2.3 Model Validation of the AHP for Objective Three

Because AHP is based on the preferences of the decision maker, validation of the resulting weighting of alternatives is not possible or practical with traditional means. Kangas (1993) points out that it may be easier for the decision-maker to understand and accept this if he or she can be made aware of the fact that his or her preferences actually determine the outcome of the decision analysis. The comparison of results from an application of AHP with historic results is not appropriate because it is assumed that past results are not based on consistently applied expert judgment, otherwise there would be no reason to implement AHP. In many cases the professional judgment required to structure the problem as a hierarchy and inform the model of preferences is the same professional judgment that determines if AHP is producing adequate results. The lack of a solid means of validating AHP results is one of the concerns that keep many decision makers from utilizing the power of AHP. However, AHP is by nature designed to be used in situations where science has not yet been able to define quantifiable relationships and decisions rely, in large part, on professional judgment (Coulter et al., 2006).

3.5 Trend Analysis for Testing Objective Four

Trend analysis is the practice of collecting data and attempting to spot a pattern or trend in the data. It is a method of analysing time-series data (information in sequence over time) which involves a comparison of the same item over a significantly long period to detect a pattern of a relationship between the variables and to project the future direction of this pattern. Although this can be used to predict future events/happenings, it is also employed in estimating past occurrences. Statistically speaking, trend analysis refers to techniques for extracting an underlying pattern of behaviour in a time series that would otherwise be partly or completely hidden by noise. This tool will be used to analyse data to address research objectives one and two. The IBM statistics package for social scientists (SPSS) 21 was used in carrying out this trend analysis.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, AND INTERPRETATION

4.1 Introduction

Imperatively, all collated data employed in the course of this research work are presented, analysed, and interpreted here in this chapter. The research hypotheses are further tested in this chapter, with detailed follow-up explanations where necessary. The secondary data utilized for this research study is the destination of import cargo discharged at the various Nigerian ports data, covering a period of 2000 – 2011, as obtained from the Nigerian Ports Authority statistics. This data presents a breakdown of destinations of imported cargoes discharged at the various Nigerian seaports of entry on a state-by-state basis, as declared by the importers (or their agents). This data is shown in table 4.1 and will used as proxy for potential traffic to Onitsha river port.

It is worthy to note that not all imported cargo destinations are declared by the importers (Note the unspecified row). Also, some cargoes (especially consolidated container loads) may be declared for one state whereas its constituent cargoes may be bound for different other states, thus this data serves as the clearest form of data for analysis but does not reflect the 100% state of the true picture. Extracting the data for south-eastern states bound cargoes (south-eastern states are projected as the areas that will serve as the immediate hinterland of the Onitsha river port), see table 4.1.

4.2 Tests for Objective One

Objective One: To analyse the share of Onitsha river port bound import cargoes to the total national volume of import cargo.

4.2.1 Data Presentation for Objective One and Two

Table 4.1: Showing South Eastern Bound Cargo Traffic from the Lagos Port Complex

S/EAST STATES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Abia	84,318	125,907	150,292	136,049	113,997	317,137	181,381	338,156	258,440	303,512	443,229	671,329	**3,123,747**
Anambra	135,222	160,562	144,267	246,132	193,791	243,761	88,887	275,612	309,083	575,782	554,600	957,576	**3,885,275**
Ebonyi	154	304	126	2,069	892	64	8,886	104	22,207	10,626	nil	Nil	**45,432**
Enugu	7,727	16,366	13,619	30,028	27,735	12,499	5,259	Nil	100,812	34,778	492,760	100,664	**842,247**
Imo	2,823	3,969	10,802	10,612	12,685	16,826	14,216	24,179	188,657	25,656	404,800	200,421	**915,646**
Total	**230,244**	**307,108**	**319,106**	**424,890**	**349,100**	**590,287**	**298,629**	**638,051**	**879,199**	**950,354**	**1,895,389**	**1,929,990**	**8,812,347**

Source: Nigerian Ports Authority Abstract of Ports Statistics (2000 - 2011)

In the course of this research, a trend series analysis was carried out on the data presented in table 4.1 and a time series modeller was further applied to determine the fit of these analyses. The result of these analyses provides proof for hypotheses 1 and 2.

4.2.2 Test for Hypothesis One

Ho_1: The share of Onitsha river port bound import cargoes to the national import volume is not statistically significant.

4.2.3 Presentation of Results for Objective One and Two

Table 4.2: Time series modeller output for south-east (Onitsha River Port) bound cargo volume trend showing fit

Model Description

			Model Type
Model ID	Cargo volume	time series modeler	ARIMA(0,0,0)

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile						
					5	10	25	50	75	90	95
Stationary R^2	.723	.	.723	.723	.723	.723	.723	.723	.723	.723	.723
R-squared	.723	.	.723	.723	.723	.723	.723	.723	.723	.723	.723
RMSE	329402.969	.	329402.969	329402.969	329402.969	329402.969	329402.969	329402.969	329402.969	329402.969	329402.969
MAPE	50.086	.	50.086	50.086	50.086	50.086	50.086	50.086	50.086	50.086	50.086
MaxAPE	169.479	.	169.479	169.479	169.479	169.479	169.479	169.479	169.479	169.479	169.479
MAE	257518.394	.	257518.394	257518.394	257518.394	257518.394	257518.394	257518.394	257518.394	257518.394	257518.394
MaxAE	527609.107	.	527609.107	527609.107	527609.107	527609.107	527609.107	527609.107	527609.107	527609.107	527609.107

Source: SPSS V21 Iterations

From the data in table 4.1, the volume of inbound cargoes to the south-eastern states as recorded through the various seaports amounts to 8,812,347 tonnes the equivalent of 402,390 TEUs (assuming all are dry bulks and containerized). This represents 2.73% of the total national volume. If cargo volumes of seaport hosting states Lagos, Rivers, Cross River, Delta, are discounted, the south-east states record the highest volume of inbound cargoes. We can further equate the proportions of imported cargoes bound for south-eastern states with the national cargo volume total. The following pie chart further illustrates this.

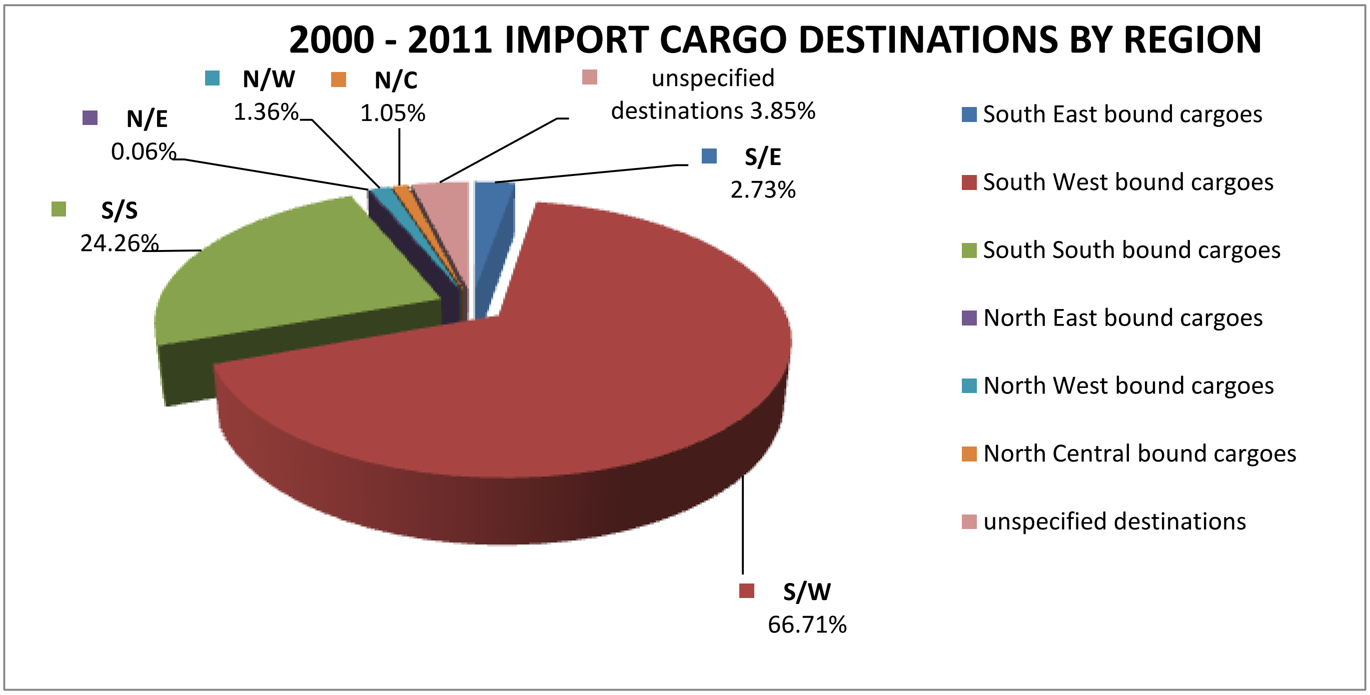


Figure 4.1: Pie Chart Representation of Share of import Cargoes Cleared in Nigerian Seaports by Geopolitical Zones.

Source: *compiled from NPA statistics.*

South-west (215,906,608 tonnes) and South-South (78,527,722 tonnes) regions records the highest volume of inbound non-oil cargoes, with Lagos state alone contributing 97.74% (211,025,694) of the total volume of cargoes (215,906,608 tonnes) destined for south-western states, and Rivers, Delta and Cross river states contributing 74.44% (58,455,910), 12.88% (10,114,894), and 11.3% (8,736,992) respectively, of 78,527,722 tonnes of cargo destined to the south-south states within the study period. Discounting these states (which all hosts seaports), the states with the highest flow of inbound cargoes are Anambra, Abia, Oyo and Kano states in that order. Two of these states (Anambra and Abia) form part of the hinterland for the river port under study.

With an MAPE of 50.086% as depicted by the time series modeller, this means that south-east bound cargoes within the study period was predicted to as much as

13,226,099.12 tonnes but fell 50.086% short of its trend prediction. For a river port located deep in the heart of the country, the volume is impressive enough and can sustain operations at the river port of Onitsha. With an average annual inbound cargo volume of 734362.25 tonnes within the study period (predicted to 1,101,543.38 tonnes), and not taking into consideration, the volume of cargoes from the various land borders, nor the volume of exports originating from the south-east, the volume of cargo movements to and from this region will sustain economic activities at the river port of Onitsha, thus the null hypothesis (**H_o**) is rejected and the alternative hypothesis (**H_A**) is accepted.

4.3 Tests for Objective Two

Objective Two: To examine the traffic and evaluate the shipping impact of port activities at the river port of Onitsha.

4.3.1 Presentation of Data and Results for Objective Two

The data and results for objective (two) are same as presented in table 4.1 and 4.2.

In performing a time series modeller to the above cargo trend series, the results (table 4.2) shows that the fit statistics from the time series modeller output shows an acceptable percentage value of R-squared and stationary R-squared (72.3%). This summarily explains that as much as 72.3% of the total variations in the trend series are explained in this time series model.

The trend of flow of imported cargoes into the country in general and South-eastern states in particular has been more or less irregular, and has only witnessed a steady rise in volume since 2008 till 2011. The causes of these irregularities can be hugely attributed to numerous government reform policies as it affects the ports and transportation generally, ban of some import items, revival of some local manufacturing interests (thereby limiting the importation of such items being locally manufactured), among others. Figure 4.2 below shows the trend analysis of inbound cargoes movement in Nigeria and south-eastern states. As visibly seen, the cargo flows took a steep dive in 2004 after recording steady increase from 2000.

It made another rise in 2005 and took a dive afterwards in 2006 and has since 2007, maintained a steady rise in volume. In all these movements, the south-east as a region has maintained a fair share of the inbound cargo volume, as compared to other regions and the national volume of cargoes.

4.3.2 Tests for Hypothesis 2

$H0_2$: The river port at Onitsha will not have a significant cargo traffic and shipping impact.

$H0_A$: The River port of Onitsha will have a significant cargo traffic and shipping impact

The time series modeller with a Mean Average Percentage Error (MAPE) of 50.066 shows that even with the current cargo flow trend, south-east bound cargoes have recorded approximately 50% of the trend predicted volume. In other words, the current cargo volume flow is still short of what can be forecasted using the current trend. There is a positive upward trend in cargo flow to the south east hence the null hypothesis (**H_o**) is thus rejected and the alternative hypothesis (**H_A**) is accepted.

4.4 Tests for Objective Three

Objective Three: To analyse the choice of Onitsha River port to importers and logistics managers as a preferred alternative route to other transport modes.

4.4.1 Data Presentation and Analysis for Objective Three

Table 4.3: Distribution of the Respondents by Organisations or Companies.

S/N	Company/ seaport	No Distributed	No. Returned	%
1	Nigerian Inland Waterways Authority (NIWA)	11	11	100
2	Rabani GeoLogistics	6	6	100
3	Nigerian Ports Authority (NPA) Onne	10	10	100
4	Clarion Bonded Terminal	8	8	100
5	SINOMA Cargo	5	5	100
6	Diamond Star Nig. Ltd	6	6	100
7	MedLog Nig Ltd	4	4	100
	Total	**50**	**50**	**100**

Source: Field work 2015

Table 4.3 Shows that the survey target was met by administering 50 questionnaires manually to Logistics managers, Barge operators, Bonded terminals, Government agencies, freight forwarding companies, etc. Nigerian inland waterways Authority, Nigerian Ports Authority, Clarion Bonded Terminal, SINOMA Cargo, Diamond Star, and MedLog Nigeria Limited where the relevant agencies and companies in charge of inland waterway transport in Nigeria. However, all the 50 respondents completed and returned the questionnaire. Delphi method was deployed in selecting the respondents and return rate of 50 questionnaires in all (100%). The 100% success rate of return of the filled questionnaires was achieved because the author took his time to guide the respondents on how to fill the questionnaires and collects same as soon as they were through. The data collected was subjected to analysis done using AHP (EVM multiple inputs) calculator by K.D. Goepel Version 12.08.2013.

Table 4.4: Summary Sheet of Returned Questionnaires

Compare which factor is more important when making decisions on the importance of choosing the inland waterway transport over the other modes (Air/Road)										
Priority Criteria	**EI (1)**	**I (2)**	**MI (3)**	**I (4)**	**SI (5)**	**I (6)**	**VSI (7)**	**I (8)**	**ExI (9)**	**Total**
Cost Vs Safety	0	0	1	0	2	0	0	0	0	3
Cost vs Timeliness	1	0	0	0	1	0	0	0	0	2
Cost vs carrying capacity	0	0	0	0	1	0	1	0	0	2
Costs vs efficiency	0	0	0	1	0	0	0	0	0	1
Safety vs timeliness	1	0	0	0	0	0	0	0	0	1
Safety vs carrying capacity	0	0	0	0	0	0	0	0	1	1
Safety vs efficiency	0	0	0	0	0	0	0	0	0	0
Safety vs costs	1	0	0	0	0	0	0	0	1	2
Timeliness vs carrying capacity	0	1	0	0	0	0	0	0	0	1
Timeliness vs efficiency	0	0	0	0	1	0	0	0	0	1
Carrying capacity vs efficiency	0	1	0	0	0	0	0	1	0	2
Total										**16**

Section C

Compare the following alternatives factors in mode selection										
Alternative Criteria	**EI (1)**	**I (2)**	**MI (3)**	**I (4)**	**SI (5)**	**I (6)**	**VSI (7)**	**I (8)**	**ExI (9)**	**Total**
	Costs Factor									
Inland waterway vs Road	0	0	0	0	3	0	2	0	0	5
	Safety Factor									
Inland waterway vs Road	0	0	0	0	4	0	3	0	1	8
	Timeliness Factor									
Inland waterway vs Road	0	0	0	0	1	0	0	0	0	1
	Carrying Capacity									
Inland waterway vs Road	0	0	2	0	5	0	3	0	2	12
	Efficiency Factor									
Inland waterway vs Road	2	0	1	0	2	0	1	0	2	8
Total										34
Grand Total								**34 +16 = 50**		

Equal Importance (1), Moderate Importance (3), Strong Importance (5), Very Strong Importance (7), Extreme Importance (9), while (2), (4), (6) & (8) are intermediates (I) between the choices.
Source: Authors Field work 2015

4.4.2 Tests for Hypothesis 3

H_{03} : The choice of Onitsha river port by importers and logistics managers as a preferred alternative route to other transport modes is not statistically significant.

To test this hypothesis, the primary data is applied. This was sourced from the AHP structured questionnaire which was designed to obtain scaled responses to the questions posed in the questionnaire, which were all structured towards addressing this hypothesis. All AHP calculations were done using AHP (EVM multiple inputs) calculator by K.D. Goepel Version 12.08.2013.

4.4.3 Analytical Hierarchy Process (AHP) Results

Table 4.5: Consolidated (Weighted geometric mean of participants' responses) responses from pair wise comparisons (level 1)

	Cost	***Safety***	***Timeliness***	***Carrying capacity***	***efficiency***
Cost		0.13	0.72	5.55	2.18
Safety	7.47		5.72	8.78	7.31
Timeliness	1.39	0.17		8.28	4.39
Carrying capacity	0.18	0.11	0.12		0.22
efficiency	0.46	0.14	0.23	4.5	

Source: AHP Iterations

Table 4.6: Pairwise Comparisons, Weight and Rank for Level 2 Priorities

Number of criteria (n) = 5 ***Scale*** = Linear (Saaty) ***LEVEL 2 PRIORITIES***

Selected Participants = Consolidated α = 0.1 ***Consensus*** = 90.8%

	Cost	***Safety***	***Timeliness***	***Carr.Cty.***	***Efficiency***	***Weight***	***Rank***
Cost	1	0.13	0.72	5.55	2.18	0.1174	3
Safety		1	5.72	8.78	7.31	0.6026	1
Timeliness			1	8.28	4.39	0.1822	2
Carr.Cty.				1	0.22	0.0286	5
Efficiency					1	0.06910	4

Lambda = 5.440; **CI** = 0.1099; **CR** = 0.098

Source: AHP Iterations

Table 4.6 presents a summary of the analysis of responses done using the AHP calculator for level 2 priorities. The priorities of level 2 provide the relative importance of the five criteria when choosing a means for carriage of freight. From the results of the calculations, the sampled respondents gave the Safety criterion a weight of 0.6026. This means that safety of carriage/ freight forms 60.26% of their freight decisions and means of freight, thus this criterion is ranked first. Timeliness is ranked second and forms the second basis of their freight decision with a weight of 0.1822 (18.22%). This goes ahead to give credence to Just-In-Time (JIT) services as one of the basic features of modern transport and logistics operations. Cost (optimal) ranks third, with a weight of 0.1174 representing 11.74% basis for decision, for choice of freight movement. Efficiency of service for the freight medium and carrying capacity of medium has weights of 0.06910 and 0.0286 respectively, representing 6.91% and 2.86% of choice decision basis respectively. All responses are consistent as the consistency ratio (CR) is 0.098 which is within the 0.1 acceptable maximum level of inconsistency. Safety of freight is thus of the utmost importance to the freight forwarder / logistics manager and forms his basic choice of means to transport freight.

Level 3 priorities show the relative importance of the three alternative means of freight carriage (Inland waterways-IWT, Road transportation-Trucks, and Air transport), with respect to each of the five selection criteria that forms the level two priorities. Analyses of the level 3 priorities are presented in table 4.6 below.

Table 4.7: Pair-wise-comparisons weight and rank for level 3 priorities

Number of criteria (n) = 5 ***Scale*** = Linear (Saaty) ***LEVEL 3 PRIORITIES***

Selected Participants = Consolidated α = 0.1

	Criteria	Level 2 priorities	level 3 priorities	
1.	***Cost***	*0.1174*	***IWT***	*0.551*
			Road	*0.393*
			Air	*0.056*
	Lambda = *3.034;* ***CI =*** *0.020;* ***CR =*** *0.035*			
2.	***Safety***	*0.6026*	***IWT***	*0.6783*
			Road	*0.1432*
			Air	*0.1785*
	Lambda = *3.003;* ***CI =*** *0.017;* ***CR =*** *0.030*			
3.	***Timeliness***	*0.1822*	***IWT***	*0.1585*
			Road	*0.3207*
			Air	*0.5208*
	Lambda = *3.054;* ***CI =*** *0.033;* ***CR =*** *0.056*			
4.	***Carrying Capacity***	*0.0286*	***IWT***	*0.7120*
			Road	*0.2300*
			Air	*0.0580*
	Lambda = *3.094;* ***CI =*** *0.057;* ***CR =*** *0.098*			
5.	***Efficiency***	*0.0691*	***IWT***	*0.0713*
			Road	*0.8002*
			Air	*0.1284*
	Lambda = *3.072;* ***CI =*** *0.044;* ***CR =*** *0.075*			

Source: AHP Iterations

From the table 4.7 summaries of level 3 priorities, the findings present that with cost selection criterion in mind, importers / logistics managers will choose Inland Waterways (0.551) as a means of shipment, approximately 1.5 times over road trucking (0.393), and approximately 10 times over air shipment (0.056).

For safety criterion as a basis for decision, Inland waterways (0.6783) as a means of shipment are adjudged approximately 5 times safer than road trucking (0.1432), and approximately 4 times safer than air (0.1785).

For timeliness of shipments as a decision criterion, air shipments (0.5208) are adjudged approximately 2 times better in timely delivery than road trucking (0.3207) and approximately 3 times better than inland waterways (0.1585).

Carrying capacity as a decision criterion adjudged inland waterways (0.7120) as approximately 3 times better than road trucking (0.2300) and approximately 12 times better than air (0.058).

Efficiency of services rendered as a selection criterion shows road trucking (0.8002) as approximately 6 times better than air mode (0.1284) and approximately 11 times better than inland waterways (0.0713).

It is worthy to note here that, in efficiency of mode, the sampled respondents majorly based their response on efficiency of services they have received from the various options available and the flexibility of the services and reach and how it best suits to their need. It does not reflect the efficiency of the transporting medium for any of the available options.

Table 4.8: Weight and rank for Global priorities

Number of criteria (n) = 5 ***Scale*** = Linear (Saaty) ***GLOBAL PRIORITIES***

Selected Participants = Consolidated α = 0.1

	CRITERIA						
ALTERNATIVES	**COST** (0.1174)	**SAFETY** (0.6026)	**TIMELINESS** (0.1822)	**CARRYING CAPACITY** (0.0286)	**EFFICIENCY** (0.0691)	**GLOBAL PRIORITIES**	**RANK**
IWT	0.551	0.678	0.159	0.712	0.071	**0.5276**	**1**
ROAD (TRUCKING)	0.393	0.143	0.321	0.230	0.800	**0.2527**	**2**
AIR	0.056	0.179	0.521	0.058	0.128	**0.2197**	**3**

Source: AHP Iterations

Table 4.8 summarily shows the findings of the AHP as regards the ultimate goal of the intended research (choice of means of freight movement). The global priorities show the final ranks of the alternatives in relation to the overall consideration of the selection criteria; cost, safety, timeliness, carrying capacity and efficiency. The Inland waterway is ranked first with a weight of 0.5276 (52.76%), road trucking second with a weight of 0.2527 (25.27%) and Air 0.2197 (21.97%). This implies that the respondents sampled when considering all selection criteria would choose inland waterway transportation approximately 2 times over road and air means of freight movement if presented the opportunity. Road maintains preference over air even though they are close.

4.5 Tests for Objective Four

Objective Four: To estimate the trend of flow of import cargoes to the southeast and the capacity of Onitsha River port to accommodate them

4.5.1 Data Presentation for Objective Four

The data for the analysis of objective four is same as presented in table 4.1.

4.5.2 Presentation of trend Analysis Results and Analysis for Objective Four

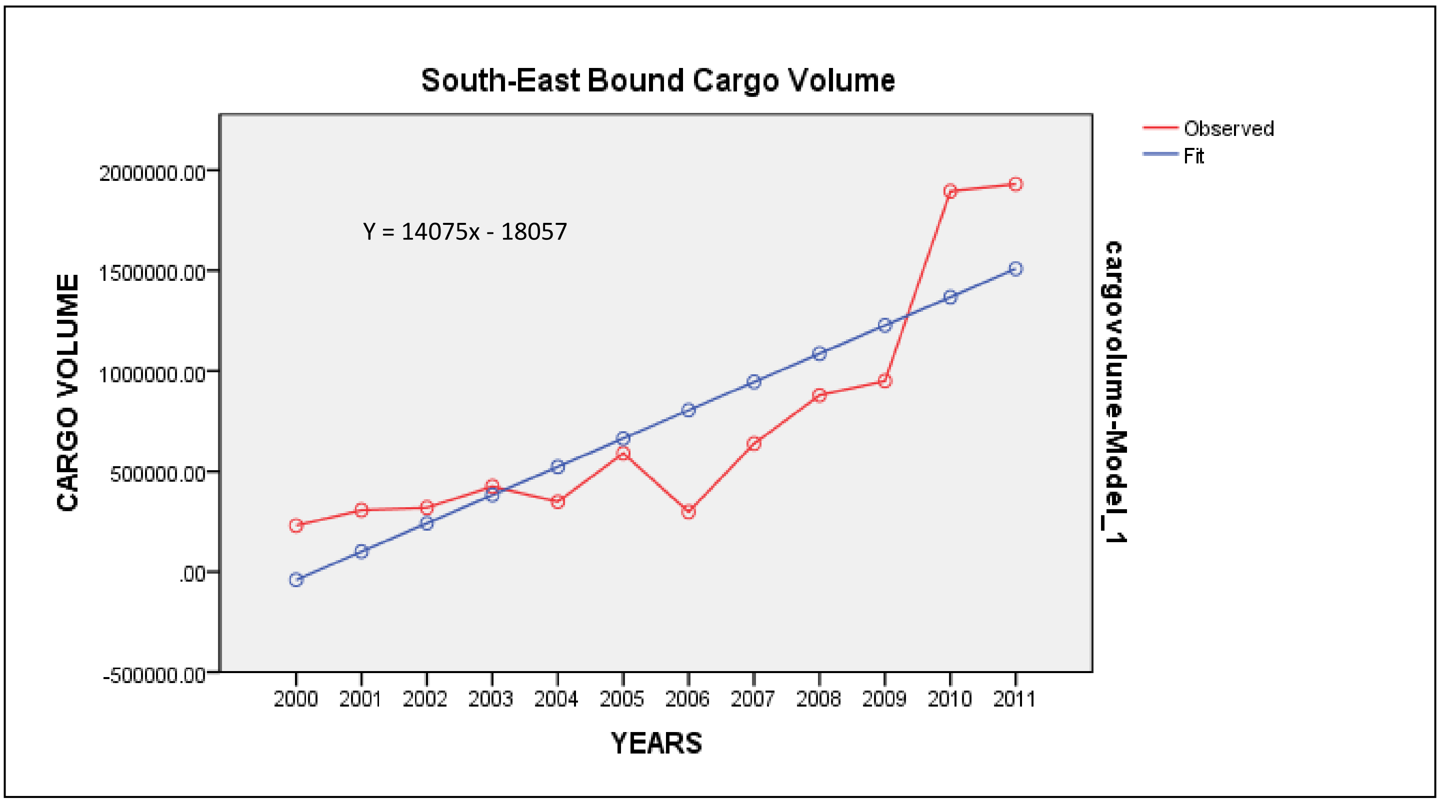


Figure 4.2: Time series modeller plot for Onitsha River port bound import cargoes trend showing fit

Source: SPSS V21 Iterations

The total volume of inbound cargoes destined to south-east during the study period amounted to 8 812,347 tonnes. This volume is 4, 413,752 tonnes (201, 541 TEUs) short of the predicted total volume for the period under survey. This volume is enough to sustain full economic activities at this river port. Also, with an increased government intervention here, neighbouring south-eastern states of Edo, Kogi, Benue and parts of Delta closer to the Onitsha River port can start diverting their inbound cargoes through this river port. In attempting to evaluate the shipping implications of carriage of this volume of cargo through the inland waterways, we would assume that all these cargoes are dry-bulk and containerized/containerizeable. A twenty-foot unit of container has a maximum gross weight allowance of 24 tonnes as stipulated in ISO 668:1995, out of this max weight, the average tare weight of twenty-foot containers is 2.1 tonnes. This means that on the average, a twenty-foot unit of container can contain a maximum of 21.9 tonnes of cargo. By implication, the foregoing proves that approximately the equivalent of 402,390 TEUs of containerized cargoes have passed through the various seaports with their destinations declared as south-east, while approximately, the equivalent of 568,402 TEUs of containerized cargoes have passed through the various seaports with their ultimate destinations not declared by the cargo owners or their agents. Further examination of this would have seen this inbound cargo volume engaging an approximate 5,875 barges (based on the earlier stated carriage comparison illustration of a barge's ability to carry 1500 tonnes) in shipping activities. The towing of barges requires the services of at least three crew members; engineer, pilot and captain. By implication, the movement of inbound cargoes in the south-east using the inland waterways would be capable of providing a minimum of 17,625 employment opportunities on board barges. This is discounting the other employment prospects like deck hands and other ancillary services required by this sector. On an eco-friendly note, if this volume had been moved through inland waterways via Onitsha river port, this would have seen the atmosphere saved from unhealthy carbon emissions from up to 300,000 truck units or at least the volume of emission substantially reduced as the trucks will now be making shorter haulage delivery trips, this goes a long way in reducing the risk of rapid climate changes and also reduction of road accidents associated with road haulage of these items as well as damages caused on these roads they are plying. Agricultural products, especially grains, are one of the major products being carried on inland waterways. The South-East region produced a total of 14,547,680 MT of commercial food crops (Beans, Cassava, Cocoyam, Groundnut, Maize, Melon, Rice and Yam) (NBS, 2006). A substantial proportion of these food produces were transported out of this region where they were consumed, though unaccounted for, would have helped boost traffic if they were moved through Onitsha river port. On the outbound cargo side of things, the five southeast states in year 2006, produced a total of 14, 547,680 MT (NBS, 2006) of agricultural cash crops (Beans, Cassava, Cocoyam, Groundnut, Maze, Melon, Rice and Yam). A good percentage of these food items were moved out of the region and some exported out of the country, the volume moved outside would readily help in boosting the activities of the river port.

4.5.3 Tests for Hypothesis 4

H_{04} : There is no positive trend in the flow of import cargoes bound for the Onitsha river port.

H_{A4} : There is a positive trend in the flow of import cargoes bound for the Onitsha river port.

The trend analysis carried out on the data resulted in the linear regression model; Y = 14075x -18057. This linear regression line shows a positive (positive slope value) trend relationship between the analysed variables. Also, the R^2 value (0.723) shows a high correlation coefficient (0.85) between the variables. This entails that there exists a large positive linear association between the variables analysed and as such, a trend exists.

A number of heavy manufacturing industries are cited in the southeast; two automobile plants, a handful of motorcycle assembly plants, breweries, cement plant, vegetable oil mills etc. These industries move large volumes of cargoes and are ready markets that will sustain the port. Few kilometres from the river port is a private refinery which is projected to operate on 55,000 bpd. The products and other support services will greatly need the services of the river port which will greatly render support services to their operations and also help in products evacuation.

This volume of south-east's cargoes when compared to Bangkok port's 328,650 tonnes of inland cargo (Suthiwart-Narueput, 2011) and Myanmar Inland Water Transport's 2010 volume of 4, 791, 000 tonnes of domestic and international cargoes (AJTP, 2010), shows how positive and sustainable Onitsha river port can be with sole dependence on south-east bound / originating cargoes, Hence the null hypothesis (**H_O**) is rejected and the alternative hypothesis (**H_A**) is accepted.

4.6 Discussion on Findings

The results from the various analytical tools applied lends support to the various hypothesis earlier proposed. The trend analysis carried out on the data resulted in the linear regression model; Y = 14075x -18057. This linear regression line shows a positive (positive slope value) trend relationship between the analysed variables. Also, the R^2 value (0.723) shows a high correlation coefficient (0.85) between the variables. This entails that there exists a large positive linear association between the variables analysed and as such, a trend exists.

The time series modeller fit measures show the trend series had good measures of fit. With a stationary R^2 and R^2 of 0.723 which are within acceptable limits. The MAPE of 50.066 shows that the trend series only accounted for 50.066% of the total volume capacity inherent in the trend, thus the series is almost 50% short of predicted values. The RMSE with the value of 329,402.969 tonnes shows how much the volume of southeast bound import cargoes varies from their predicted level.

The AHP analysis shows that safety (0.6026) is the most considered factor when choice of freight is being made, followed by timeliness (0.1822), cost (0.1174), efficiency (0.06910) and carrying capacity (0.0286). All decisions were consistent with a CR of 0.098. The second level findings shows that with optimum cost as basis of decision, logistics managers and importers will prefer Inland waterways (0.551), road trucking (0.393) and air (0.056) in that order of preference. With safety as a decision factor, Inland waterways (0.6783), air (0.1785) and road (0.1432) are in that order of preference. While considering timeliness, their order of preference is air (0.5208), road (0.3207) and Inland waterways (0.1585). Considering carrying capacity, the order of preference is inland waterways (0.7120), road (0.2300) and air (0.0580). With efficiency as a decision factor, road (0.8002), air (0.1284) and inland waterways (0.0713) are the order of their preference. On the global priorities level, the inland waterways show the most preferred means according to the sampled population with a weight of 0.5276, road (trucking) is the second preferred with a weight of 0.2527 and air with a weight of 0.2197. These values show that the sampled population while bearing in mind the earlier listed factors (safety, timeliness, cost, efficiency and carrying capacity) which influences their choice of freight carriage, will consider the choice of inland waterways 2 times over the choices of road and air as a means of freight movement, while they would slightly consider road (trucking) over air means of transportation.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMENDATIONS

5.0 Summary of major findings

This research work is aimed at highlighting the economic potentials of inland waterways as a means for freight transportation in a developing economy like Nigeria, with special emphasis on the river port of Onitsha. This research work has gone ahead to expose the huge potentials inland waterways the world over possesses and the great contributions they have rendered to the economic growths of the countries where they are utilized, and even regions. The research work went further to showcase the state of inland waterways transportation in the world acclaimed emerging economic superpowers of Brazil, Russia, India and China (BRIC nations). This research showed that all BRIC nations have a very vibrant and functional inland waterways system, and some are still pursuing plans to improve on the present capacity and contribution of their individual waterways. Averagely, the inland waterways of BRIC nations freight 7% of their inland cargo with China being the greatest beneficiary of the economic benefits of inland waterways, as 35% of their GDP are generated in the Yangtze River basin and their inland waterways witness a cargo volume movement of over 1 billion tons annually with the river ports handling over 188 million tons of cargo and 8.8 million TEUs annually.

On the regional level, some select few regions have been tapping into the potentials of inland waterways for improved regional economic integration, participation and welfare. Trade and ties between these regions continue growing as they keep trying to improve on the results of regional inland waterways networks. The Nile River basin region has 9 countries and within them boasts of 72 river ports, with Egypt and Uganda have the most (18 each) of the ports. The total volume of import and export trades between these Nile basin economies are 4.685 billion dollars and 3.454 billion dollars respectively (IMF DOT, 2011). The inland waterways in European Union averagely accounts for 8.15% of the inland cargo transportation across its four corridors (NAIDES, 2013) and in places like Rotterdam and Antwerp, more than 50% of the sea tonnages are carried via inland waterways. This research work lends credence to the fact that a good functional transport system translates to a good economic growth as all the largest economies of the world has a functional inland waterway and a continuously developing and expanding inland waterways to accommodate and stimulate further growth.

The situation in Nigeria presently is different though. The inland waterways are greatly losing its economic vantage position from the early colonial days when it was the only bulk transport option for the Europeans aiding them in their trades and exploration to the present when activities in the waterways are almost reduced to passengers ferrying. Since the completed dredging of the river Niger from lots 1 to 5, gradual freight transportation activities are returning to the river port of Onitsha despite the stall of full economic activities resuming there as a result of government's delay in their concessioning plans for the river port. Despite this delay some local entities are already utilizing the benefits of moving freight through the Onitsha river port; Milotrans is a local inland waterways transportation company presently engaged in transporting ceramic tiles and granites from Lokoja to Onitsha river port. Julius Berger a multinational construction outfit and presently undertaking the construction project of the second Niger bridge are presently leasing a part of the Onitsha river port's yard for their project and are using the Onitsha river port to move most of their construction plants and equipment from Lagos to Onitsha for the project. The absence of an installed weigh bridge at the river port of Onitsha made it impossible to give accurate figures for the volume of cargoes thus far moved through the river port of Onitsha.

The research objectives earlier set out for this research were all met and the research questions duly answered. The literature review amply gave a comparative picture of what is obtainable in similar places.

5.1 Conclusion

Conclusively, this study has shown through its trend analysis results and its time series modeller results that the southeast bound import cargoes from the seaports can well serve the Onitsha river port and are even short of their projected volume for the time period. These shortfalls though are largely attributable to the inconsistencies in government's import policies and import ban on some items.

Also from further analysis of responses through AHP, Safety of cargoes being transported is the most basic criterion that informs a customer's choice of freight transport means. Timeliness is the second criterion on which a customer bases their freight movement decision. This implies that customers are willing to pay an extra cost or are willing to overlook the cost provided they have their cargo where they want it and most importantly, when they want it, hence Just-In-Time services presently taking an increased position in logistics decisions. Cost of freight and services gets the third criterion position as what informs a customer's decision on choice of freight medium to use. Carrying capacity and efficiency occupies the fourth and fifth positions respectively on the criteria that influence the choice of a freight transport medium for a customer.

With all these selection criteria in consideration and using the AHP, the IWT comes out top as the preferred choice of transport medium, followed by road trucking and closely followed by air transport medium. By implication of this, the sampled population of freight forwarders, clearing agents and logistics managers will readily embrace the choice alternative of a functional Onitsha river port when given the opportunity as they feels it presents a safer, less expensive alternative to other options and as well as possesses the carrying capacity to transport almost any size of cargo.

5.2 Recommendations

The ultimate aim of this research work is to highlight the underlying economic potentials Onitsha river port possesses and to showcase the possible economic results that can be obtained through careful planning and execution of plans geared towards full utilization of this river port in particular. In order to fully harness the potentials of the inland waterways in Nigeria and the Onitsha river port in particular, this research work makes the under listed recommendations, which are mainly from findings of this research work and complaints received from sampled population during the course of research which the researcher believes if implemented fully, would help improve the present state of the inland waterways system in the country.

- Government should ensure continuous dredging and training of inland waterways and river banks to ensure all round navigability of the waterways.
- Government or future concessionaires of Onitsha river port should ensure installation of handling and storage facilities for bulk agricultural products like grain storage silos, pumps and tanks for vegetable oil, etc. to ensure the river port is capable of handling shipments of bulk agricultural products.

- Installation of weigh bridges at the river port of Onitsha to ensure adequate and accurate record keeping of cargo throughput at the port.
- Government should provide 100% electronic charting of all the waterways. This will aid in easier navigation of these waterways electronically and not the present condition where navigation is based on a pilot's knowledge of the waterways.
- Installation of relevant and necessary navigational aids along the waterways to ensure safe and round the clock navigation of the waterways.
- Relevant government agencies like customs, port health etc. should be cited at the port so that southeast bound import cargoes can be transhipped straight to the river port where inspections and other related activities will be carried out, this will help in decongestion of major seaports.
- Enacting of relevant laws that will mandate a maximum allowable volume of cargo to be transported through the roads. This will ensure that heavy cargoes are transported through the waterways or rails and also help elongate the life span of highways, and reduce road accidents risks.
- Establishment of naval security posts along the waterways to ensure round the clock waterways naval patrols to provide security and safe passage for intending crafts that will be plying the waterways.
- Continuous dredging activities of the Inland waterways, particularly rivers Niger and Benue, can position Nigeria as cargo transit and consolidation hub for neighbouring landlocked African countries like Niger, Burkina-Faso, Chad, Mali and Central African Republic which will readily embrace such cheaper alternative for their cargo imports.

- Establishment of free trade zone within an area around the river port, as this will help to promote citing of manufacturing industries around the port and help boost economic activities at the port.
- Shipping companies intending operating in the river port of Onitsha should acquire a large area and warehouse that they can use as export/outbound cargo consolidation point to help eliminate empty back runs for their barges.

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APPENDIX 1

Destination of non-oil Import cargoes discharged from the various Nigerian seaports 2000 - 2011.

State	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	**TOTAL**
Abia	84,318	125,907	150,292	136,049	113,997	317,137	181,381	338,156	258,440	303,512	443,229	671,329	**3,123,747**
Abuja	27,014	43,210	47,006	61,730	29,941	21,719	214,131	34,324	90,507	29,752	789,492	381,028	**1,769,854**
Adamawa	808	3,520	237	2,844	422	316	11,004	353	10683	4181	nil	Nil	**34,368**
Akwa Ibom	276	3,263	16,456	22,312	1,755	899	11,960	22407	52,709	5796	5,417	67514	**210,764**
Anambra	135,222	160,562	144,267	246,132	193,791	243,761	88,887	275,612	309,083	575,782	554,600	957,576	**3,885,275**
Bauchi	1,914	16,662	8,257	2,158	1,321	969	5,168	18,534	13,663	2,550	nil	Nil	**71,196**
Bayelsa	54	109	24	64	35	92	3,175	39,084	10,979	9,984	2,130	43,841	**109,571**
Benue	312	349	932	539	866	951	22,263	1,407	20,026	3,644	nil	Nil	**51,289**
Borno	1,427	4,956	1,370	449	561	9,931	1,293	13,771	6,386	9,150	nil	Nil	**49,294**
Cross rivers	23,533	22,096	248,023	324,843	596,831	715,773	21,399	941,908	1,085,057	1,452,774	1682696	1,622,059	**8,736,992**
Delta	482,716	757,768	654,715	503,972	584,068	711,427	792,754	684,869	1,129,811	984,316	1,687,726	1,140,752	**10,114,894**
Ebonyi	154	304	126	2,069	892	64	8,886	104	22,207	10,626	nil	Nil	**45,432**
Edo	18,431	25,031	52,268	29,140	24,446	47,212	72,080	63,229	103,914	34,329	204,339	225,172	**899,591**
Ekiti	163	723	640	186	594	18	14,049	24	27,665	6,080	nil	Nil	**50,142**
Enugu	7,727	16,366	13,619	30,028	27,735	12,499	5,259	nil	100,812	34,778	492,760	100,664	**842,247**
Gombe	100	349	163	567	nil	121	4,942	nil	4,060	2,881	nil	Nil	**13,183**
Imo	2,823	3,969	10,802	10,612	12,685	16,826	14,216	24,179	188,657	25,656	404,800	200,421	**915,646**
Jigawa	74	110	9	nil	34	30	3,691	nil	4,594	2,685	nil	Nil	**11,227**
Kaduna	74,280	206,616	130,209	162,298	42,480	106,844	51,970	151,312	41,768	18,985	575143	296,690	**1,858,595**
Kano	205,615	456,111	207,646	144,077	131,897	90,764	22,563	127,400	86,724	61,325	447698	274,523	**2,256,343**
Katsina	13,652	18,916	731	3,549	1,138	606	1,264	nil	12,160	21,217	nil	Nil	**73,233**
Kebbi	8,104	4,266	nil	2,559	72,496	168	2,740	nil	8,597	12,583	nil	Nil	**111,513**
Kogi	478	1,184	170	1,815	657	60,356	5,864	69,258	30,542	40,302	nil	Nil	**210,626**
Kwara	1,203	1,824	987	2,683	2,433	11,639	8,838	22,610	35,575	17,427	674743	404,246	**1,184,208**
Lagos	11,890,228	14,631,355	15,604,627	16,274,858	16,951,176	18,631,920	7,353,488	26,667,866	19,571,596	33,359,504	12562862	17,526,214	**211,025,694**
Nasarawa	17	375	23	36	111	15	6,393	nil	6,676	25,938	nil	Nil	**39,584**
Niger	425	325	608	1,797	12,449	995	20,156	nil	16,300	27,103	nil	Nil	**80,158**
Ogun	34,066	63,166	55,889	57,025	39,731	93,315	55,422	134,714	25,394	96,558	491,509	422,899	**1,569,688**
Ondo	4,054	5,483	4,275	3,840	4,651	3,519	4,132	18,970	22,562	6,764	203,548	107,386	**389,184**
Oshun	5,568	4,020	2,690	8,554	1,986	8,943	20,236	13,058	18,611	24,519	268770	80,127	**457,082**

Oyo	74,517	158,283	201,450	264,746	154,114	389,294	65,500	494,638	61,606	71,549	266,479	212,642	**2,414,818**
Plateau	1,438	3,834	1,549	3,652	2,312	5,663	7,736	nil	7,000	11,666	nil	Nil	**44,850**
Rivers	2,847,199	4,335,413	3,989,542	4,749,137	4,315,251	4,540,220	3,464,211	4,045,458	5,309,035	5,923,909	7137105	7,799,430	**58,455,910**
Sokoto	724	26,942	265	646	3,946	1,003	2,642	nil	6,972	1,727	nil	Nil	**44,867**
Taraba	233	1	24	73	222	5	nil	nil	5,859	1,895	nil	Nil	**8,312**
Yobe	479	2,012	491	428	588	198	1,061	nil	4,087	2,170	nil	Nil	**11,514**
Zamfara	139	516	94	130	21,129	439	3,988	nil	7,385	6,011	nil	Nil	**39,831**
Unspecified	41,579	44,440	272,574	44,250	11,138	5,583	nil	86,892	11,940,024	1,512	nil	Nil	**12,447,992**
Total	**15,991,064**	**21,150,336**	**21,823,050**	**23,099,847**	**23,359,879**	**26,051,234**	**12,574,742**	**34,290,137**	**40,657,726**	**43,231,140**	**28,895,046**	**32,534,513**	**323,658,714**

Source: Nigerian Ports Authority statistics**.**

APPENDIX II
RESEARCH QUESTIONNAIRE

Research Topic: **A Review of Economic Potentials of The River Port of Onitsha**

Dear respondents,

This questionnaire has been designed to help analyze responses to the subject of this research. The purpose of the Parts B and C of this survey is to assess your opinion towards the relative importance of five factors as regards your choice of means of cargo transportation. With respect to the pair comparison, you are requested to express which factor is more important and how important the factor is when compared to its counterpart, when making a choice of means for freight transport.

Section A

1. Duration of experience in the maritime industry? …………………………………………….
2. Please state your occupation/ business? ……………………………………………………
3. Can you quantify the volume of cargo / freight you have handled within the last year? ……..
4. With which transport mode did you transport these cargoes? ……………………………..
5. If presented with a viable inland waterways option for freight movement, would you utilize it? ....

Section B

In making pair comparisons of the relative importance between any of the following factors, the following nine scales are to be used.

- **(1)** **Equal Importance** in case of both factors contributing equally to the objective**.**
- **(3)** **Moderate importance** if experience and judgment strongly favor one activity over another.
- **(5)** **Strong importance** if experience and judgment strongly favor one activity over another.
- **(7)** **Very strong** if a factor is favored very strongly over another, demonstrated in importance and its dominance demonstrated in practice
- **(9)** **Extreme importance** if the evidence favoring one activity over another is of the highest possible order of affirmation.

2, 4, 6 and **8** are **intermediates** between two adjacent judgments to be used when compromise is needed.

6. In comparing *Cost* and *Safety,* which factor is more important when making your decision and how important is it relative to the other factor?

Cost ( ) versus Safety ( )

1 2 3 4 5 6 7 8 9

7. In comparing *Cost* and *Timeliness,* which factor is more important when making your decision and how important is it relative to the other factor?

Cost ( ) versus Timeliness ( )

1 2 3 4 5 6 7 8 9

8. In comparing *Cost* and *Carrying Capacity,* which factor is more important when making your decision and how important is it relative to the other factor?

Cost ( ) versus Carrying Capacity ( )

1 2 3 4 5 6 7 8 9

9. In comparing *Cost* and *Efficiency,* which factor is more important when making your decision and how important is it relative to the other factor?

Cost ( ) versus Efficiency ( )

1 2 3 4 5 6 7 8 9

10. In comparing *Safety* and *Timeliness,* which factor is more important when making your decision and how important is it relative to the other factor?

Safety ( ) versus Timeliness ( )

1 2 3 4 5 6 7 8 9

11. In comparing *Safety* and *Carrying Capacity,* which factor is more important when making your decision and how important is it relative to the other factor?

Safety ( ) versus Carrying Capacity ( )

1 2 3 4 5 6 7 8 9

12. In comparing *Safety* and *Efficiency,* which factor is more important when making your decision and how important is it relative to the other factor?

Safety ( ) versus Efficiency ( )

1 2 3 4 5 6 7 8 9

13. In comparing *Timeliness* and *Carrying Capacity,* which factor is more important when making your decision and how important is it relative to the other factor?

Timeliness ( ) versus Carrying Capacity ( )

1 2 3 4 5 6 7 8 9

14. In comparing *Timeliness* and *Efficiency,* which factor is more important when making your decision and how important is it relative to the other factor?

Timeliness ( ) versus Efficiency ( )

1 2 3 4 5 6 7 8 9

15. In comparing *Carrying Capacity* and *Efficiency,* which factor is more important when making your decision and how important is it relative to the other factor?

Carrying Capacity ( ) versus Efficiency ( )

1 2 3 4 5 6 7 8 9

Section C

Please use the same scale in **Section B** to pass your judgment on the following factors

16. In considering **COST**, please compare the following alternatives;

Inland waterways ( ) versus Road (trucking) ( )

1 2 3 4 5 6 7 8 9

17. In considering **SAFETY,** please compare the following alternatives;

Inland waterways ( ) versus Road (trucking) ( )

1 2 3 4 5 6 7 8 9

18. In considering **TIMELINESS,** please compare the following alternatives;

Inland waterways ( ) versus Road (trucking) ( )

1 2 3 4 5 6 7 8 9

19. In considering **CARRYING CAPACITY,** please compare the following alternatives;

Inland waterways ( ) versus Road (trucking) ( )

1 2 3 4 5 6 7 8 9

20. In considering **EFFICIENCY,** please compare the following alternatives;

Inland waterways ( ) versus Road (trucking) ( )

1 2 3 4 5 6 7 8 9

Thanks for your unequalled cooperation

APPENDIX III

Summary Sheet of Returned Questionnaires

Compare which factor is more important when making decisions on the importance of choosing the inland waterway transport over the other modes (Air/Road)										
Decision Criteria	**EI (1)**	**I (2)**	**MI (3)**	**I (4)**	**SI (5)**	**I (6)**	**VSI (7)**	**I (8)**	**ExI (9)**	**Total**
Cost Vs Safety	0	0	1	0	2	0	0	0	0	3
Cost vs Timeliness	1	0	0	0	1	0	0	0	0	2
Cost vs carrying capacity	0	0	0	0	1	0	1	0	0	2
Costs vs efficiency	0	0	0	1	0	0	0	0	0	1
Safety vs timeliness	1	0	0	0	0	0	0	0	0	1
Safety vs carrying capacity	0	0	0	0	0	0	0	0	1	1
Safety vs efficiency	0	0	0	0	0	0	0	0	0	0
Safety vs costs	1	0	0	0	0	0	0	0	1	2
Timeliness vs carrying capacity	0	1	0	0	0	0	0	0	0	1
Timeliness vs efficiency	0	0	0	0	1	0	0	0	0	1
Carrying capacity vs efficiency	0	1	0	0	0	0	0	1	0	2
Total										**16**

Section C

Compare the following alternatives factors in mode selection										
Alternative Criteria	**EI (1)**	**I (2)**	**MI (3)**	**I (4)**	**SI (5)**	**I (6)**	**VSI (7)**	**I (8)**	**ExI (9)**	**Total**
	Costs Factor									
Inland waterway vs Road	0	0	0	0	3	0	2	0	0	5
	Safety Factor									
Inland waterway vs Road	0	0	0	0	4	0	3	0	1	8
	Timeliness Factor									
Inland waterway vs Road	0	0	0	0	1	0	0	0	0	1
	Carrying Capacity									
Inland waterway vs Road	0	0	2	0	5	0	3	0	2	12
	Efficiency Factor									
Inland waterway vs Road	2	0	1	0	2	0	1	0	2	8
Total										**34**

Equal Importance (1), Moderate Importance (3), Strong Importance (5), Very Strong Importance (7), Extreme Importance (9), while (2), (4), (6) & (8) are intermediates (I) between the choices.

Source: Authors Field work