International Journal of Entrepreneurship, Management and Social Sciences (IJEMSS)
Volume 2, Issue 1; ISSN: 3026-9881
email: ijemss@futminna.edu.ng

Analysis of Logistic and Infrastructural Constraints of Inland Water Transportation in North Central Nigeria

[1]ONAH, CHINONYE CLETUS; [2]OJEKUNLE, JOEL ADEKUNLE

[1,2]Department of Logistics and Transport Technology, Federal University of Technology, Minna, Nigeria
*Corresponding Author Email: *onah.pg2010101@st.futminna.edu.ng*. 08036045336

Abstract

In spite of the high potentials for Inland Waterway Transport (IWT) development in Nigeria, its service has not been able to meet the required standard. This decline in the utilization of the inland waterways as a viable transport mode in Nigeria can be attributed to, among others, logistic and infrastructural constraints. This study aims at examining logistic and infrastructural challenges of IWT in North Central Nigeria from both the river ports perspective and waterways perspective. It was cross-sectional survey research carried out on river ports of Baro, Lokoja and Makurdi, and their waterways linking different jetties. Data was collected through questionnaires, oral interview and field observations. A total of 473 structured questionnaires were distributed (392 to users, and 81 to the operators) while 465 were retrieved. Perception of respondents on conditions and functionalities of jetty and waterway infrastructure was obtained using the Likert Scale of measurement. Descriptive statistics was used in data analysis using tables, charts, percentages, mean score, skewness and kurtosis. The analysis of infrastructural conditions on the jetties revealed that accessibility to jetties, loading and unloading equipment, and storage facilities were rated highly while availability of boats/jetties, punctuality of boats/ferry, and availability of safety gadgets were rated highly in the analysis of infrastructural conditions for waterways. The study therefore recommends upgrade and maintenance of jetty infrastructure through public private partnership. The paper also recommends regular capital and maintenance dredging in order to give room to all year-round navigation in the waterways.

Keywords: infrastructure, jetties, waterways, logistic constraints, inland waterway transportation.

1.0 Introduction

Transport is made up of different modes through which passengers and freight achieve mobility. Transport modes are designed to carry either passengers or freight, but most modes can carry a combination of both, (Rodrigue, 2014). An efficient transportation system covering rail, waterways, air, and road, is a catalyst for economic growth and development (Olaniyi and Oniru, 2017). Water transport is of two categories: marine (sea) transport and inland water transport. Marine transportation uses cargo ships, passenger ships, boats, etc. in logistics and transport service delivery, while inland waterway transport (IWT) concerns with movement of freight and person by inland water that is not categorized as 'sea', such as on canals, rivers, lakes, and estuaries. IWT takes place either between a deep-sea port and an inland port or between inland ports

themselves. It offers safer and cheaper rates in areas where water exist naturally and is also considered more effective, and environmental pollution is lower compared with corresponding volumes of movement by road, rail or air (Ojile, 2006).

In spite of the high potentials for IWT development in Nigeria, the mode has been highly underdeveloped, its service has not been able to meet the required standard, and it has suffered so much neglect over time in terms of investment and drive by both the government and the private sector (Akpudo and Stephens, 2020; Akpudo *et al*., 2022). The decline in the utilization of inland waterways as a viable transport mode in Nigeria can be attributed to factors such as poor water transportation infrastructure, poor safety measures, inadequate and obsolete fleet capacity, lack of navigational charts and river maps, blockage of channels by water hyacinth, among others (Obeta, 2014; Akinbamijo *et al.,* 2016; Obamiro *et al.*, 2018; Akpudo and Stephens, 2020; Osuji and Agbakwuru, 2023).

It can be seen from the above that most of the challenges of inland waterway transportation in Nigeria are logistic and infrastructural related. It is against this backdrop that this study appraises logistic and infrastructural constraints of IWT in the North Central Nigeria.

2.0 Literature Review

2.1 Conceptual framework

2.1.1 The concept of inland water transportation

The inland waterway transportation (IWT) system is playing an increasing role in the trade and commerce of both developed and developing nations, especially with increase in Container on Berge transportation which facilitates intermodal transportation (Caris *et al.*, 2011; Bu and Nachtmann, 2021). The worldwide concerns about global warming and highway traffic congestion are among the incentives to revitalize inland waterway shipping in some developed countries (Wang and Li, 2012). Inland waterways are made up of navigable rivers, lakes, coastal creeks, lagoons and canals (Aderemo and Mogaji, 2010). Inland water transportation (IWT) as a component of water transport deals with the movement within national territories by the use of watercrafts such as pontoons, river ferries, and boats over a body of water, such as a lake, river or canal (Akpudo and Stephens, 2020). IWT processes, involves several actors which usually include inland port and terminal operators, shippers, vessel operators, skippers, truck operators for pre- and end-haulage and logistics service providers. Inland water transportation plays a key role in the socio-economic and political development in Nigeria as a factor of exchange, mixing of population and sub-regional integration (Akali and Idoko, 2010). Inland waterway infrastructure is defined as terminals, rivers, canals, bridges and locks (Wiegmans and van Duin, 2017). The comparative advantages of IWT in transporting large quantities over longer distances include safety, sustainability, and cost-efficiency in terms of overall transport costs, the energy consumption per ton-kilometre, low rate of accidents and low congestion. IWT plays a vital role in urban growth and development as well as serves as a link between urban centres and agricultural rural areas by offering cheap means of conveying passengers and bulk produce (Akpudo and Stephens, 2020).

However, the use of IWT in the inland transport logistics chains is highly dependent on a country's access to a waterway network (UNECE, 2019).

2.1.2 The concept of transportation infrastructure

Transport system is an organized whole of all modes of transport, operating in a particular area, and thus including all fixed and non-fixed assets, the human factor and the intermodal interconnections of the whole entity, as well as the links of the entire transport system with the environment. Adeniran and Yusuf (2016) identified four elements of transport system, of which two of them are infrastructural. They include transportation network (i.e. roads, railways, airways, canals, pipelines) and nodes or terminals (such as airports, railway stations, bus stations, river ports, and seaports). According to Szymonik, (2013), the inland waterway infrastructure includes: land, channels, works for waterways shut off and safety, dams and weirs, navigable locks, mooring equipment and jetties, movable bridges, devices for marking channels, signaling, safety, telecommunications, and lighting, traffic control devices, toll collection devices and buildings used by the infrastructure section. Inland waterway infrastructure is defined as terminals, rivers, canals, bridges and locks (Wiegmans and van Duin, 2017). Wiegmans *et al.* (2015), defined inland ports as transportation infrastructures along waterways with facilities and equipment for loading and unloading ships.

El-Nakib, and Roberts, (2006), identified elements of inland water infrastructure as the following;

- Navigational channels, comprising, water level existence of locks and bridges, connections between different navigational channels, Facilities for night navigation, navigational aids/traffic signs, navigational maps
- River Ports which include accessibility to jetties/inland ports, intermodal/multimodal connectivity, jetty facilities such as warehouses, parking spaces, cargo handling equipment

In their conclusion they stated that investment in inland waterway infrastructure is an important one because they must accommodate current traffic and anticipate future trends and also technological and logistical changes.

2.2 Theoretical Framework

2.2.1 The theory of spatial interaction

A systematic approach to the study of transportation in the context of spatial interaction was developed by Edward Ullman (1954). The fundamental concept also known as Ullman's Principles stated that conditions for spatial interaction are often used to explain the theoretical basis for movement in space. The theory stipulates those three conditions; complementarity, intervening opportunity and transferability are important for movement to take place.

Complementarity: This implies that for two places to interact there must be a demand in one place and supply at another and these demands and supplies must be specifically complementary. Complementarity alone would guarantee interaction if and only if there are no intervening opportunities between the two places.

Intervening opportunity: When there is emergence of alternative areas to satisfy the demand of initial area, there will be reduced movement or the movement can stop completely. According to Abler *et al.,* (1971) intervening opportunity is a spatial sponge soaking up potential interaction between two complementary places. Complementarity among places can generate interaction only in the absence of intervening opportunities.

Transferability: The third condition necessary for interaction to take place is transferability. That is the friction of distance which is measured in terms of time and money costs. Transferability is a very critical condition as it determines the level of allowable interaction between places. Even if the other two conditions are met, the monetary cost of traversing distance is too high or the time is very long, the level of interaction will reduce drastically. Transferability differs from one mode to the other and from one place to another.
The spatial interaction theory of Ullman has offered explanations to the trend and structure of interaction in inland waterways and transportation as well as freight and passenger movements across the water. Improvement in transport infrastructure such as waterways may reduce time and monetary costs to traversing distance, thereby increasing accessibility, in other words, the level of interaction between places.

2.3 Empirical Review of Literature

Several studies have been undertaken on inland waterway transportation in Nigeria and beyond ranging from evaluation of operational performance, growth and development; operational efficiency, sustainability of the system (conditions and functionalities of the infrastructure), through factors affecting its operational efficiency, including policies and institutions that have shaped the growth and operations, and its contributions to the socio-economic development, to prospects, challenges and problems of the transport system.

From the mainland China, He *et al.,* (2017) measured water transport efficiency in the Yangtze River Economic Zone (YREZ) from 2003 to 2011. They conducted spatial analysis to identify the leading factors influencing efficiency; and provided scientific evidence for a macroscopic grasp of water transport development and optimization of YREZ. Data Envelopment Analysis (DEA) and the Malmquist Index were used as a model framework. The research came up with the following results: the water transport technical efficiency (TE) in the YREZ is low and in fluctuating decline; the spatial pattern of TE has gradually changed from complexity and dispersion to clarity and contiguity; and the water transport efficiency has slightly improved through technological change. The authors recommended that decision-makers should consider strengthening intra-port competition and promoting water transport efficiency.

Baodu *et al.,* (2021) addressed numerous constraints which impede smooth operations and industrial development of IWT system in Ghana and other countries. The authors used observation, personal interview and questionnaires to collect data from industry players and other informal IWT operators. Based on the feedback from the respondents, the predominant constraints include: market constraints, logistics and infrastructural

constraints, administrative constraints, and technical constraints. The study went further to recommend improvement and infrastructural development, institutionalization and proper regulations of IWT, dredging or periodic maintenance of navigational channels, and promotion of integrated transport planning.

Akpudo and Stephens, (2020) assessed operational characteristics and supply of IWT in the coastal area of Anambra State, Nigeria. The authors used survey design approach, and in their analysis, used descriptive statistics for the assessment of operational characteristics, and multiple regression for determination of the factors that influence the supply of IWT in the area. The operational characteristics revealed a male dominated, low educated, privately owned vessels, and no government presence in the area. Demand had the most significant impact on the supply of IWT in the area. The authors recommended government intervention in form of providing convenient, safe, affordable and regular ferry services to boost economic activities in the area.

Akpudo *et al.,* (2022) assessed the problems and prospects of IWT in South Eastern Nigeria, using Omo - Mbala River in Anambra State as a case study. The authors used on the spot survey and administration of questionnaires to water transport users and all registered operators within the three selected routes in the study area. Descriptive statistics was used in the analysis of data. The study revealed that insecurity and poor state of the terminals are the major challenges of IWT operations in the area. The study further revealed that the prospect of IWT in the study area would be mostly for trade and commerce. The authors recommended collaboration between the government and stakeholders in funding, upgrading and managing the available infrastructure in the study area.

Ahmad *et al.*, (2022) examined the users and operators' challenges facing IWT in Borgu Local Government Area of Niger State. This study led to measuring of performance management of the operators, and to tracking IWT performance against the targeted objectives in terms of productivity, job satisfaction, turnover and quality of service. The scholars adopted questionnaire survey (395 respondents), designed on a 5-point Likert scale. In assessing the users' challenges, the researchers revealed there is difficulty in access to the boat, boats are old, too long waiting time, boats are not safe, no security, etc. For operators' challenges, the study found out that there is lack of operational control and regulations, poor infrastructures, extortion of money from the operators by the marine police, obstruction of waterways, and seasonality in water level/volume. The authors recommended provision of life jackets and other safety gadgets, adequate maintenance of vessels, and construction of motorable roads to improve intermodal connectivity.

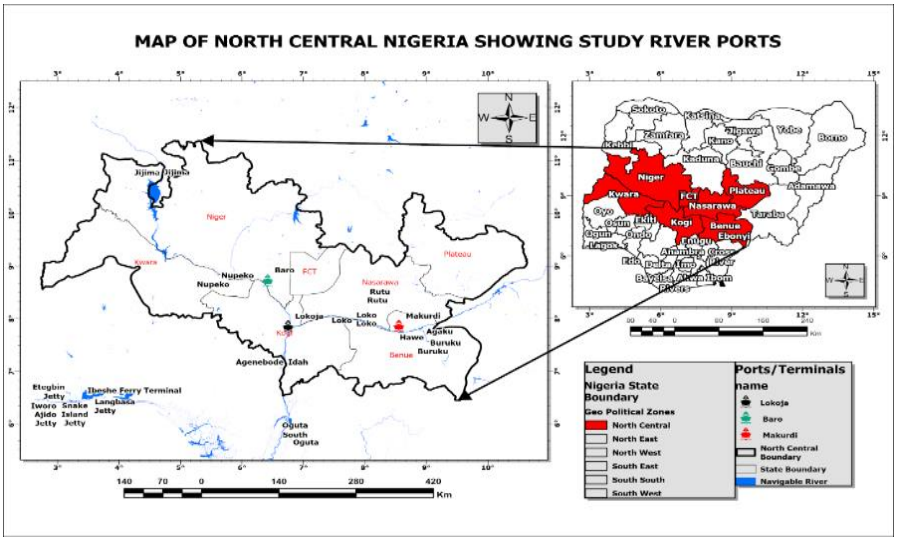
It can be seen from the reviewed studies above, that most of them were done outside North Central Nigeria, and the one carried out in North Central Nigeria, did not focus on infrastructural and logistic constraints. It is in this light that this study examined the logistic and infrastructural constraints of IWT system in North Central Nigeria.

3.0 Methodology

3.1 Study Area

The study area is North Central Nigeria, which lies between Latitude 6˚32' and 11˚21' N, and Longitude 2˚45' and 10˚38' E, altogether enclosing a total landmass of 242,425 square kilometers. Case study river ports include Baro River Port (Niger State), Lokoja River Port, (Kogi State), and Makurdi River Port (Benue State) and their waterways (Figure 1.1).

Figure 1.1: Map of North Central Nigeria, showing Rivers Niger and Benue and study river ports.



Source: Author's fieldwork, 2024.

Nigeria is blessed with a large resource base of waterways spanning 10,000 kilometres; about 3,800 kilometres is navigable seasonally, plus an extensive coastline of more than 852 kilometers (Figure 1.2). Twenty-eight of the nation's 36 States can be accessed

through water. Nigeria can also link five of its neighbouring countries–Benin Republic, Equatorial Guinea, Cameroon, Chad, and Niger Republic by water, (NIWA 2006; Badejo 2009; Ndikom, 2013; Obeta, 2014; Obamiro *et al*., 2018; Osuji and Agbakwuru 2023).

3.2 Methods

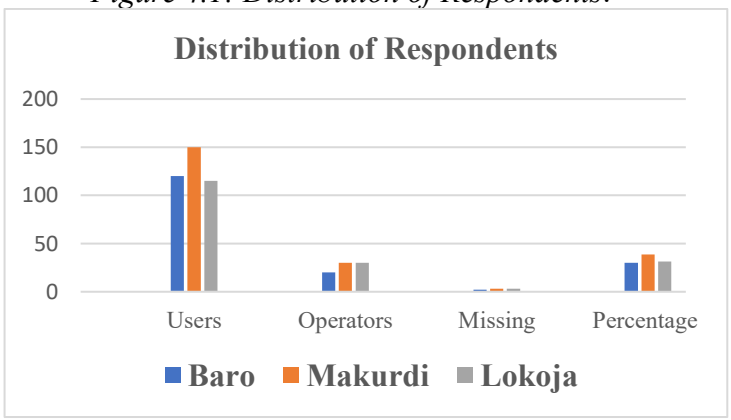
This study focuses on three river ports, Baro River Port, Lokoja River Port, and Makurdi River Port, and their waterways. They were selected due to their strategic locations in Nigeria, and because they are navigable throughout the year by means of dredging. The study employed survey research design and data used was collected mainly from IWT users and operators. The users (passengers and shippers) and operators were the primary

focus because they commonly use and work the inland water transport system respectively. A total of 473 questionnaires were distributed while 465(385 for users, and 80 for operators) were returned. Samples were randomly collected from each case study river port which served as a cluster. The questionnaires were structured to obtain the ratings on conditions and functionalities of jetty and waterway infrastructure using Likert Scale of measurement ranging from 5 (Very Good), 4 (Good), 3 (Poor), 2 (Very Poor) to 1 (Not Available). Descriptive statistics was used in data analysis using tables, charts, percentages, mean score, skewness and kurtosis. The analysis was performed in SPSS Version 23.

4.0 Results and Discussion

The distribution of the respondents selected across the three jetties, namely, Baro, Makurdi, and Lokoja is illustrated in Figure 4.1.

Figure 4.1: Distribution of Respondents.



Source: Authors Computation, 2024

A summary of data used to determine the conditions and functionalities of jetty infrastructure and waterway infrastructure in the study area are presented in Table 4.1 and Table 4.3 respectively, while Table 4.2 and Table 4.4 presented responses on the regularity of maintenance of jetty infrastructure and waterway infrastructure respectively.

Table 4.1: Conditions and Functionalities of Jetty Infrastructure

Infrastructure/Facility	Very Good (5)	Good (4)	Poor (3)	Very Poor (2)	Not Available (1)	Mean
Accessibility of jetty	95	125	85	65	95	3.13
Availability of car parks	80	110	100	95	80	3.03
Intermodal connectivity	60	115	95	120	75	2.92

Loading and unloading equipment	75	140	100	85	65	3.16
Storage facilities	85	125	85	110	60	3.14
Cleanliness and maintenance of jetty	90	135	70	85	85	3.22
Comfort on jetty (toilets, shelter, seats)	55	100	120	105	85	2.89
Traffic control devices/Navigation Aids	70	115	90	90	100	3.04
Boat calls (Frequency of boats/ferries)	65	120	85	110	85	3.00
Communication	60	110	95	85	115	2.89
						3.04

Source: Field Survey, 2024

The findings from the Table 4.1 indicate that factors such as accessibility to jetty, loading and unloading infrastructure, and cleanliness of jetties were rated highly, well above the criterion mean score of 3.04. On the other hand, respondents have a low perception of factors such as intermodal connectivity, comfort on jetty, and communication whose rating were below the mean score.

Table 4.2: Frequency of Jetty Facilities Maintenance

Maintenance Frequency	Frequency
Regularly	110
Occasionally	150
Rarely	100
No comment	60
Never	45

Source: Field Survey, 2024

The frequency at which jetty facilities were subjected to maintenance, as indicated in Table 4.2, was a question posed to the respondents. A majority, 150, claimed that maintenance occurred from time to time, while 110 respondents observed that maintenance was conducted regularly. However, an overwhelming number, 100 of the

respondents reported that maintenance was undertaken on rare occasions and 45 others indicated that no maintenance was ever done. The findings show unevenness in maintenance experience and signal irregularity in the frequency of upkeep carried out between one location and another.

Table 4.3: Conditions and Functionalities of Waterway Infrastructure

Infrastructure/Facility	Very Good (5)	Good (4)	Poor (3)	Very Poor (2)	Not Available (1)	Mean
Accessibility of boats/ferry	90	140	75	85	75	3.18
Punctuality of boats/ferry	80	130	95	85	75	3.12
Onboard facilities (seats, toilets)	55	120	105	95	90	2.90
Onboard information	60	115	90	100	100	2.86
Availability of dams and locks	85	135	70	90	85	3.10
Cleanliness and maintenance of boats	75	130	80	100	80	3.07
Traffic control devices/Navigation Aids	60	125	95	85	100	3.00
Onboard communication	65	115	90	85	110	2.94
Availability of safety gadgets	100	140	85	70	70	3.34
						3.06

Source: Field Survey, 2024

The analysis from Table 4.3 indicates that waterways infrastructural facilities such as accessibility to boats/ferry, punctuality of boat/ferry, and availability of safety gadgets were rated to be in good condition and functioning, with their respective means above the criterion mean score of 3.06. Conversely, the conditions and functionalities of waterways facilities such as onboard facilities (seats, toilets), onboard information and onboard communication were rated below the criterion mean of 3.06 indicating that their conditions and functionality require much to be desired.

Table 4.4: Frequency of Waterways Maintenance

Maintenance Frequency	Frequency
Regularly	125
Occasionally	155
Rarely	95
No comment	50
Never	40

Source: Field Survey, 2024

Table 4.4 shows the frequency of maintenance of boat and waterway facilities. Based on the response of the surveyed population, as indicated in Table 4.16, the majority of the respondents—155—stated that maintenance happens only from time to time, while 125 have reported that it happens regularly. Similar to jetty infrastructure though, a quite disturbing number of 95 respondents reported that maintenance of boats and supposedly of waterways themselves is rarely conducted, while 40 respondents stated that this was never done. These results indicate that the facilities along the waterways are not uniformly maintained, since most areas receive irregular upkeep that may affect the overall performance and safety of the water transport services.

The findings of this study is line with some past research findings. For instance, Owoputi (2017), in assessing the opportunities and challenges of inland waterway transport in the South Western Nigeria scored IWT high on accessibility to boats, low on jetty facilities, high on radar coverage and navigation equipment, and reported a dire need in the area of channelization and dredging. Other studies which earlier revealed poor and inadequate infrastructure, insufficient number of vessels, and poor river dredging are Ahmad *et al*. (2022), and Ogboeli (2024).

5.0 Conclusion and Recommendations

The study focused on the logistic and infrastructural challenges of inland waterway transportation in North Central Nigeria by examining the conditions, functionalities, and regularity of maintenance of jetty and waterways infrastructure. The study adopted cross sectional survey research in which three river ports of Baro, Lokoja and Makurdi were used as case study ports. Descriptive method of data analysis was used in the investigation. The outcome of the study shows that intermodal connectivity, jetty facilities and communication pose logistic constraints in the IWT in the area. The study also concluded that the greatest infrastructural challenges on the waterway is lack of onboard facilities, lack of onboard communication and information. Surprisingly though, loading and unloading equipment, traffic control devices, and availability of safety gadgets are found to be available and functioning.
It is therefore recommended that:

1. Intermodal connectivity with other means of transportation should be pursued. This will bring about logistic efficiency and increased demand for inland transport.
2. Regular maintenance of infrastructure both on the jetties and on the waterways to avoid decay. Maintenance and Capital dredging are required to make some sections of the waterways navigable all the year round
3. Adequate and timely communication is key in logistics industry, and as such, communication should be improved.

References

Abler, R., Adams, J. S., & Gould, P. (1971). Spatial Organization: The geographer's view of the world. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Adeniran, A.O. & Yusuf, T.B. (2016). Transportation and national development: emphasis to Nigeria. *Developing Country Studies,* 7(9). ISSN 2225-0565. www.iiste.org.

Aderemo, A.J. & Mogaji, S.A. (2010). Rural transportation of public facilities in Nigeria: A case study of Edu Local Government Area of Kwara State. *Journal of Human Ecology*, 29(171). https://doi.org/10.1080/09709274.2010.11906260

Ahmad, G.B.M., Ojekunle, J.A., Dere, I.G., & Ajiboye, A.O. (2022). Assessment of users and operators' challenges on inland water transport in Borgu local government area, Niger state. *Discovery*, 58(315), 198-209. https://www.discoveryjournals.org

Akali, K. E., & Idoko, O. (2010). River transport and economic empowerment; An assessment of Lokoja Crossing Port on the Niger. *53rd Annual Conference of Association of Nigerian Geographers, Lagos.*

Akinbamijo, O., Ipingbemi, O. & Bayode, T. (2016). Inland water-based transport in Lagos State: Challenges and remedies. In Ebohon, O. J., Ayeni, D. A, Egbu, C. O, & Omole, F. K. *Proceedings of the Joint International Conference (JIC) on 21st Century Human Habitat: Issues, Sustainability and Development, 21-24 March 2016, Akure, Nigeria,* 825-831.

Akpudo, C. U. & Stephens, M. S. (2020). Operational characteristics and supply of inland waterway transportation service in the coastal area of Anambra State, Nigeria. *African Journal of Science Policy and Innovation Management,* 1(2), 2020. www.ajspim.oauife.edu.ng

Akpudo, C. U., Okoli, S.C., & Stephens, M. S. (2022). Challenges and prospects of inland waterways in southeast Nigeria: the case of Oma-Mbala River, Anambra state. *IMSUCDS International Journal of Development E-ISSN:2811-2865*, 5 (2022), 50-68. https://www.imsucds-ijd.com

Bu, F. & Nachtmann, H. (2021). Literature review and comparative analysis of inland waterways transport: Container on barge. *Maritime Economics & Logistics, 25 (2023) 140-173.* https://doi.org/10.1057/s41278-021-00195-6

Badejo, B. (2009). Perspectives of inland waterways transportations and development in Nigeria, being a
paper presented at a Retreat Organized for the Honourable Minister of Transportation at Federal Palace Hotel, Victoria Island, Lagos on 26th January 2009.

Boadu, S., Otoo, E., Boateng, A., & Koomson, A. (2021). Inland waterway transportation (IWT) in Ghana: A case study of Volta Lake transport. *International Journal of Transportation Science and Technology,* 10 (2021), 20 – 33. https://doi.org/10.1016/j.ijtst.2020.05.002, www.elsevier.com/locate/ijtst.

Caris, A., Macharis, C. & Janssens, G.K. (2011). Network analysis of container barge transport in the port of Antwerp by means of simulation. *Journal of Transport Geography,* 19 (1), 125–133. https://doi. org/ 10. 1016/j. jtran geo. 2009. 12. 002.

El-Nakib, I. and Roberts, C. (2006). Challenges to inland waterways logistics Development: the case of Egypt, Conference paper. DOI: 10.13140/RG.2.1.1103.8563.
https://www.researchgate.net/publication/252134276

He, D., Gao, P., Sun, Z., & Lau, Y. (2017). Measuring water transport efficiency in the Yangtze River Economic Zone, China. *Sustainability,* 9 (2278). doi:10.3390/su9122278. www.mdpi.com/journal/sustainability

Ndikom, O., (2013). A Critical Assessment of the inland waterway operations and management on the development of the Nigerian maritime industry. *Greener Journal of Environmental Management and Public Safety ISSN: 2354-2276,* 2 (2), 099-107. https://www.researchgate.net/publication/313237849

Nigerian Inland Waterways Authority (NIWA) (2006). Annual Report Publication Bulletin. https://niwa.gov.ng/nigerian-waterways/

Obamiro, J. K., Elegunde, A.F., & Kumolu-Johnson, B.O. (2018). Inland waterways transportation system and promotion of business activities in Lagos State, Nigeria. C*rawford Journal of Management Review.* 1(2):57-65. Accessed May, 2023.

Obeta, M. C. (2014). The characteristics of inland waterway transport in Nigeria. *IOSR Journal of Humanities and Social Science (IOSR-JHSS),* 19 (3), 119-126. *e-ISSN: 2279-0837. www.iosrjournals.org* DOI: 10.9790/0837-1934119126

Ogboeli, G.P., Brown, I. & Onuegbu, W. (2024). Evincing the social and economic impact of inland waterways transportation in the development of the Port Harcourt metropolis. *International Journal of Hydrology.*8(1):27–35. DOI: 10.15406/ijh.2024.08.00370

Ojile, M.O., (2006). Draft report of the socio-economic characteristics for the idealization of the Port Harcourt Warri roads. Submitted to Messer Allots Nigeria Limited on behalf of the Federal Ministry of Works, Abuja. p. 60.

Olaniyi, A.A. & Oniru, S.A. (2017). Efficiency of Nigerian Transport System: Lessons

Derived from the Developed Nations. *Developing Country Studies* 7(2). https://d1wqtxts1xzle7.cloudfront.net. www.iiste.org

Osuji, J.N. & Agbakwuru, J. (2023). Sustainable inland ports in Nigeria: An opportunity for growth of Nigerian Nation. *Journal of Applied. Sciences Environmental Management,* 27 (5), 965-973. https://dx.doi.org/10.4314/jasem.v27i5.12

Owoputi, E.A. (2017). Opportunities and Challenges of Inland Waterways Transport in the Southwest Coastal Belt of Nigeria. [Unpublished doctoral dissertation]. University of Ilorin, Nigeria.

Rodrigue, J. (2014). Reefers in North American Cold Chain Logistics: Evidence from Western Canadian supply chains. *The Van Horne Institute*, Calgary. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.731.3967

Szymonik, A. (2013). Transport Economics for Logistics and Logisticians: Theory and practice. https://www.researchgate.net/publication/297369663_

United Nations Economic Commission for Europe [UNECE)] (2011). Whitepaper on Efficient and Sustainable Inland Water Transport in Europe, (2011). *ECE/TRANS/SC/.3/189, Geneva*

UNECE (2019). Current situations and trends in inland water transport: Revision of the White Paper on efficient and sustainable inland water transport in Europe. *Informal document SC,.*3 (4), 2019*, Geneva.*

United Nations Economic Commission for Europe (UNECE), (2020). *Inland Transport Committee World Forum for Harmonization of Vehicle Regulations Working Party on Pollution and Energy* Eightieth session. Geneva, 14-17 January 2020. https://unece.org/2020

Ullman, E.L. (1954). Amenities as a Factor in Regional Growth. *Geographical Review,* 44 (1), 119-132. Taylor & Francis, Ltd. doi.org/10.2307/211789. https://www.jstor.org/stable/211789

Wang and Li (2012). Inland waterway transport in the Pearl River Basin, China. https://www.cairn.info/revue-espace-geographique-2012-3-page-196.htm

Wiegmans, B., Witte, P., & Spit, T. (2015). Inland port performance: a statistical analysis of Dutch inland ports. European Transport Conference 2014 – from Sept-29 to Oct-1, 2014. *Transportation Research Procedia,* 8 (2015), 145 – 154. www.sciencedirect.com

Wiegmans, B. & van Duin (2017). Inland water operations. *Intermodal Freight Transport and Logistics* 75-94, DOI:10.1201/9781315177762-4, https://www.researchgate.net/publication/345733256_Inland_waterway_operations