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Incidences and Trend of Marine Accident Fatalities in Various River Routes Connecting the Major Sea Ports of Nigeria

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Abstract: The study investigated the incidences and trends of marine accident fatalities in various river routes connecting the major sea ports in Nigeria. This was necessitated by the various cases of deaths, drop in government revenue and presence of wrecks from abandoned boats and ships in the coastal waters. The cross-sectional survey research design was adopted relying on both primary, secondary data and the use hypothesis to draw conclusions. Primary data was got through acquisition from satellite imageries from the loading and exit point of various river routes and designed questionnaires distributed while secondary data such as accident and disaster occurrence was collected several marine sector regulatory agencies in charge of the marine sector for a period of thirty (30) years (1989 to 2018). The study showed that river route incidence is dependent primarily on the population of the destination route and its frequency of usage. Although, other factors such as poor visibility, channel width and sharp bends, inaccurate meanders and over speeding increased its probability of occurrences. Study also found that areas without alternative transport route experienced high incidences of boat accidents compared to areas with road transport exits that suffer exorbitant fair and proximity challenges. There was no statistically significant relationship between the length of the water route and the frequency of incidence ($r=0.006$; $p>0.05$). Hence study recommends that Security agencies in charge of maritime routes should be equipped with modern surveillance gadgets, combatant firearm, and warships to enhance maritime security and other response operations.

Keywords: Marine, Fatalities, Sea Ports, Brass, Tombia, River route, Bakana

I. Introduction

The use of water ways is one of transportation alternatives available to most riverine, however it is an integral part of the overall transportation system. It is predominantly intermodal transportation because a high percentage of waterway traffic is interchanged with other transportation modes (Ibeawuchi, 2013). For the riverine who can use the water way system, it provides a low-cost alternative. Inland waterway transportation ranks at or near the top among other transportation modes in terms of ton-miles produced per unit of energy consumed, and the number of employees and man-hours as well as other resource inputs. It is an important factor in assuring the Nation of a highly competitive and efficient transportation system (Brown & Savage, 1996).

With inland navigable water ways of about 10,000km and an extensive coastland of about 852km, Nigeria has a great potential in the movement of goods from the coast to the hinter land by water transport. The country's water ways centre on the Rivers Niger and Benue which dissect Nigeria into East, West and Northern regions. The two rivers form a confluence at Lokoja and flow into the Atlantic Ocean. The coastal water ways extend from Badagry through Warri to Calabar (Nigerian Inland Waterways Authority, NIWA, 2006).

The Nigerian inland water ways have great potentials. The areas adjacent to the rivers are major agricultural areas. Agricultural products from the middle belt areas can be transported to the delta areas through the water ways and vice versa. The importation of raw materials through the ports in the delta areas for use at the Ajaokuta steel complex, which is a major industrial centre on the Niger, will benefit from the importation and export of cargo movement on the waterways. In all, Nigeria has about 2,200km of route, out of the total drainage of the rivers from source to month. The system is connected to about 880km of inter-coastal water ways from Lagos through Warri, Port Harcourt and Calabar.

No wonder, in the year 1953 when Alhaji Tafawa Balewa visited the United States of America, he observed the enormous contribution of the Missipi River to the US economic development and became convinced that the Niger and Benue Rivers could play a similar role. Subsequently, the Netherland Engineering Company (NEDECO) were contracted to provide a feasibility study of water ways development which they carried out in series of reports: 1955, 1959, 1961.

As a follow-up to the draft Environmental Impact Assessment (EIA) report, the dredging of the river was first carried out in 1958 by NEDECO and secondly by a consortium of LCHP and Westminster Dredging company in 1978 from Baro through Lokoja to Onitsha, Onya to Warri and Port Harcourt. Although the nation inland water ways operation has been in existence since the colonial

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era, the National Inland Waterways Authority (NIWA) formally the Inland Waterways Department (IWD) under the Federal Ministry of transport, was set up in 1956. As a statutory body, 100% owned by the Federal government, NIWA was established by Decree No. 13 of 1997.

Although, inland waterways provide cheaper means of transport and also open up economic activities, we cannot neglect the costs attached to its operation. According to Ogwude (1998), the advent of mechanized transport has both increased our mobility and enriched our lives by widened experience; but it has also increased the price of transport usage in terms of human lives and sufferings due to accidents. The valuation of waterways transport accident reduction can be viewed as resource cost or as an investment appraisal item. As a resource cost, it can be used to evaluate the cost associated with accident in terms of human and material losses. But its interpretation as an investment appraisal item is perhaps more important. This means that it can be used to assess the achievements of transport safety measures and the relative benefit of alternative transport programmes and policies (Ogwude, 1998). Oil-spillage is greater for collision, materials and equipment failure accidents with regards to tank barge accidents. Other studies have investigated the determinants of the vessel accident oil spillage of oil-cargo vessel (Anderson & Tally, 1995; Tally *et al*., 2005).

However, this study attempts to capture the incidences and trend of marine accident fatalities in various river routes connecting the major sea ports in Nigeria. This research was necessitated by the various cases of deaths, drop in government revenue and presence of wrecks from abandoned boats and ships in the coastal waters. This will bridge the gap created between previous researches on the above challenges. The findings of this study will also add more knowledge to the existing literature and act as supportive insight for further research that will reveal facts that could aid the government in its policy and decision making that will be of mutual interest to all parties involved in this menace.

II. Materials and Methods

Area of Study

States of interest were Lagos, Cross Rivers and Rivers, respectively. The choice of these States was based on the fact that these States are the only States in Nigeria where major marine transport activities are carried out. The study also covers agencies in charge of the management of marine transportation; Nigerian Shipping Council, Nigerian Maritime Administration and Safety Agency (NIMASA), Nigerian Inland Waterways (NIWA), Nigerian Port Authority (NPA) and Maritime Police. Six (6) months was the duration of the field work while accident-related data were collected between 1989 and 2018. The related maps for this study are shown in Figures 1, 2, 3, 4 and 5.

Research Design

According to Jongbo (2013), research design is a set of strategies and procedures that is aimed at achieving the purpose of the study. It also explains the steps that were taken in conducting the research which is aimed at providing the required answers to research questions. This present study applied the cross-sectional survey research design. This is because cross-sectional research design as one in which the subjects or variables are investigated or observed at one or more points in time and no effort is made to manipulate the variables or control the subjects (Ojo, 2005). Both primary and secondary data was used for the study. Primary data was gotten from the acquisition of satellite imageries while Secondary data such as accident/disaster occurrence was collected from the regulatory agencies; Nigerian Inland Waterways (NIWA) and Maritime Police in charge of the marine sector for a period of thirty (30) years (1989 to 2018). This data was used to determine Incidences and Trend of Marine Accident Fatalities in various River Routes connecting the Major Sea Ports in Nigeria and were analyzed with the use of simple percentile analysis.

The population of the study consists of all river route loading points across the study area. Lagos State (CMS- Apapa, Ebute-ero-Ikorodu, Ajah-Ikorodu, Ikorodu-Beshi, Badegry-Apapa, Ipakodo- Ikorodu, Ikorodu- Igbogbo), Rivers State (Degema-Harry's Town, Ogbogoro-Isaka, Iwofe-Ogbakiri, PH-Abonnema, PH-Nembe, PH-Brass, Akpos-Okujagu, Marine Base Creek-Okrika, PH-Bonny, Opobo Creek-Kala Ibiama, Kono-Opobo/Ikot Abasi, Ataba-Opobo, Buguma-Bakana, Abonnema-Bille, Abonnema-Bakana, Bonny Creek-Opobo, Iwofe-Tombia, PH-Isaka Town and Ogu Bolo-Onne) and Cross-rivers State (Ekwatai-Ikom, Ikom-Itighidi, Itighidi-Itu, Itu-Oron (Inland Waterway), Ekpri-Ine Ikoi, Adiabo-Oron, Creek Town-Ikang, Idundung-Ekpene Esuk and Mbube-Ogurude).

Methods of Data Analysis

Hypothesis which states that there is no statistically significant relationship between the length of the water route and the frequency of incidence along the route was employed. The regression analysis was used which assesses the relationship between a dependent variable and an independent variable. The simple linear model is expressed using the following equation:

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$Y = a + bX + \epsilon$

Where:

Y – Dependent variable ϵ – Residual (error)

X – Independent (explanatory) variable

a – Intercept b – Slope

The maps of river routes in creeks and jetties (across the rivers with roads) and in local government areas are shown in Figures 1 and 2. The river routes in Lagos, Rivers and Bayelsa states are showed in Figures 3, 4 and 5 respectively.

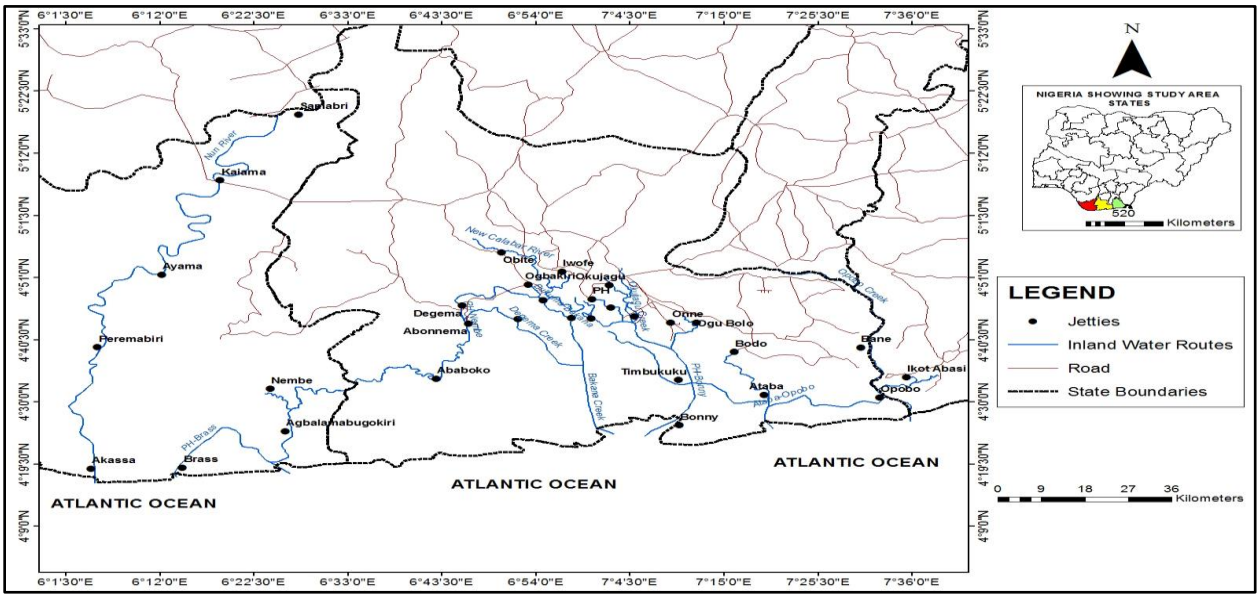

Figure 1: Creeks and Jetties with Roads

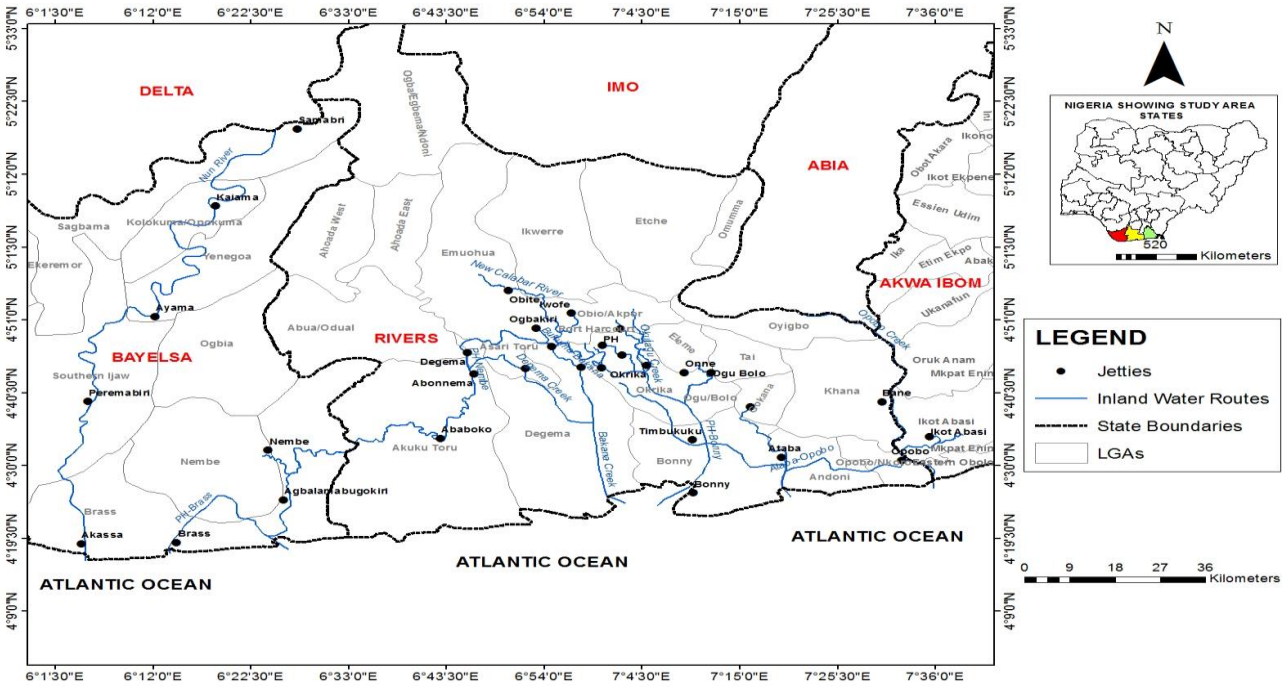

Figure 2: Creek, Jetties and LGAs

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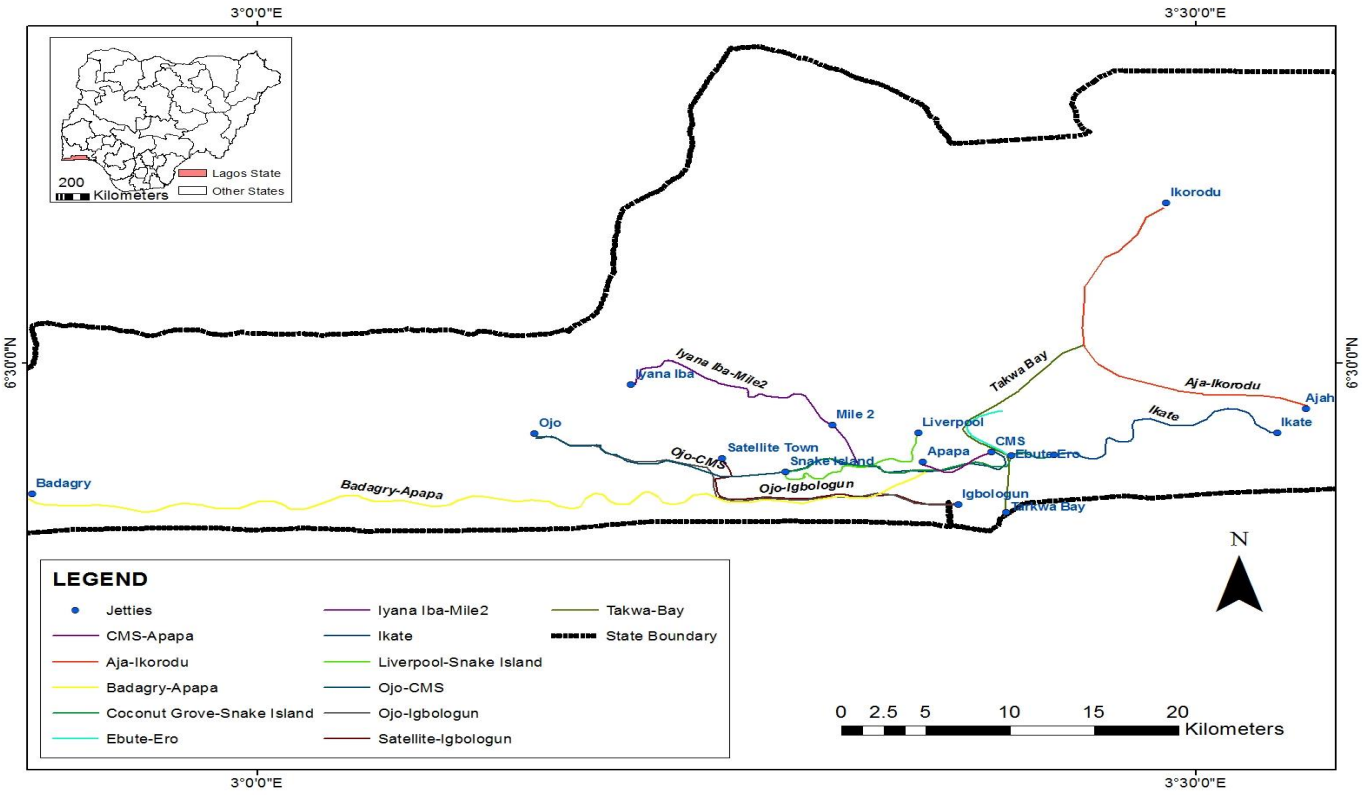

Figure 3: Lagos State River Routes

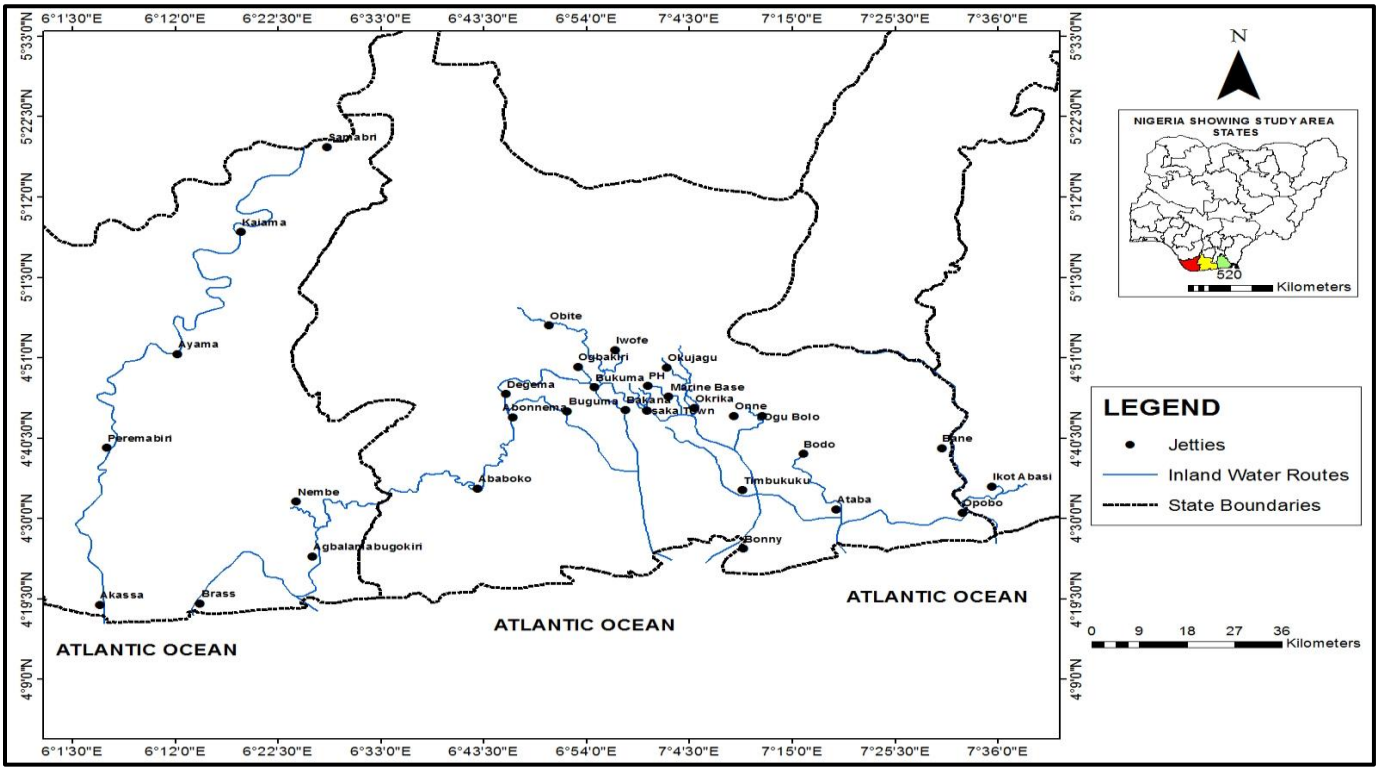

Figure 4: Rivers State River Routes

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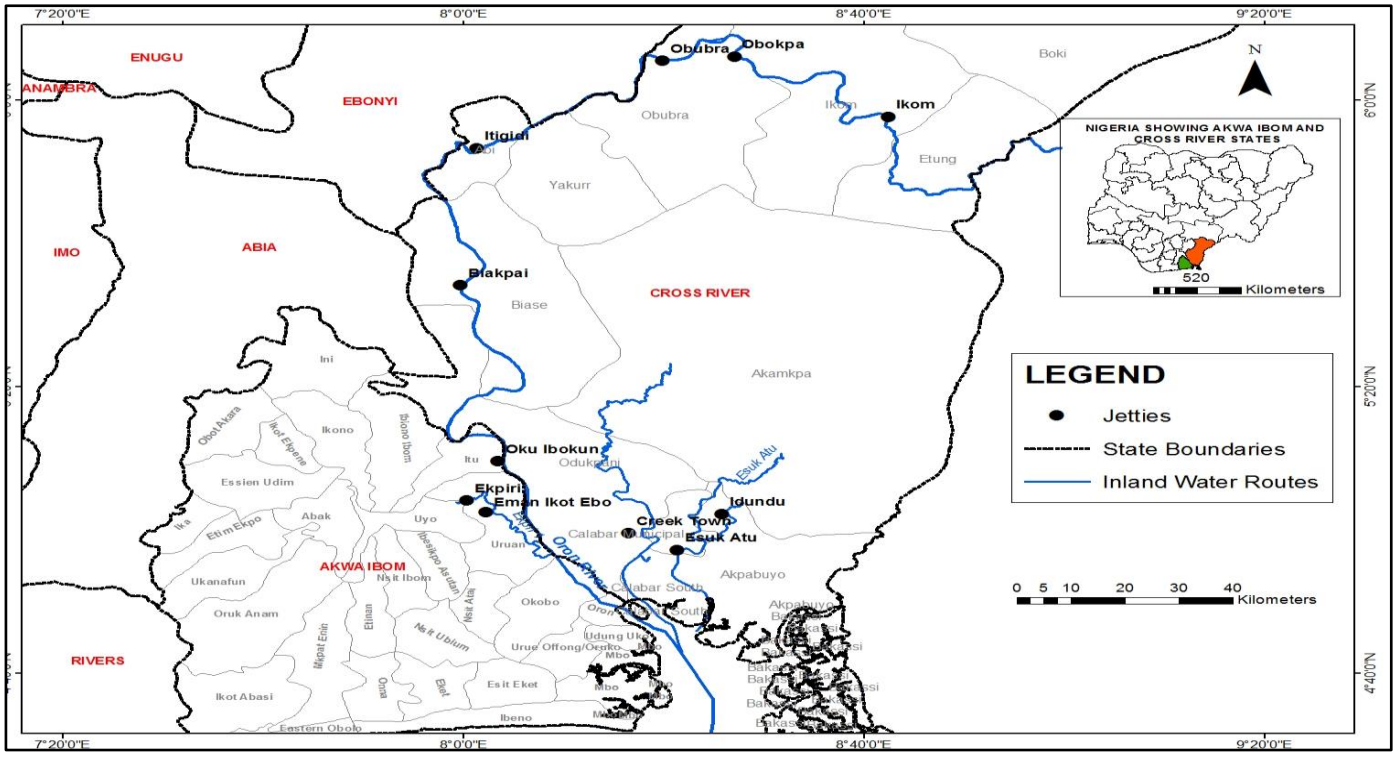

Figure 5: Cross River State River Routes

Research Question

How frequent is the occurrence of marine transportation incidences in various routes connecting the major sea ports in the study area between 1989 and 2018?

Research Hypothesis

In this study, the following hypothesis was put forward.

Ho: There is no statistically significant relationship between the length of the water route and the frequency of incidence along the route.

H_1: There is statistically significant relationship between the length of the water route and the frequency of incidence along the route.

III. Theoretical Framework

Accident / Loss Causation Theories

There exist many theories which seek to explain the causal factors of accident and the accident loss. The reason for many of the theories is to lay sound foundation for the understanding of the key accident causal factors, to enable application of control and management measures, to eliminate or reduce accident occurrence (Young *et al*., 2016). Haddon (2003) opines that accident theories support the valid opinions that accident are not always Acts of God and misfortunes to be suffered by people not at peace with gods, as believed until the 19th century when accident theory began to explain the causal factors of accidents. Thus, accident theories provide explanation for occurrences of accidental losses and lay basic foundational steps for effective accidental damage and loss control and management. Considering the volatile nature of the marine sector, building environment devoid of fear and recovery mechanism from upsurge of eventuality and capability to sustain certain level of performance is imminent. According to Awala and Hasegawaba, (2017), maritime accidents take place in a complex socio-technical context. In such accidents, a single root cause may be traced back in the cause-effect chain, but it is not enough for preventing similar accidents in the future. Maritime accidents have shocked the world every now and then, maritime accidents are quite in exhaustive as well as high casualties very grievous. Accident theories and models include statistical analysis and trends, risk analysis, domino theory and epidemiologic theory (Awala & Hasegawaba, 2017). Nwokedi *et al*. (2017) evaluated the economic loss of vessel-based marine accidents to Nigeria and the impact on marine transport sub-sector output and/or performance.

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IV. Results

Table 1 reveals that CMS- Apapa, Ebute-ero-Ikorodu, Ajah-Ikorodu, Ikorodu-Beshi, Badegry-Apapa, Ipakodo- Ikorodu, Ikorodu-Igbogbo has 11%, 10%, 9.3%, 8.9%, 8.5%, 8.4%. 6.4% and 6.0% respectively. The least value was 3% recorded in Takwa Bay-Ebute Ero. Fig. 6 showed the proportion of different frequency of incidences across the different river routes in Lagos state.

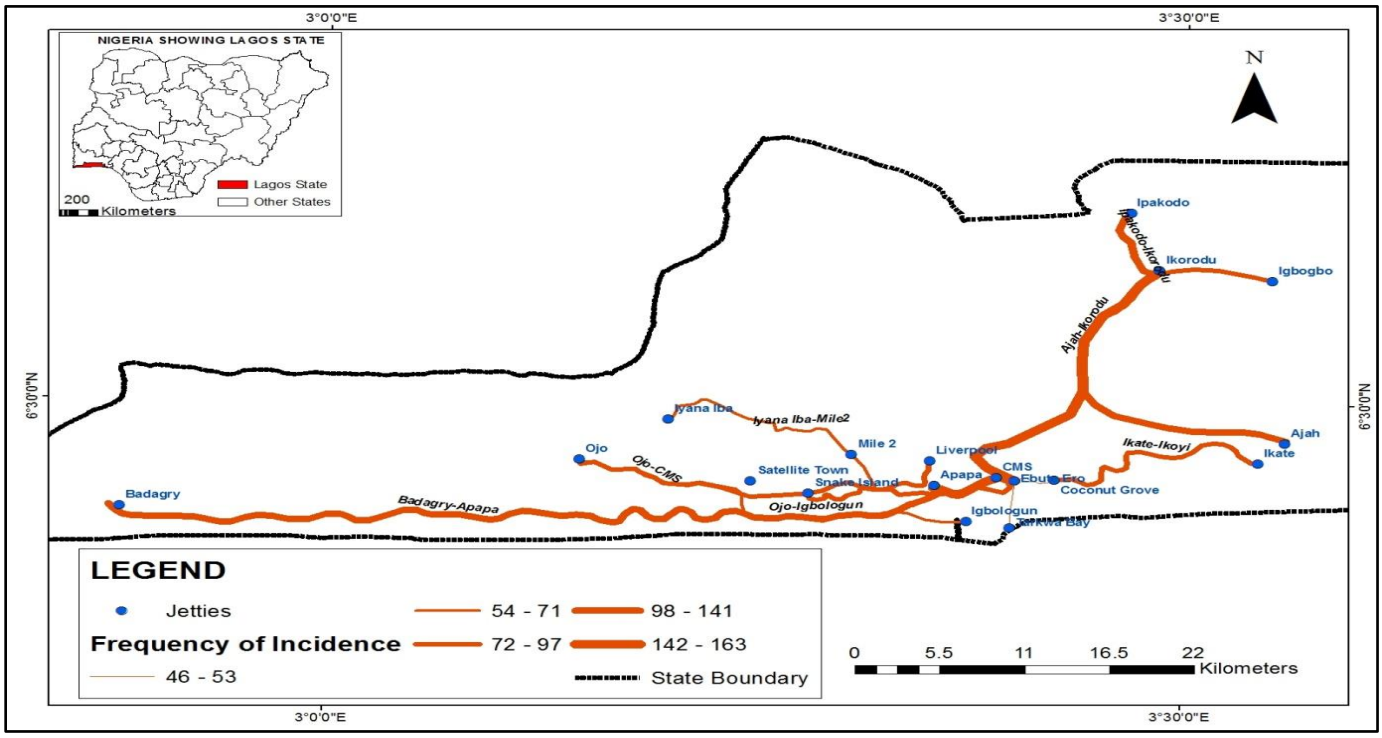

Fig. 6: Frequency of marine incidences in different river routes in Lagos State

Table 1: Frequency of Incidences and Length of River Routes in Lagos State

Name	Frequency	Percentage %	Length (m)
Badagry-Apapa	130	8.5	57686.62
Ojo-CMS	83	5.5	30838.91
CMS-Apapa	163	11	4865.40
Iyana Iba-Mile2	62	4.1	18432.34
Ojo-Igbologun	71	4.7	27575.10
Ajah-Ikorodu	141	9.3	26828.74
Coconut Grove-Snake Island	53	3.5	17463.54
Ikate-Ikoyi	86	5.7	17096.49
Liverpool-Snake Island	79	5.2	10914.60
Ipakodo-Ikorodu	128	8.4	6631.71
Ikorodu-Igbogbo	97	6.4	7697.24
Takwa Bay-Ebute Ero	46	3.0	4128.34
Ebute Ero-Ikorodu	154	10	25109.20

Sources: Marine Police Accident Report, Ikeja, Port Harcourt and Calabar (1989 – 2018) and Google Earth 2020

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Similarly, Fig.8 shows the frequency of incidences in various river routes in Lagos State

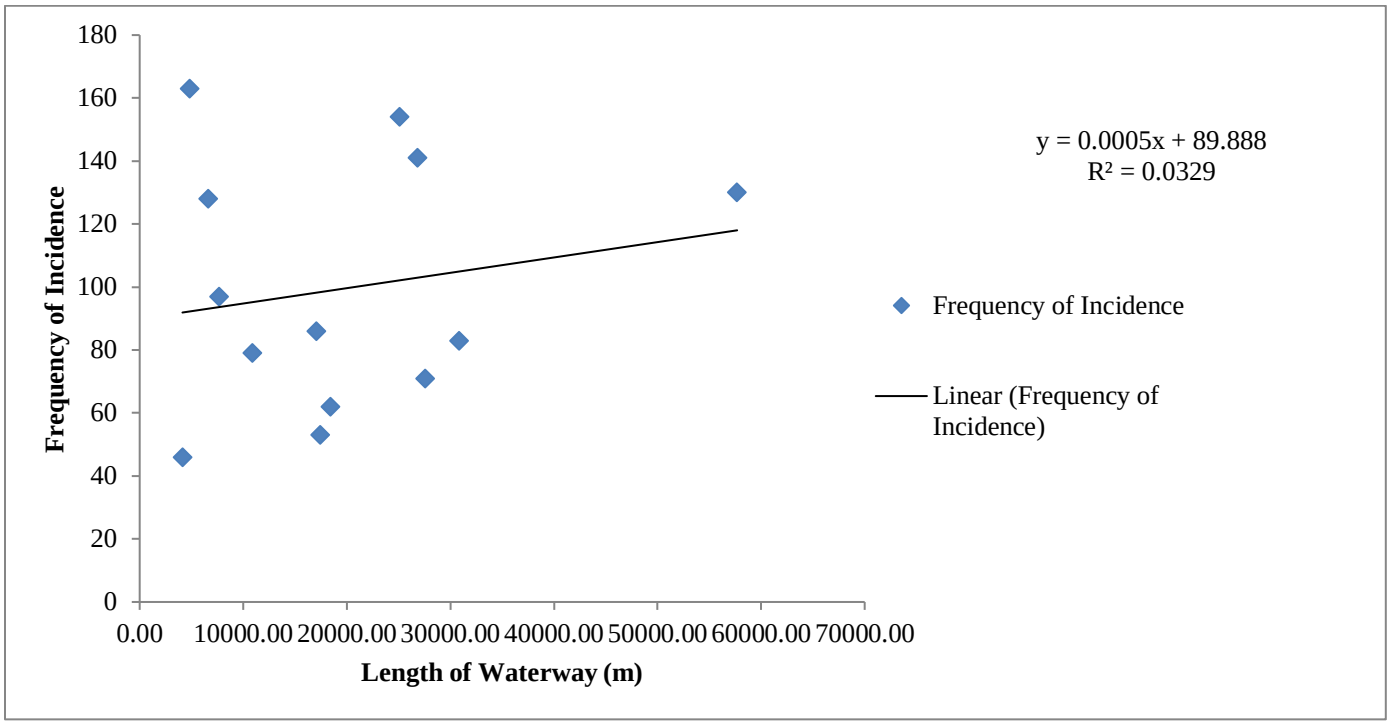

Fig 7: Scatter Diagram of Frequency of Marine Incidences in River Route in Lagos state

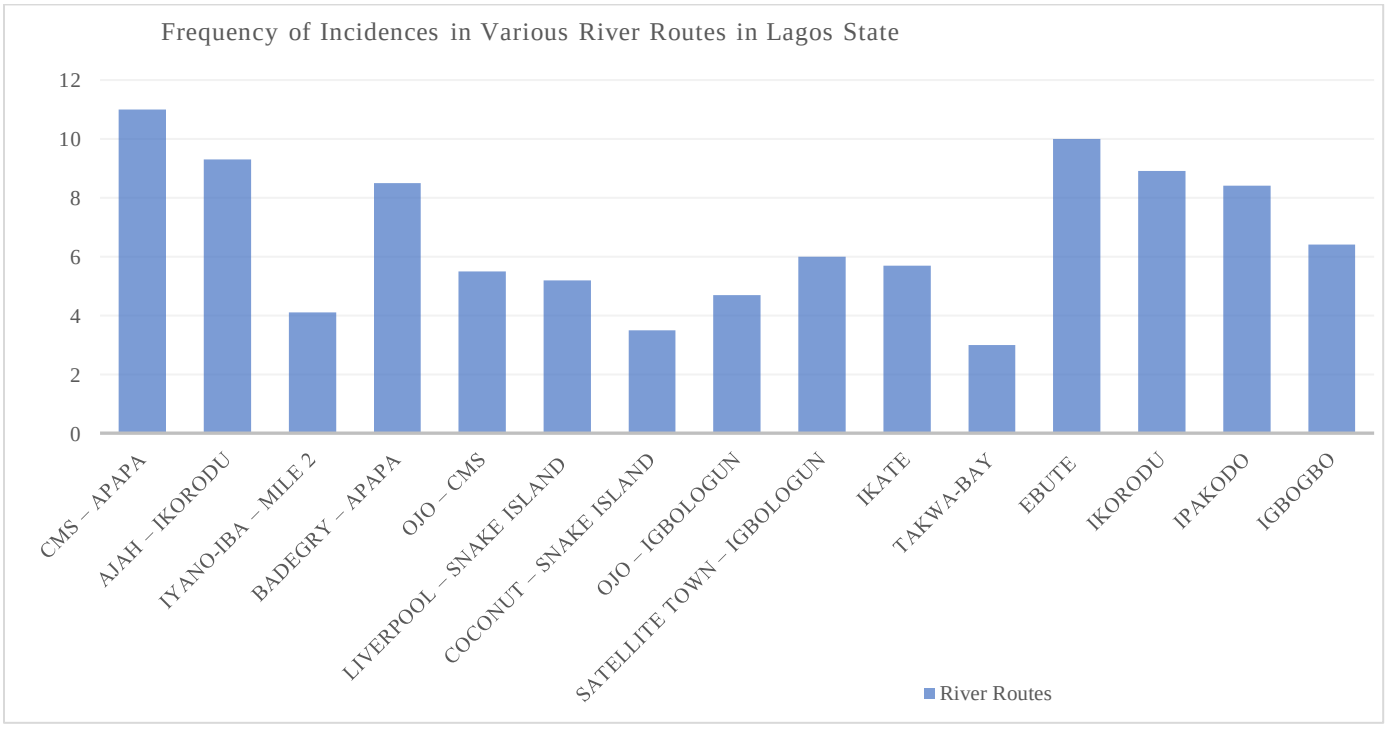

Fig. 8: Frequency of Incidences in Various River Routes in Lagos State

River routes in Rivers State (Table 2) showed that PH-Bonny has river craft accident of 13%. Others are Kono-Opobo/Ikot Abasi-12%, PH-Abonnema -8.5%, PH-Nembe -7.7%, PH-Brass -6.7%, Buguma-Bakana 5.6%, Marine base-Okirika – 5.3%, Akpos-Okujagu -5.1% and Iwofe-Ogbakiri -4.4%. Different proportion of frequency of incidences were also shown in Fig 9.

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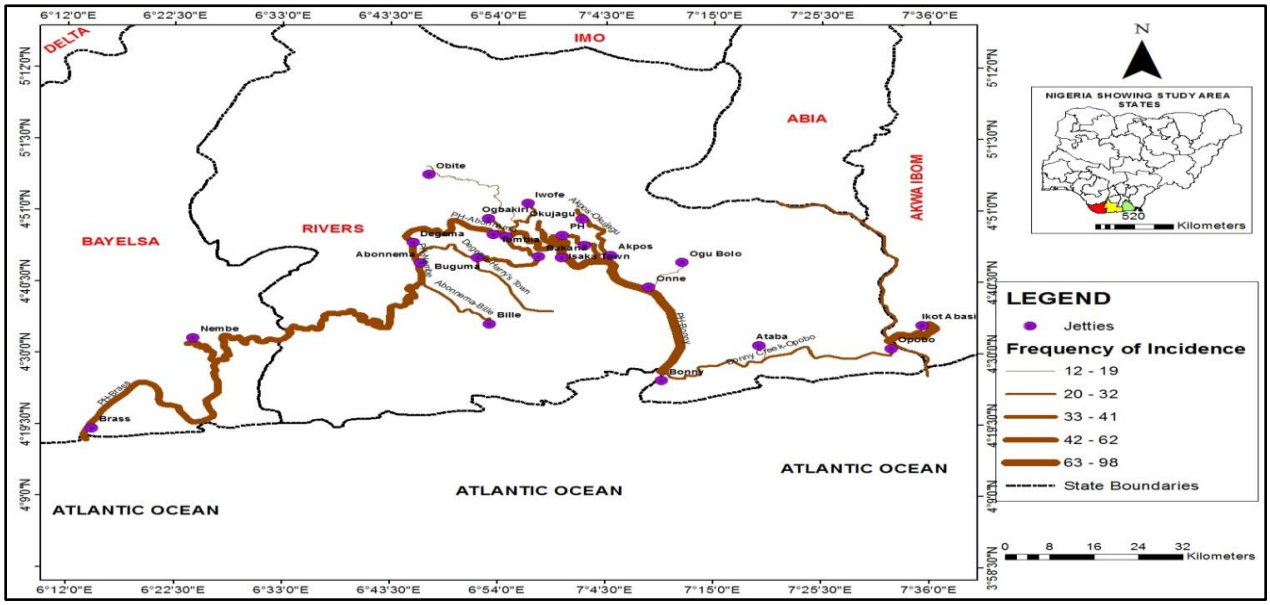

Fig. 9: Frequency of Marine Incidences in Different River Routes in Rivers State

Table 2: Frequency of Incidences and Length of River routes in Rivers State

Name	Frequency of Incidence	Percentage %	Length (m)
Degema-Harry's Town	21	2.9	37634.25
Ogbogoro – Isaka	12	1.6	31212.29
Iwofe-Ogbakiri	32	4.4	21162.61
PH-Abonnema	62	8.5	49638.56
PH-Nembe	56	7.7	143734.36
PH-Brass	49	6.7	188514.43
Akpos-Okujagu	37	5.1	17680.75
Marine Base Creek-Okrika	39	5.3	11819.80
PH-Bonny	98	13.5	53461.99
Opobo Creek-Kala Ibiama	29	4.0	69345.90
Kono-Opobo/Ikot Abasi	84	11.5	12840.47
Ataba-Opobo	13	1.8	33338.98
Buguma-Bakana	41	5.6	14361.70
Abonnema-Bille	25	3.4	24459.34
Abonnema-Bakana	27	3.7	29207.52
Bonny Creek-Opobo	22	3.0	55048.75
Iwofe-Tombia	38	5.2	22923.09
PH-Isaka Town	26	3.6	8183.28
Ogu Bolo-Onne	19	2.6	13414.13

Source: Marine Police Accident Report, Ikeja, PH and Calabar (1989-2018) and Google Earth 2020

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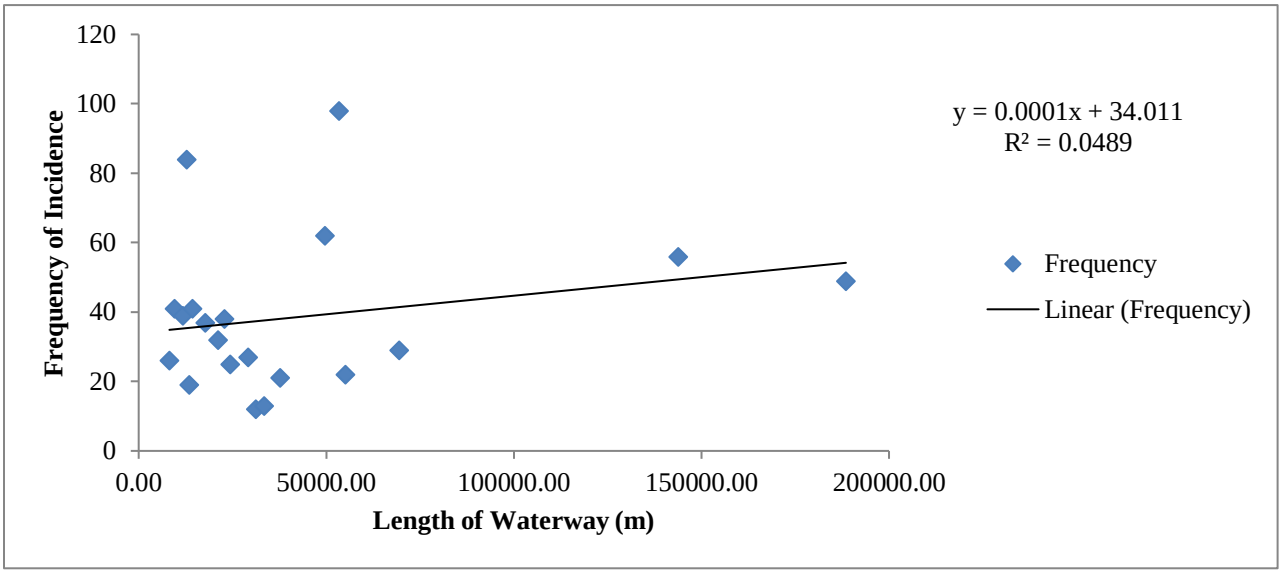

Fig.10: Scatter diagram of frequency of marine incidences in different river route in Rivers State

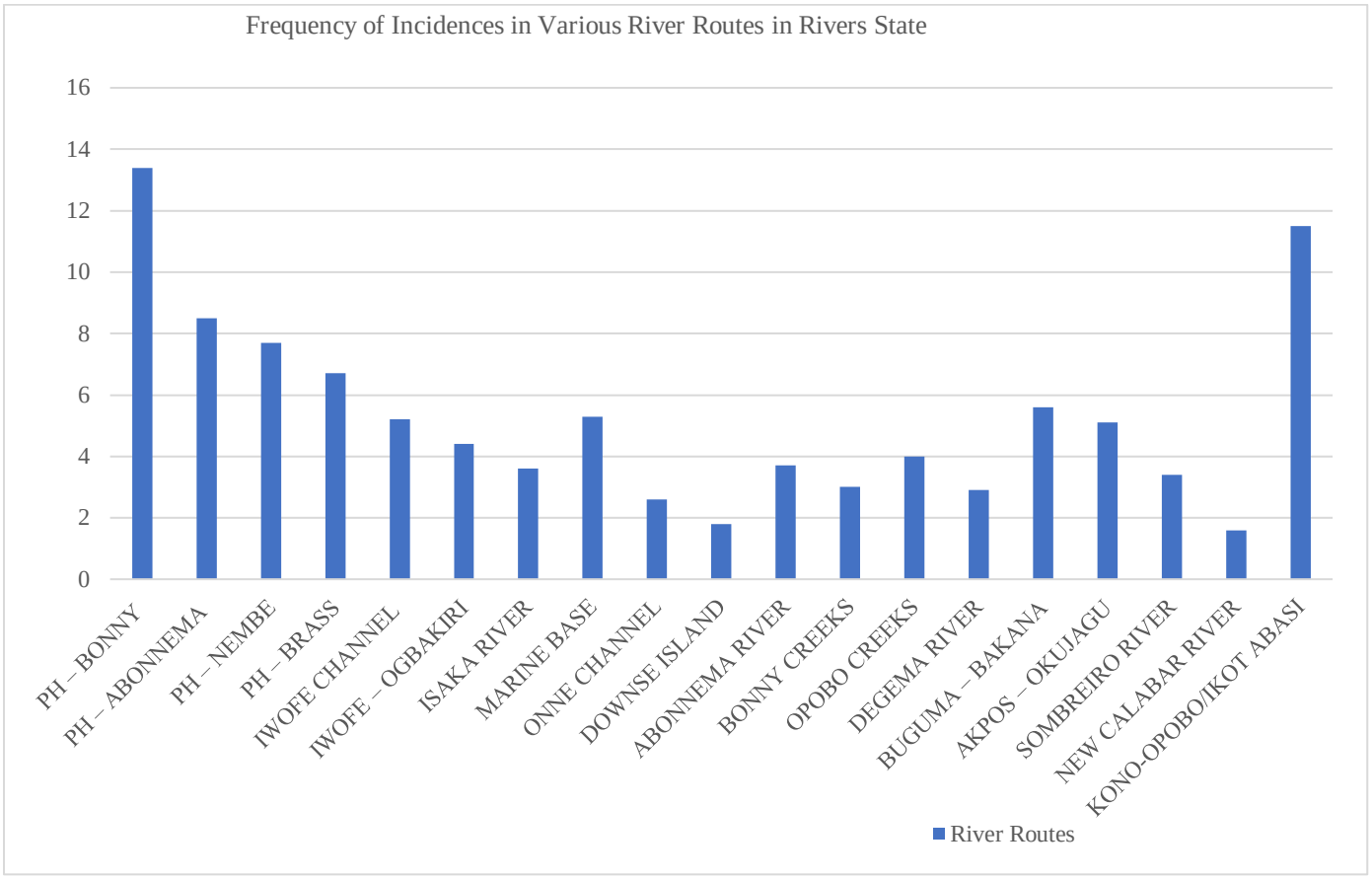

Fig. 11: Frequency of Incidences in Various River Routes in Rivers State

For Cross Rivers State, Table 3 showed the frequencies and percentage as fellows; Inland waterways – Itu 16.1%, Ekpri Ikang- Ine Ikoi 13.6%, Ikom- Itighidi 12.2%, Itighidi- Itu 11.1%, Idudung- Ekpere Esuk 11.0%, Adiabo- Oron 8.9%, Mbube- Ogurude 8.7% and Creek town-Ikang as 7.8%. Fig.12 shows the frequency of marine incidences in different river routes in Cross Rivers State.

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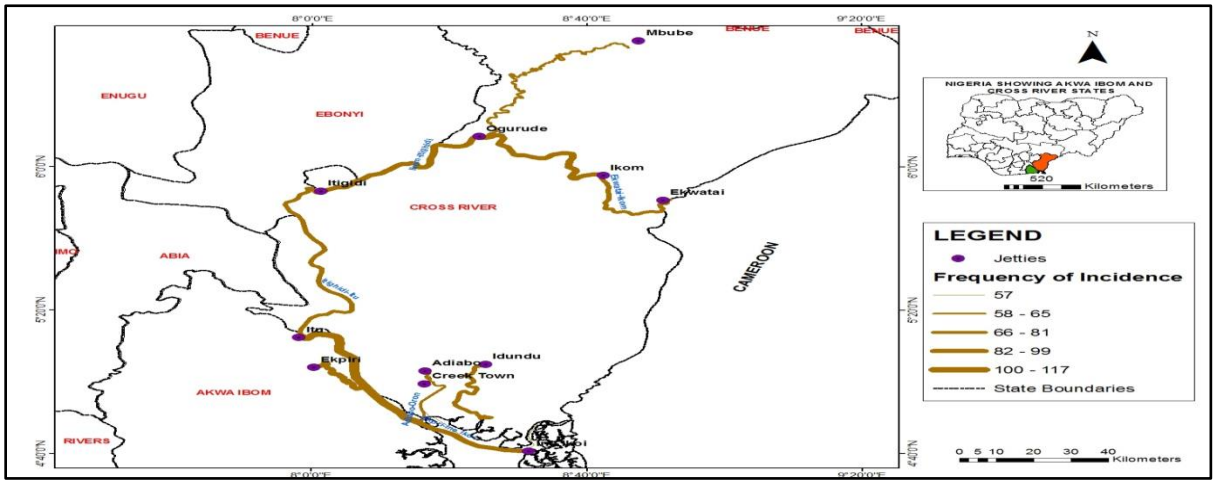

Fig.12: Frequency of Marine Incidences in Different River Routes in Cross Rivers State

Table 3: Frequency of Incidences and Length of River Routes in Cross Rivers State

Name	Frequency of Incidence	Percentage %	Length(m)
Ekwatai-Ikom	77	10.6	43956.82
Ikom-Itighidi	89	12.2	118663.78
Itighidi-Itu	81	11.1	103786.74
Itu-Oron (Inland Waterway)	117	16.1	62104.05
Ekpri-Ine Ikoi	99	13.6	83377.14
Adiabo-Oron	65	8.9	37151.38
Creek Town-Ikang	57	7.8	71848.19
Idundung-Ekpene Esuk	80	11.0	48934.08
Mbube-Ogurude	63	8.7	116131.84

Sources: Researchers field report (2019)

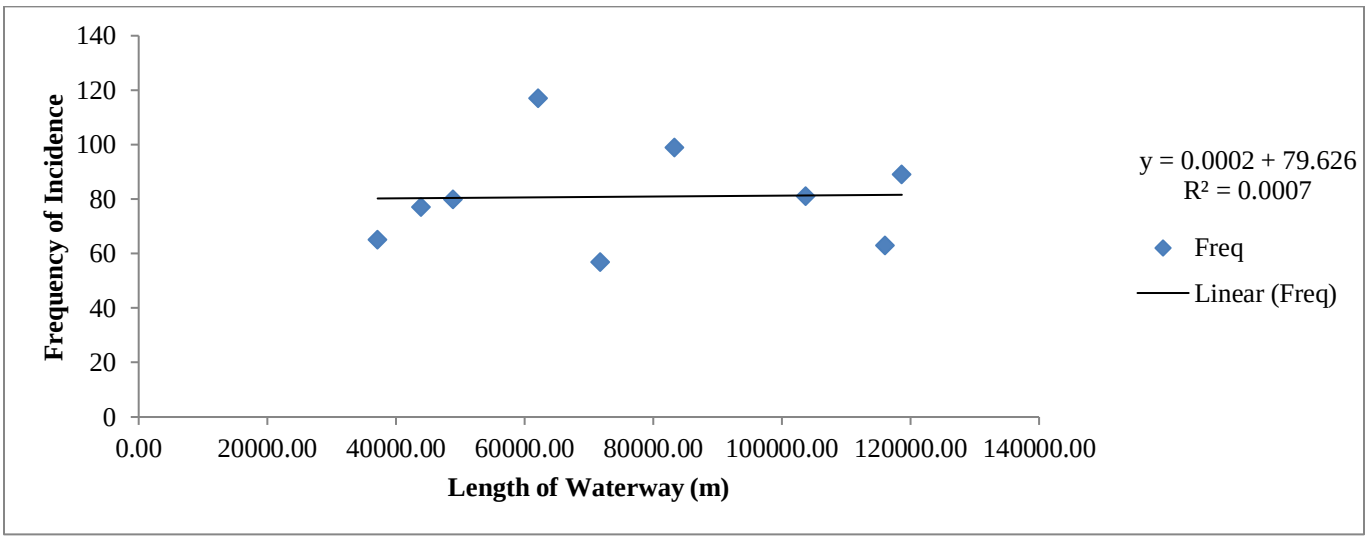

Fig. 13: Scatter diagram of Frequency of Marine Incidences in Cross Rivers Routes

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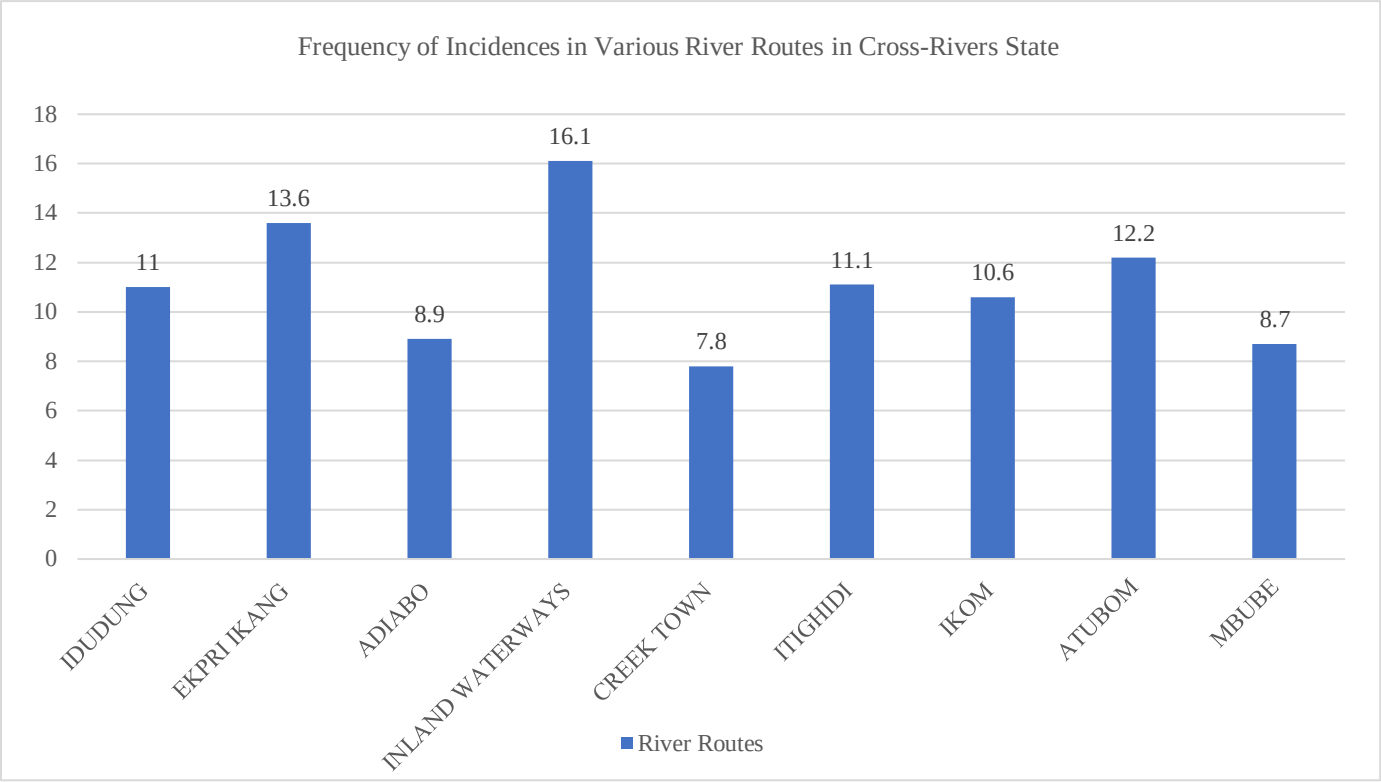

Fig. 14: Frequency of Incidences in Various River Routes in Cross Rivers State

V. Discussion of Findings

Study showed that zones with longer distances had higher frequency of incidence, however zones with shorter distance with commercial activities also had higher frequency of incidence occurrence owing to frequency of usage. The tourism sector which is one of the fastest growing sectors in Nigeria suffers greatly as some of the tourist attraction areas like Island and beaches are been accessed through water. The Banana Island, Snake Island and Bar Beach in Lagos are all major tourist attraction areas but increased marine accidents in these areas leading to loss of lives, dwindles the people's confidence to visit such places. At such affects the general output of the tourism sector of the economy (Ukoji & Ukoji, 2015). The frequency in the occurrence of marine transportation incidences in various routes connecting the major sea ports in the study area between 1989 and 2018 in Nigeria lies between 1.6% (Ogbogoro-Isaka route) and 13.5% (PH-Bonny) for Rivers route; 3.0 (Takwa Bay-Ebute Ero-11%) – 11.0% (CMS-Apapa) in Lagos route while Cross River State route had 7.8 (Creek town-Ikang) -16.1% (Itu-Oron inland waterway).

The scattered diagram analysis shows that there was a weak, negative linear relationship between frequency of incidence and length of the waterway as well as the coefficient of determination (r^2) which was 0.07% and histogram for the distribution of Cross River routes (Figures 13 and 14 respectively). This implies that only 0.07% of maritime transport incidences can be explained by the length of water routes in the study area. The scattered diagram analysis of frequency distribution of river route incidences in Rivers State showed that there was a strong positive linear relationship between frequency of incidence and length of the waterway. Study also showed that there is no land route to Bonny, Brass, Isaka, Okujagu, Bille, Tombia, Sangama, Kula, Bakana, Soku, Krakra-ama, Igbeboko, Ifoko, Oporo-ama, Ida-ama communities hence increasing the risk of river craft. The coefficient of determination (r^2) was 4.89% (Fig. 7). This implies that only 4.89% of maritime transport incidences can be explained by the length of water routes in the study area. The scatter diagrams and histogram for the frequency distributions in the Rivers State route as shown in Figures 10 and 11 respectively. The scattered diagram analysis shows that there was a positive linear relationship between frequency of incidence and length of the waterway. The coefficient of determination (r^2) was 3.29% (Fig. 7) which implies that only 3.29% of maritime transport incidences can be explained by the length of water routes in the study area.

The calculated value of F (Fcal.of 0.001) is less than the table value (P val., of 0.972). Based on this, it was established that there was no statistically significant relationship between the length of the water route and the frequency of incidence along the route. The frequency of incidence in various river routes connecting the major seaports in the study area shown in Table 3 reveals that areas with longer distance were found to be more prone to higher incidences when compared to short distance route. Communities such as Autbom, Ekpri Ikang, and Itighidi depends only on river route for accessibility hence prone to more incidences of marine

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accidents and fatalities. This could be due to mechanical fault, fatigue, stress, water turbulence and nature of the river route. However, small percentage of the incidence were also identified in proximity. This zones were largely occupied by commercial activities and dense population hence an increase in usage. Study also identified lack of land route to most of these destinations in Lagos State other than the river routes such as Takwa-Bay among others. The proximity scale where road transport does not exist are exorbitant. Most of the parameters leading to increasing river boat accidents includes poor visibility, narrow channel and sharp bends, inaccurate meanders and over-speeding accounts for the increasing river boat accidents. This was corroborated by Idiapho and Awwal (2020) on human factors assuming the most usual cause of mishaps as the study established that the major cause of boat accidents in Nigeria is human-related factors (67.21%) followed by natural factors (22.13%). Some researchers identified overloading, lack of efficiency, storm, inadequate navigational and radio equipment, unsafe river route, lack of monitoring, absence of exemplary trial and punishment as sources of marine incidences (Tosin, 2014). This was though classified differently as major causes of boat and ferry accidents in Nigeria were due to human factor errors, natural factors, and technical factors (Psaraftis *et al.*, 1998; Rothblum *et al*., 2002; Donatus, 2013; Idiapho & Awwal, 2020). This was explained further as human factors were due to overloading, over speeding, collision, night sailing without adequate light, grounding, overcrowding while natural factors investigated were sea condition (current), tides and tidal stream, severe wind, reduced visibility, stormy seas, darkness, rainstorms and waves (Tosin, 2014; Idiapho & Awwal, 2020). Technical factors include shortcomings within the ship, such as, steering failure, engine failure, corrosion or hull failure arising from defective materials or construction (Psaraftis *et al*., 1998; Idiapho & Awwal, 2020). However, for river routes in Rivers State, Port Harcourt-Bonny has the highest river-craft incidence of 13%. Study also shows that there is no land route to Bonny, Brass, Isaka, Okujagu communities and some communities in Abuloma town. This was also corroborated by Akpudo (2021) that the major cause of boat accidents in Nigeria is human-related factors (67.21%) followed by natural factors (22.13%). The study also indicated that passenger boats (52.46%) and Cargo boats (14.21%) are the highest boat types responsible for accidents in Nigeria waterways (Akpudo, 2021).

A few areas where road transport exist such as Opobo, Abonnema, Okrika, Ogu town just to mention but a few has a wide proximity scale by road transportation and its fare are extravagant hence placing river route transport on a priority scale (Idiapho & Awwal, 2020). In Cross River State, frequencies and percentage varied from one location to another. Ukoji and Ukoji (2015) posited that fatalities of boat mishaps are relatively very high with risks associated with water borne transportation. According to the findings of the study communities such as Autbom, Ekpri Ikang, and Itighidi depends only on river route for accessibility. Study also showed that all the neigbouring state has a major river route which were Benue, Ebonyi, Abia, Akwa-Ibom and Cameron. Michael (2005) reports showed that over 102 lives were lost when a ship capsize mid-River Jalingo River in Taraba State. Similarly, not less than 40 persons' lives were claimed by a boat capsized in the State, although both reports did not indicate accident hour of occurrences (Dogorawa, 2012). Abdullahi (2003) noted that human error had influencing factor in nautical and navigation of vessels. Egbuh (2006) found out that over 102 wrecks were located at 62 wreck sites within the ports of Lagos area and also another seven wrecks at Lagos bar which was approximately calculated cost of US$40 to be evacuated which may increase rate of boat mishap incidences. Similarly, 20 have also been reported of losing their lives along River Benue when the boat navigating at mid-night was attacked by turbulent current in 2007. This is in agreement with Dennis (2007) and Dogarawa (2012) that most of the problems leading to increasing river boat accidents are poor visibility, narrow channel and sharp bends, inaccurate meanders and over-speeding accounts for the increasing river boat accidents and their frequency of occurrence is very high.

VI. Conclusion and Recommendation

Conclusion

The research results asserts that incidence in various river routes connecting the major sea ports and river route incidence is dependent primarily on the population of the destination route and its frequency of usage. Although, other factors such as poor visibility, narrow channel and sharp bends, inaccurate meanders and over speeding increased its probability. Study also identified that several communities across the study area do not have alternative route except the river route hence increased the chance of boat mishap. These coastal communities includes; Lagos State-Takwa Bay Island, Rivers State - Bonny, Brass, Isaka, Okujagu, Bille, Tombia, Sangama, Kula, Bakana, Soku, Krakra-ama, Igbeboko, Ifoko, Oporo-ama, Ida-ama and Cross Rivers State-Ekpri Ikang, Atubom while areas with road transport exit suffer exorbitant fair and proximity challenges.

Conclusively, the incessant boat mishap that has characterized the various river routes in Nigeria are generally caused by over-speeding, narrow channels sharp bends, inaccurate meanders, poor visibility and poor bridge procedure and so forth has contributed to more than 85 percent of marine accidents occasioned by human factor. Similarly, there was no statistically significant relationship between the length of the water route and the frequency of incidence along the route.

In the re-evaluation process, river route accident may remain as predominantly as several communities do not have alternate route home hence training of more seafarers and other maritime related professionals should be considered by the Government in order to bridge the gap of inadequate trained personnel operation as well as linking coastal communities to functional coastal areas by

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road. There is a need for the adoption of radar technologies to monitor the sea for prompt information gathering, which will enhance rescue operation. There is need for training and retraining of boat drivers along each marine route to enhance efficiency and marine incidence reduction.

Recommendations

i. Security agencies in charge of maritime routes should be equipped with modern surveillance gadgets, combatant firearm, and warships to enhance maritime security and other response operations.
ii. There is a need for the adoption of radar technologies to monitor the sea for prompt information gathering, which will enhance rescue operation.
iii. There is need for training and retraining of boat drivers along each marine route to enhance efficiency and marine incidence reduction.

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