Assessment of Safety Measures and Operational Challenges of Inland Waterway Transport along Oron - Calabar Route, Nigeria

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Abstract- This study assessed the safety measures and operational challenges of inland waterway transport along the Oron - Calabar route. Observation and structured questionnaires were used for the collection of data. Quantitative data was analyzed using descriptive statistics, while qualitative data was coded and analyzed using the 4-point Likert scale, which was converted to a relative importance index (R.I.I.) for each factor, posing a challenge to operators. The result showed that safety equipment was provided onboard boats by operators. The R.I.I. computed showed that boat and engine replacement (R.I.I. = 0.874) was the most challenging factor, while water hyacinth (R.I.I. = 0.418) was the least. Other challenges were frequent bad weather conditions, high running costs, floating logs and debris, extortion by law enforcement agents, difficulty making headway against the opposite current, high cost of safety equipment, passengers' refusal to adhere to safety measures, and poor berthing facilities in their order of impact. Proper funding and enforcement of safety measures are hereby recommended.

Keywords: Inland waterways, safety measures, operational challenges, relative importance index

Introduction

Inland waterways transport (I.W.T.) is the transport activities that occur within the inland water routes of a nation or a place and does not include coastal or ocean transport. Adimoha (2014) refers to inland waterways as the bodies of water in the interior parts of a country or region, and they constitute natural or artificial navigable inland bodies of water or systems of interconnected bodies of water used for transportation. Inland waterways are made up of navigable rivers, lakes, coastal creeks, lagoons, and canals (Aderemo and Mogaji, 2010). Inland water transport is the movement of persons or goods through inland waterways between inland ports, jetties, quays, and wharves. It is a cheap transport, operates on natural tracks, and hence does not require massive capital in the construction and maintenance of its tracks except in the case of canals where the channels have to be created artificially by men. Based on this, Obeta (2014) considered inland water transport as a low-cost water-based transportation alternative to ferry people and goods along waterways. Inland waterways transverse twenty (20) out of the thirty-six (36) states within Nigeria, and the areas adjacent to the navigable rivers represent the nation's most important agricultural and mining regions (Ezenwaji, 2010).

The existence of waterways has been an essential issue in developing nations and places worldwide; waterways contribute to exploration and new settlement, leading to opportunities for economic development. Though inland water transport is slower than road and air transport, it is less expensive and has a large carrying capacity, which makes it suitable for transporting bulk goods such as foodstuff, oil, metal ores, coal, grain, lumber, water, and construction sand. Inland waterways vary in size, from shallow barge-carrying rivers and canals to deep seaways that accommodate ocean-going vessels (Adimoha, 2014). According to Bassey and EkpenyangNsia (2018), Nigeria is blessed with the second longest length of inland waterways in Africa, with a total length of about 8,600 kilometers. The two longest rivers in Nigeria are River Niger and River Benue, which...
flow into each other at the confluence town (Lokoja). At this point, the two rivers join and flow south into the Atlantic Ocean. The coastal region extends from Badagry through Warri to Calabar (Ezenwaji, 2010). This coastland covers about 852 kilometres (Ndikom, 2008). People highly prefer using this water route when traveling between Oron and Calabar because it is the shortest distance between the two cities compared to the road. Although water transport is slow and inapt for faster movement of passengers, a well-organized coastal and inland waterways improvement and operation generally can no doubt reduce the pressure on the infrastructure of other modes of transport, notably rail and road, in any nation (Ndikom, 2008).

Water transportation is suitable for development in any region if well developed and maintained. In the case of Nigeria, water transport is still very far behind when compared to other modes of transport. This hinders the total contribution of this mode as a tool for economic development. This study, therefore, assesses the operational challenges of inland waterway transport along the Oron - Calabar route, Nigeria, with objectives of assessing boat traffic and types of boats plying the route, safety measures applied by operators, and operational challenges along the Oron- Calabar route.

Materials and Methods

The Study Area

The study focused on the challenges militating against water transport operations and was conducted on the Oron – Calabar waterway. The waterway, which served as the study area, lies between Oron city in Akwa Ibom State and Calabar city in Cross River State, all in Nigeria. The Oron – Calabar waterway is integral to the Cross River estuary, the major estuary in the Bight of Bonny (Nwosu, 2005). Many rivers, notably the Akpa Yafe River, Cross River, and the Great Kwa River feed this estuary (Evans et al., 2017). The Oron – Calabar waterway is not as polluted as the other routes in the Niger Delta because of low oil exploration activities. However, the Oron – Calabar water route has been significant for transporting passengers and their goods and agricultural and industrial products between Akwa Ibom and Cross River States for many years. The use of the Oron – Calabar water route for transportation of passengers and goods dates back to the colonial era when the Calabar agents G. H. Arezathe in 1920 put a 10-ton lighter towed by a launch on a daily run between Oron and Calabar (Affia, 1997).

The Oron – Calabar waterway also provides access routes to other states in Nigeria and other countries, such as Equatorial Guinea and Cameroon. The presence of fishing ports in the Cross River estuary, particularly the Parrot Island along this waterway, and the poor state of road networks between Akwa Ibom and Cross River State (the Calabar-Itu highway inclusive) have left many travelers with no choice but to patronize this water route at great extent. The geographical distance between Oron and Calabar on the water route is 12 nautical miles, which is about 22 km or 13.8 miles, making the water route the most preferable for travelers going to Calabar from Oron and vice versa as it is by far the shortest distance as compared to the road (about 200 km). These make the Oron – Calabar waterway grow into one of the busiest water routes in the Gulf of Guinea (Evans et al., 2017). The hydro-physical-chemical properties of the lower reaches of the Cross River estuary, which contains the Oron – Calabar route, have a temperature ranging between 23°C and 30°C, and pH ranges between 5 and 9. In contrast, water salinity ranged between 0.15% and 0.20%. This range of salinity indicates that the estuary has been dramatically diluted.

Sampling and source of data

The study adopted the survey research design. Data for the study were sourced through questionnaires and personal observation. Primary data were used for this study. From a reconnaissance survey, the population of the study (the operators) was one hundred and twenty (120). The sample size was drawn from the one hundred and twenty operators during the study period, from September 1 to September 28, 2020. A simple random sampling technique was used for sampling. A suitable sample size of ninety-one operators for the study was derived from Cochran’s sample size formulae as presented in Equations 1 and 2. Equation 1 is Cochran’s formula for calculating sample size when the population is infinite; Equation 2 is Cochran’s formula for calculating sample size from a finite population.
\[ n_o = \frac{Z^2 PQ}{e^2} \]  
(1)

\[ n = \frac{n_o}{1 + \frac{n_o - 1}{N}} \]  
(2)

Where:

- \( n_o \) = sample size for infinite population;
- \( Z \) = critical value at desired confidence level (1.96);
- \( P \) = the estimated proportion of an attribute that is present in the population (0.5);
- \( Q \) = 1 - \( P \) = (1 - 0.5), i.e., estimated proportion of an attribute not present in the population;
- \( e \) = level of error (0.05);
- \( N \) = size of population of study.

To calculate the sample size (no) from the infinite population, Equation 1 was applied as follows:

\[ n_o = \frac{1.96^2 \times (0.5)(0.5)}{(0.05)^2} = 384 \text{ (sample size for infinite population)} \]

To calculate the sample size (n) from a finite population of 120 (population of study), Equation 2 was applied as follows:

\[ n = \frac{384}{1 + \frac{384 - 1}{120}} = 91 \text{ (sample size from study population of 120)} \]

Hence, the required sample size for questionnaire distribution was ninety-one.

Each of the respondents was chosen randomly and entirely by chance, such that each respondent has the same probability of being chosen from the population of study at any stage during the sampling process. Since
the sampling size \( (n) \) was 91 and the population of the study \( (N) \) was 120, the probability of each being chosen for sampling from the population of the study was given as \( n/N = 91/120 = 0.758 \) (in the case that any given individual can only be selected once).

**Data presentation and analysis**

The data collected was presented in tabular and graphical form; descriptive and inferential statistical tools were used for data analysis with the help of Microsoft Excel 2010. The inferential tool used was the relative importance index (R.I.I.). Data were analyzed quantitatively and qualitatively, considering the qualitative nature of the research. The qualitative data was coded and analyzed using the 4-4-point Likert scale, which was converted to each factor's relative importance index (R.I.I.). This made it possible to cross-compare the relative importance of each challenging factor as perceived by the respondents (operators). The relative importance index was formulated as expressed in Equation 3 (Lim and Alum, 1995).

\[
RII = \frac{4(n1)+3(n2)+2(n3)+n4}{A+N} \tag{3}
\]

Where \( 0 \leq (R.I.I) \leq 1 \); \( A \) represents the highest weight (in this case, it is 4); \( N \) represents the total number of respondents; \( n1 \) represents the number of respondents for Strongly Agree; \( n2 \) represents the number of respondents for Agree; \( n3 \) represents the number of respondents for Disagree and \( n4 \) represent a number of respondents for Strongly Disagree.

**Results**

Table 1 shows the type of boat plying the route and the average boat traffic for each day of the week. It was observed that the boats used for transport operations along the route were outboard engine boats, and the two models used were the W23 and the W19, as presented in Table 1. From the observation, the boats were fiberglass made, having single hulls and crossbench seats. The boats were propelled with 115 and 120-horsepower engines. As illustrated in Figures 2 and 3, all the boats were uncovered, which affected the operations by rainfall. Hence, a reduction in the operation capacity of the operators could lead to financial loss. However, the gain is in the convenience of handling since an uncovered boat is easier to maneuver than a covered boat of the same size in transport operations along the route. The passenger capacity of the W23 boat was 20 passengers, while that of the W19 boat was 16. Table 2 shows the operational challenges faced by boat operators along the route in order of relative importance index (R.I.I.). As presented in Table 2, the high cost of boat and engine replacement is ranked as number one, while water hyacinth is assigned the least ranking in the R.I.I. order.

**Table 1. Boat type and average boat traffic**

<table>
<thead>
<tr>
<th>Days</th>
<th>Boat traffic (Oron to Calabar)</th>
<th>Total outbound boat traffic</th>
<th>Boat traffic (Calabar to Oron) Inbound</th>
<th>Total inbound boat Traffic</th>
<th>Total boat traffic for the day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W19</td>
<td>W20</td>
<td>W19</td>
<td>W20</td>
<td></td>
</tr>
<tr>
<td>Monday</td>
<td>5</td>
<td>6</td>
<td>11</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Tuesday</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Wednesday</td>
<td>6</td>
<td>7</td>
<td>13</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Thursday</td>
<td>5</td>
<td>8</td>
<td>13</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Friday</td>
<td>6</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Saturday</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Sunday</td>
<td>6</td>
<td>9</td>
<td>15</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>48</td>
<td>84</td>
<td>33</td>
<td>50</td>
</tr>
</tbody>
</table>
Table 2. Operational Challenges on Oron – Calabar Water Route

<table>
<thead>
<tr>
<th>S/N</th>
<th>Factors</th>
<th>n1</th>
<th>n2</th>
<th>n3</th>
<th>n4</th>
<th>N</th>
<th>R.I.I</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High cost of boat and engine replacement</td>
<td>55</td>
<td>29</td>
<td>4</td>
<td>3</td>
<td>91</td>
<td>0.874</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Frequent bad weather conditions</td>
<td>46</td>
<td>28</td>
<td>13</td>
<td>4</td>
<td>91</td>
<td>0.819</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>High running cost</td>
<td>36</td>
<td>45</td>
<td>7</td>
<td>3</td>
<td>91</td>
<td>0.813</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Floating logs and debris</td>
<td>37</td>
<td>34</td>
<td>14</td>
<td>6</td>
<td>91</td>
<td>0.780</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Piracy</td>
<td>34</td>
<td>40</td>
<td>10</td>
<td>7</td>
<td>91</td>
<td>0.778</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Extortion by law enforcement agents</td>
<td>30</td>
<td>45</td>
<td>10</td>
<td>6</td>
<td>91</td>
<td>0.772</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Difficulty in making headway against the opposite current</td>
<td>31</td>
<td>40</td>
<td>9</td>
<td>11</td>
<td>91</td>
<td>0.750</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>High cost of safety equipment</td>
<td>32</td>
<td>24</td>
<td>21</td>
<td>14</td>
<td>91</td>
<td>0.703</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Passengers' refusal to adhere to safety measures</td>
<td>27</td>
<td>28</td>
<td>17</td>
<td>19</td>
<td>91</td>
<td>0.673</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>Poor berthing facilities</td>
<td>21</td>
<td>29</td>
<td>19</td>
<td>22</td>
<td>91</td>
<td>0.635</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Water hyacinth</td>
<td>3</td>
<td>4</td>
<td>44</td>
<td>0</td>
<td>91</td>
<td>0.418</td>
<td>11</td>
</tr>
</tbody>
</table>

Discussion

Boat traffic

As presented in Table 1, the average outbound boat traffic (Oron – Calabar) for each day was 11, 12, 13, 13, 10, 10, and 15 for Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday, respectively. That of inbound traffic (Calabar – Oron) was 14, 8, 9, 16, 13, 14, and 9 for Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday, respectively. From Monday to Sunday, the total average for outbound boat traffic was 84 (36 W19 boats + 48 W23 boats), while that of inbound traffic was 83 (33 W19 boats + 50 W23 boats), as presented in Table 1. None of the operators used boats of smaller capacity, which could come from the desire to achieve economy of scale as fuel consumption and other expenses incurred per trip do not vary proportionally with decreased boat size. It was observed that boat traffic on Monday and Thursday was higher than on other weekdays; this could be attributed to a higher volume of passengers on Monday and Thursday since these days are beach market days.

Safety measures applied by operators

Transport operators on the Oron-Calabar water route were observed to comply with safety measures. The safety equipment observed onboard boats includes a safety jacket (life jacket), life ring, reflective jacket, torchlight, anchor, line, towing rope and hook, paddle, fire extinguishers, and water bailers. The life jackets and life rings are for personal survival in the case of a boat capsizing or a man falling overboard; the anchorage system (anchor and line) is for mooring and preventing the boat from drifting; the towing system for salvage by another boat in the case of engine breakdown; bailers for bailing out water from the boat to avoid sinking. Other safety equipment included fire extinguishers (dry chemical for class B fire and carbon dioxide for class
B and electrical fire), a reflective jacket, a paddle, and a torchlight. A reflective jacket indicates the presence of a person to avoid an accident or casualty; the paddle is for temporary maneuvering and propelling of the boat to a needed location when the engine has been disengaged or broken down; it is also used as a beacon to another boat when there is distress. The provision of dry chemical extinguishers and carbon dioxide extinguishers on board the boats is linked to the fact that the most common fire that usually occurs onboard the boats involves flammable liquids such as petrol and electrical fire. There was no occurrence or any report of an accident throughout the time of the study; this could be attributed to the operators being careful in operations, including loading of passengers and goods, driving, and landing, as human error is the most significant factor in water transport accident (Onwuegbuchunam 2013). From observation, it was discovered that the best way to survive on the route in the case of a boat mishap was the application of personal survival techniques using life jackets and other safety equipment, as there was no formal and organized search and rescue arrangement to rescue victims involved in boat accidents. Adegbemlen and Olatunji (2016) also noticed the absence of organized search and rescue teams to rescue victims in most water routes in the Niger Delta region.

The Operational challenges faced by operators of the Oron – Calabar route

Operators of inland water transport operations in Nigeria have faced many operational challenges, as reported by other researchers like Obed (2013), Obeta (2014), Ibama (2015), and Akimbamijo (2016). Operations in the Oron – Calabar water route are not without its challenges; despite the success so far recorded in the movement of passengers and goods along the Oron – Calabar water route, the operators have encountered some challenges, as was revealed in this study, these challenges were identified and ranked based on relative importance (Table 2). From the relative importance index (R.I.I) calculated for individual challenge factor as presented in Table 2, boat and engine replacement (R.I.I = 0.874) was the most significant factor posing a challenge to transport operation along the Oron – Calabar water route. This was followed by frequent bad weather condition (R.I.I = 0.819), high running cost (R.I.I = 0.813), floating logs and debris (R.I.I = 0.780), piracy (R.I.I = 0.778), extortion by law enforcement agents (R.I.I = 0.772), difficulty in making headway against opposite current (R.I.I = 0.750), high cost of safety equipment (R.I.I = 0.703), Passengers’ refusal to adhere to safety measures (R.I.I = 0.673), Poor berthing facilities (R.I.I = 0.635) and water hyacinth (R.I.I = 0.418) in their order of impact. Bassey and EkpenyongNsa (2018) and Nsan-Awaji (2019) have also explicitly reported on some of these challenges encountered by operators along the route.

Procurement of boats and engines was seen to be a very challenging issue as there is no proper or sufficient funding for inland water transport operations by government or private organizations; this issue of no funding was reported by Nsan-Awaji (2019). Obeta (2014) also noticed this challenge, and Owoputi et al. (2018) further revealed that many operators rent boats due to their inability to purchase their own; this can hinder operation and even lead to quitting the transport system by some operators. The bad weather condition was seen to be the next challenging factor after the boat and engine acquisition; this has become more of a problem as the operators on this route use uncovered boats, which are affected by rain, wind, and sun radiation. Bad weather, especially during the rainy season, can significantly hinder operations, leading to a loss of revenue and could even cause accidents (Onwuegbuchunam, 2013). The high running cost was another challenge; with the unstable economic situation in Nigeria, the operational cost can rise suddenly and affect operation budgets. There have been high costs of operational inputs like fuel, lubricants, spare parts, and maintenance, amongst others. When factored into transport fare, this high running cost makes the fare high for passengers, creating discouragement as cost plays a vital role in transport demand. This affected the operators, considering it ranked third in order of impact, as was revealed by the relative importance index. Floating logs and debris along the Oron – Calabar water route have posed a navigation challenge; Ibama et al. (2015) also saw this challenge in the navigable waters of Rivers State in Nigeria.

Floating logs and debris on a water route can cause damage to the engine propeller, boat hull, and other damages, as the case may be. To reduce the impact of the challenge from floating logs and debris, the boat conductor at the bow should keep watch in the front, also tuning his eyes port and starboard for a total watch to avoid the boat running into floating logs or debris as the driver who is at the stern may not be able to see clearly. Piracy as a challenge was rated fifth in order of impact, considering its relative importance index of 0.778, as presented in Table 4.7. This outcome is not a surprise as security measures are put in place along the route, which makes piracy lose its perceived position as first in order of impact. The Oron – Calabar route
operators pay dues towards security activities to prevent or reduce piracy; this has yielded fruit as piracy has been reduced compared to the alarming rate of piracy along the route in recent years, as Adongoi et al. (2019) reported.

Field investigation revealed extortions from law enforcement agents as one of the factors posing challenges to Oron – Calabar water route transport operations; this is a form of corruption and can impede the development of the transport system along the route. Obeta (2014) pointed out corruption as having a negative impact on the development of inland water transport in Nigeria. There was the issue of difficulty in making headway when the water flows in opposite directions as a result of high current along the route; this challenge forced the operators to use very high horsepower (H.P.) engines (115 HP and 120 HP), which adds to the running cost considering fuel consumption and even maintenance of the high capacity engine. This high horsepower engine, instead of the usual 40 and 75 H.P., allows the operators to sail at the required speed irrespective of flow direction and arrive on time for customer satisfaction, but it adds to the running cost. Therefore, for the operators to overcome this challenge posed by the opposite direction of the water current, they must acquire higher capacity engines, and this can affect some operators as they may not withstand the competition arising from just-in-time logistics (J.I.T.) of the transport operation. The high cost of safety equipment was one of the challenges facing operators on the Oron – Calabar water route. Provision of safety equipment is an operational requirement even by law; in a situation where the equipment is not easily afforded, it poses a challenge to the operators as they may lose patronage from passengers and may even have problems with law enforcement agents. Bayode and Ipingbemi (2016) also found that high safety equipment costs have posed challenges to inland water operators in the Lagos area of Nigeria.

There was the issue of some passengers refusing to adhere to safety rules like wearing life jackets. This may not sound much like a challenge. However, it is a challenge because the operators are likely to encounter problems with law enforcement agents and are also answerable to anything that may happen to such passengers onboard because of their actions. This challenge goes beyond law enforcement issues and passenger safety; another issue associated with this kind of challenge is dealing with such passengers and maintaining customer relationships, which is vital in any business. There was the issue of poor berthing facilities; this was not seen as a severe challenge to the operators as it was supposed to be, considering its rating being second to the last, meaning that few of them saw it as a severe challenge.

In contrast, more saw it as a little challenge. This does not mean that modern berthing facilities were provided or available. I saw it as a minor challenge that could be attributed to the small boat they were using, which was very easy for them to maneuver even when berthing facilities were not in good condition. This is contrary to the report by Owoputi et al. (2018), where berthing facilities was seen as a significant challenge for operators of inland water transport in some route in the Lagos area, Nigeria.

Water hyacinth is generally problematic as it can clog waterways and affect smooth transport operations. The Oron – Calabar route transport operators saw it as the slightest challenge; it may not mean the absence of water hyacinth but may be perceived by operators to have a minor impact if it did not affect their operations. This contrasts the report by Bayode and Ipingbemi (2016) concerning operators in some routes in southwest Nigeria where water hyacinth was seen as a significant challenge.

Conclusion
This study assessed the safety measures and operational challenges of inland waterway transport along the Oron - Calabar route. The number and types of boats, safety measures, and operational challenges along the route were studied. Observation and structured questionnaires were used for the collection of data. The result showed that all the boats used were outboard engine boats, uncovered, fiberglass made, having single hulls, with crossbench seats, and propelled with 115 and 120-horsepower engines. The boat was of two models, W19 and W23, with carrying capacity of sixteen (16) and twenty (20) passengers respectively. Daily boat traffic ranged from 22 to 29, with more traffic on Thursdays and Fridays. Safety equipment was provided onboard boats by operators. From the relative importance index (R.I.I.) computed for individual factors posing operational challenges to operators along the Oron – Calabar waterway, boat and engine replacement (R.I.I. = 0.874) was the most significant factor. The least factor was water hyacinth (R.I.I. = 0.418). Other factors include frequent bad weather conditions, high running costs, floating logs and debris, piracy, extortion by law enforcement
agents, difficulty in making headway against the opposite current, high cost of safety equipment, passengers' refusal to adhere to safety measures, and poor berthing facilities in their order of impact.

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