



Assessment of Associated Risks and Causal Factors of Passenger Vessels Mishaps Along Bonny Inland Waterways, Rivers State, Nigeria

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Abstract: Boat and ferry accidents are more prevalent than ever before in Nigeria due to water transportation exposure to various risk factors giving rise to need for continuous risk assessment and safety practice for minimization of mishap in the maritime industry. This study aimed at assessing vessels mishap risk factors along Bonny waterways in Rivers State, Nigeria. The Port Harcourt – Bonny – Bodo routes were purposively selected and 119 operators representing 40% of the target population were randomly drawn a total of 298 registered operators in the archive of Nigerian Inland Waterway Authority (NIWA). The study revealed that human factor (52.1%) is the most fundamental factor responsible for vessels mishaps along the waterways whereas overloading (48.7%), collision (24.4%) and over speeding (23.5%) are other leading causes mishap along the Bonny waterways. The result further shows type passenger boat (60.5%) were majorly involved in recorded mishap with fatal consequences (58.8%). The ANOVA test result shows that H_1 was rejected since ($P < 0.05$) and PR1 (0.068), PR3 (0.471), PR4 (0.060), PR5 (0.152), PR6 (0.676), PR7 (0.562), PR8 (0.317), PR9 (0.775) and PR10 (0.067) whereas H_1 was accepted at PR2 (0.041) since $p > 0.05$. It was concluded that Vessels are exposed to high risk level of hazards resulting in devastating consequences. Therefore, constant sensitization of stakeholders on the importance of safety, enforcement of safety rules and regulation, increased education and training of boat operators were recommended for urgent action.

Keywords: Assessment, Passenger vessels, Mishap, Risk factors, Jetties.

I. Introduction

Marine transportation is essential for the development of the world economy as it constitutes the main means of transporting goods and people from one location to another. It is the main means of trade while the shipping industry currently delivers over 90 % of all world trade and (Hyungju, et al., 2016). Due to the frequency of shipping activities, ship accidents have become a growing concern, because of consequences, which includes casualties, economic losses and various types of environmental pollution. The concept of marine accident is the occurrence of an event in a vessels/ship involving any equipment, investment and properties exposed to the marine environment, resulting to injuries to persons at sea or in port, and damage to the marine property or investment (Vouker, 2014). It encompasses accident in the sea or at port, quayside or anchorage, dockyards or shipyards etc. It is immaterial whether the vessel or object involved in accident is sailing or stationary at the

point and time of accident (Marine Accident Investigation Board [MAIB], 2008). According to (Akpudo, 2021; Lawal, 2012), boat and ferry accidents are more prevalent than ever before in Nigeria due to increased patronage of water transportation resulting in loss of unquantifiable numbers of lives and properties worth billions of Naira. However, Investigations into the causes of shipping accidents show that over 30 % of the accidents are caused by poor weather, and an additional 25 % remain completely unexplained Faulkner, (2004).

According to Obedi, (2013), these rivers and several others have been utilized for water transportation. As such, ocean, coastal water, and inland water transports are regarded as the three main components of water transportation in Nigeria. Heavy traffic is moved especially through the coastal waterways where speed is less important than cost. Different types of boats use to ply over coastal and the inland waterways of Nigeria like Cargo vessels, Passenger Launches and ferries, Fishing vessels and boats, oil tankers, steamers, trawlers, and other types of boats. Tons of agricultural products are transported from production areas to major industries in urban centers where they are processed through the waterways. This process incurs less cost and boosts the availability of commercial agricultural products in waterlogged areas.

Water transportation in Nigeria has suffered severe infrastructural and human capacity neglect, a situation that propelled boat mishaps and increased fatality rates all over the country. Agencies such as National Inland Waterways Authority (NIWA), NIWA saddled with the responsibility of managing the waterways have been underfunded and mismanaged. Equipment's deployed to monitor such waterways is obsolete and staffs are unequipped with the requisite skills to man the facilities. As a result of the inefficiency in management and personnel, many people in their productive years have been lost to boat mishaps and many goods lost in recent times (Akpudo & Stephens, 2020). The precarious nature of water transportation in Nigeria is not restricted to managerial inefficiency and manpower ineptitude, but the ignorance of boat riders and passengers in safety measures has proven to be worse. The passengers on the other hand fail to heed to safety measures and mostly prefer not to use life jackets during journeys. Since accidents are not usually caused by a single failure or mistake, but by cumulative action of a whole series of errors, it is against this background that this study aims at an assessment of the spatial pattern of sea going vessels mishap along Bonny inland waterway of Nigeria.

II. Materials and Methods

The survey research design was adopted in this study as it is a specific type of field study that involves the collection of data from a sample of elements drawn from a well-defined population through the use of a questionnaire (Krosnick & Lavrakas, 2013). Bonny Island is an industrial town in Niger Delta region of Nigeria. It is situated about 40 km south-east of Port Harcourt in Rivers State, Nigeria and geographically located roughly between 4° 24' North, 7° 11' East and South of the inter-tropical convergence zone (ITCZ) (Digha & Okibe, 2016). Bonny Island is a Town and a Local Government Area in Rivers State and comprises of several towns and villages which include Ogumabie, Ligakiri, Gbolokiri, Adamakiri, Otutunbi, Wasakiri, Otokolomabie, and Kuruama. It covers a total area of 646 square kilometres and features two distinct seasons which are the rainy and the dry seasons with an average temperature of 25°C while the humidity level of the area is pegged at 92%.

The three major routes of Bonny waterway (Port Harcourt-Bonny-Bodo) were purposively selected for the study while the target population for this study comprises of a total of Two Hundred and Ninety Eight registered boat operators with a sample size of 119 respondents representing 40% of the study population randomly drawn in alignment with the opinion of Nwana (1981) cited in Adekeye & Apeh (2019) whereas it suggested that 40% sample size is adequate where the population of study is a few hundreds. The formulated research hypothesis stating that there is no statistically significant variation of mishap risk factors across the study area was tested with Analysis of variance (ANOVA) at 95% level of significance as a statistical technique which allows for exploring the statistically significant variation between more than two sets of variances.

Table 1: Sample Size for the Study

Routes	Jetties	Boat Operators	Sample Size
PH – Bonny	Marine Base	122	49

Bonny- Bodo – PH	Bonny Island	100	40
Bodo –Bonny	Bodo	76	30
Total		298	119

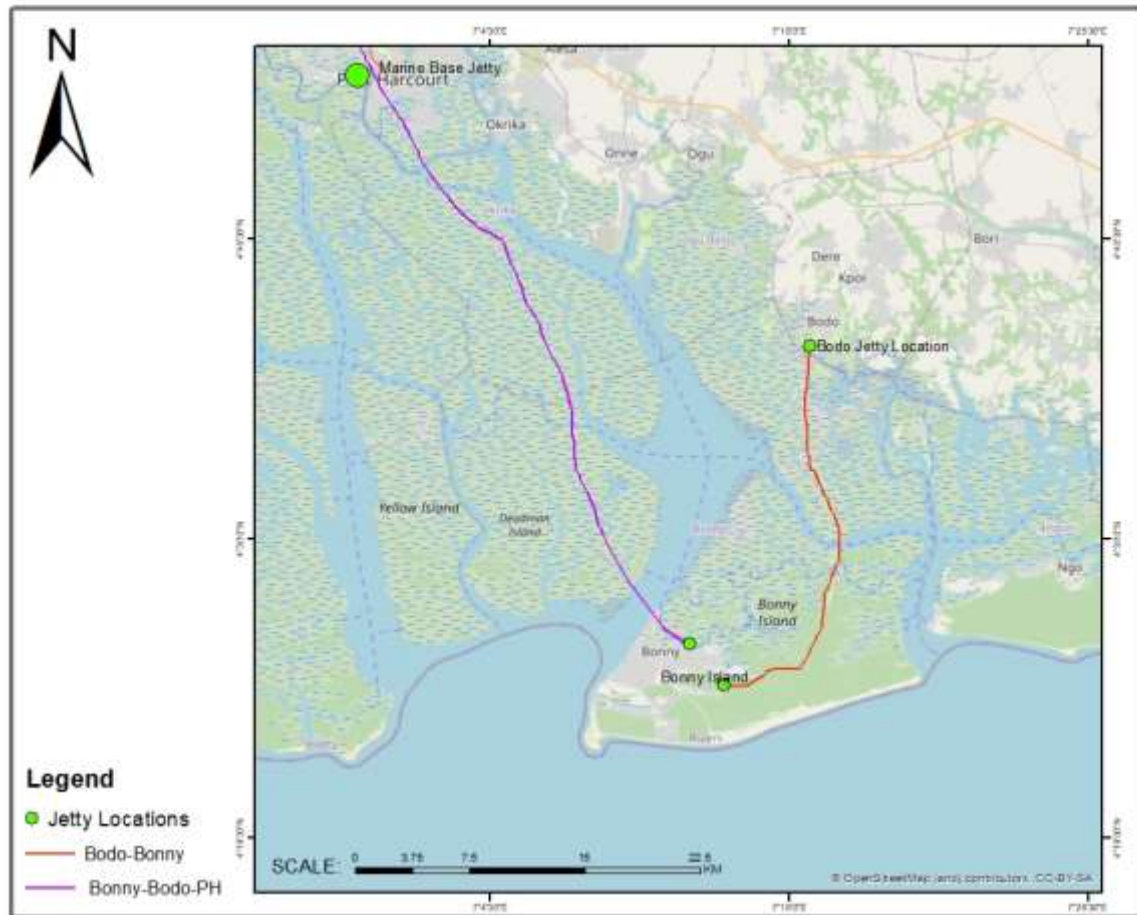


Figure 1: Study Area

Table 2: Socio-Demographic Characteristics of the Respondents

Variable	Frequency (n=119)	Percentage (%)
Gender		
Male	108	90.8
Female	11	9.2
Age (years)		
18- 35	48	40.3
36-50	61	51.3
51-65	7	5.9
Above 65	3	2.5
Educational Qualification		
None	18	15.1
Primary	45	37.8
Secondary	38	31.9
Tertiary	18	15.1
Marital Status		
Single	38	31.9
Married	72	60.5

Divorced	2	1.7
Widowed	7	5.9
Working Experience		
Less than 1year	28	23.5
2-4years	42	35.3
5-7years	23	19.3
8-10years	14	11.8
Above 10 years	12	10.1
Responsibility at the Jetty		
Official (Regulator) for NIWA	20	16.8
Boat Operators	60	50.4
Official (Regulator) for LGA	16	13.4
Boat Makers/Repairer	14	11.8
Others	9	7.6
Type of Boat Operating at the Jetties		
Utility-Fibre Boat	17	14.3
Wooden Boats/Ferries	46	38.7
Motorized-Larger Power Boats	29	24.4
Motorized-Medium Power Boats	24	20.2
Others	3	2.5

The demographic characteristic of the respondents is presented in Table 2 and the analysis revealed that 90.8% of the respondents were male whereas only 9.2% were found be female. On the other hand, it was also observed that the respondents within the age range of 36-50years (51.3%) while those within the age bracket of 18-35 (40.3%) suggesting that over 90% of the respondents were within their economic viable age. In terms of educational qualification, it was clearly revealed from the table that only 15.1% of the respondents were privileged have higher educational qualification whereas most of the respondents possessed primary level of education (37.8%), secondary education (31.9%). However, the purpose of the study was explained to them and properly guided in the filling of the questionnaire. Furthermore, a significant proportion of the respondents are married (60.5%) and majority of them are boat operators (50.4%) and the highest working experience revealed at the various jetties is 2-4 years (35.3%) while the most common type of boat operating at the jetties are wooden boat/ferries (38.7%).

Table 3: Types/Factors Responsible for Vessel Mishaps along Bonny Waterways

Variable	Frequency (n=119)	Percentage (%)
Nature of Vessel Mishaps		
Human Factors	62	52.1
Natural Factors	30	25.2
Mechanical Factors	27	22.7
Human Factors of Vessel Mishaps		
Collision	29	24.4
Overloading	58	48.7
Over-speeding	28	23.5
Piracy	4	3.4
Natural Factors of Vessel Mishaps		
Flooding	17	14.3
Poor Visibility	35	29.4
Shallow Draught	14	11.8
Storm/Wind	35	29.4

Underwater Debris	9	7.6
Stability Failure	9	7.6
Mechanical Factors of Vessel Mishaps		
Engine Malfunction	59	49.6
Fire Explosion	20	16.8
Navigator Failure	17	14.3
Equipment Failure	23	19.3
Types of Vessels involve in Mishaps		
Passenger Boat	72	60.5
Cargo Boat	15	12.6
Oil Tanker	17	14.3
Fishing Boat	15	12.6
Consequence of the Vessels Mishaps		
Fatal	70	58.8
Non-Fatal	22	18.5
Damage	27	22.7

The respondents view on the nature and types of vessel mishaps along the Bonny waterway is shown in Table and it revealed that the nature of vessels mishap along the Bonny waterways is categorized into three (3) major sub-groups namely: human factors (52.1%), natural factor (25.2%) while the least is mechanical factors (22.7%). The most common human factor responsible for vessel mishaps along the route is overloading (48.7%) while piracy (3.4%) was the least amongst the human factors. On the other hand, while poor visibility (29.4%) and storm/wind (29.4%) were listed as the major common natural factors of vessel mishaps along the route, underwater debris (7.6%) and stability failure (7.6%) were the least factors in this category. On the part of mechanical factors of vessel mishaps along Bonny waterway, it was noted that engine malfunction (49.6%) was the highest while the least factor was navigation failure (14.3%). Considering the type of vessels involve in the mishaps, the table shows that most of the vessels are passenger boat (60.5%) while the least vessels are cargo boat (12.6%) and fishing boat (12.6%) and the consequences of the mishaps is mostly fatal (58.8%) and the least is non-fatal (18.5%).

Table 4: Risk Factor Associated with Sea Going Vessels Operations

No	Variables	Disagreed N (%)	Neutral N (%)	Agreed N (%)	Total N (%)
1	Non adherence to safety standard	6 (5.1)	38 (31.9)	75 (63.0)	119 (100)
2	Safety is in God's hands	19 (16.0)	37 (31.1)	63 (52.9)	119 (100)
3	Operators not wearing Lifejacket	27 (22.7)	14 (11.8)	78 (65.6)	119 (100)
4	No enforcement of safety rules	32 (26.9)	17 (14.3)	70 (58.8)	119 (100)
5	Ignorance	20 (16.8)	16 (13.4)	73 (69.7)	119 (100)
6	Ignorance of safety importance	27 (22.6)	13 (10.9)	79 (66.4)	119 (100)
7	Commercial pressure	45 (37.8)	15 (12.6)	59 (49.5)	119 (100)
8	Poor safety attitude of boat users	39 (32.7)	19 (16.0)	61 (51.2)	119 (100)
9	Poor maintenance culture	25 (21.0)	20 (16.8)	74 (62.2)	119 (100)
10	Lack of life saving equipment	27 (22.7)	11 (9.2)	81 (68.1)	119 (100)

Table 4 show the respondent's opinion on the perceived risk factor associated with sea going vessels operations along Bonny waterways and the outcome of the analysis revealed that the respondents agreed with PR1 (63.0%),

PR2 (52.9%), PR3 (65.6%), PR4 (58.8%), PR5 (69.7%), PR6 (66.4%), PR7 (49.5%), PR8 (51.2%), PR9 (62.2%) and PR10 (68.1%) as the fundamental risk factor responsible for mishap along the Bonny waterways

Table 5: Tests of Significance Variation in perceived risk

Perceive Risk Associated with Sea Going Vessels Operations		Sum of Squares	df	Mean Square	F	Sig	Decision
PR1	Between Groups	5.027	2	2.514	2.744	0.068	H ₁ Rejected
	Within Groups	106.267	116	.916			
	Total	111.294	118				
PR2	Between Groups	8.332	2	4.166	3.289	0.041	H ₁ Accepted
	Within Groups	146.945	116	1.267			
	Total	155.277	118				
PR3	Between Groups	2.614	2	1.307	.759	0.471	H ₁ Rejected
	Within Groups	199.823	116	1.723			
	Total	202.437	118				
PR4	Between Groups	10.655	2	5.327	2.883	0.060	H ₁ Rejected
	Within Groups	214.337	116	1.848			
	Total	224.992	118				
PR5	Between Groups	6.204	2	3.102	1.917	0.152	H ₁ Rejected
	Within Groups	187.729	116	1.618			
	Total	193.933	118				
PR6	Between Groups	1.360	2	.680	.393	0.676	H ₁ Rejected
	Within Groups	200.859	116	1.732			
	Total	202.218	118				
PR7	Between Groups	2.524	2	1.262	.580	0.562	H ₁ Rejected
	Within Groups	252.585	116	2.177			
	Total	255.109	118				
PR8	Between Groups	4.331	2	2.165	1.162	0.317	H ₁ Rejected
	Within Groups	216.241	116	1.864			
	Total	220.571	118				
PR9	Between Groups	.732	2	.366	.256	0.775	H ₁ Rejected
	Within Groups	165.823	116	1.430			
	Total	166.555	118				
PR10	Between Groups	7.989	2	3.994	2.762	0.067	H ₁ Rejected
	Within Groups	167.742	116	1.446			
	Total	175.731	118				

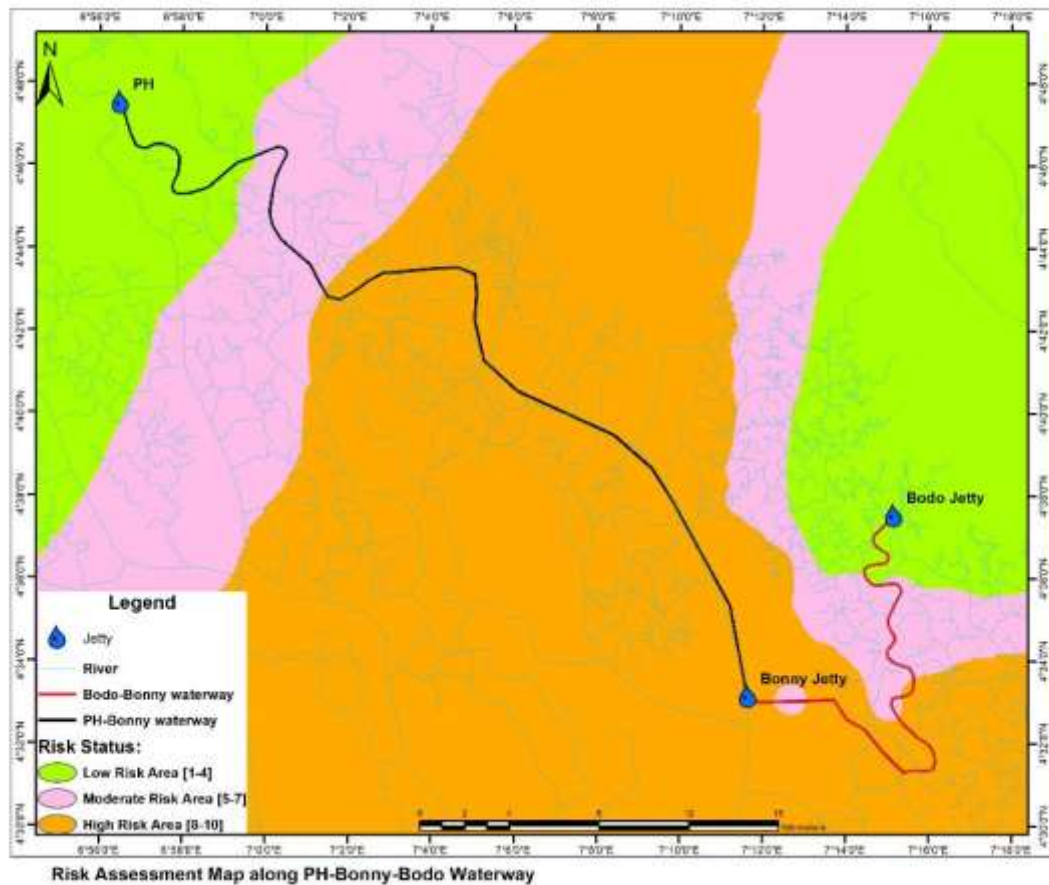


Figure 2: Vessel Mishaps Risk along Bonny Waterways

III. Results and Discussion

The study revealed that human, natural and mechanical factors respectively contributed mostly to vessels mishaps along the waterways. According to the study, the major human factors which contribute to the mishaps along the water are overloading, collision and over speeding. Overloading causes imbalance of the vessels leading to capsizing while collision can be influenced by poor visibility. Among the natural factors which cause vessel mishaps; poor visibility and storm/wind were at the forefront while engine malfunction and equipment failure were observed as the most common mechanical factors of vessels mishaps. The type of vessel involved in mishaps indicated passenger boat was more involved than other types of vessels and the consequences of the mishaps were fatal indicating loss of lives through drowning. The result showed similarity with study conducted by Akpudo (2021) which indicated human-related factors as leading cause of boat accidents and most boats were passenger boat. Similarly, it corroborates with Ukoji & Ukoji (2015) who asserted that human are natural factors are fundamental causes of boat accidents and such factors include overloading, careless driving, piracy, turbulent weather and wreckages. According to Njoku (2021), about 75-96% of sea casualties are caused by some form of human error and lack of life-saving appliance couple with unsafe practice by both commuters and operators (Anyanwu, 2014; Njoku, 2021) and that such lead to destruction of properties, injuries and loss of life in form of drowning. In alignment, Fubara *et al.* (2020) opined that boat mishaps can lead to loss of property, resources, life and cause environmental pollution. Akpudo (2021) analyzed the boat accidents data from 2010 to 2021 and revealed that the highest number of fatalities was recorded in 2021 while the major cause of boat accidents in Nigeria as established by the study was human-related factors (67.21%) followed by natural factors (22.13%). The study further indicates that passenger boats (52.46%) and Cargo boats (14.21%) are the highest boat types responsible for accidents in Nigeria waterways. According to Mia *et al.* (2021) in a similar study in Bangladesh revealed that most of the accidents and casualties are caused by collision among the vessels whereas

half of the accidents are caused by the cargo ships and trawlers. In related development, Uddin *et al.* (2017) analyzed the inland waterway accidents between 2005 to 2015 and found that the major cause of inland waterway accidents for the period of investigated is collision. It was also revealed that cargo vessels are the dominant types of vessels in maritime accidents, and almost 45% of the vessels foundered after the accidents whereas in an investigation by Probha (2017) affirmed that passenger vessels accounted for the highest percentage (37%) of accidents in inland waterways of Bangladesh during the period of 2008 to 2015. According to Pitman *et al.* (2018) analyzed the lifejacket wear, environmental factors, and casualty activity on marine accident fatality rates to better understand causation of drowning and what makes an incident at sea high risk. From the account of Poisson model applied to numerous factors recorded as part of each rescue, including environmental conditions (visibility, sea state, etc.), lifejacket wear, and response times for rescue, increased lifejacket wear significantly correlated with lower fatality rates across all spectrums of activities while survivability among those casualties wearing life jackets was found to be 94 % which is a clear evidence that increased lifejacket wear among coastal and marine users would have a dramatic effect on reducing the number of drowning related deaths each year. Additionally, Puisa, Lin, Bolbot & Vassalos (2018) unravelled the causal factors of maritime incidents and accidents and noted that accidents is limited to direct contributing causal factors without proper explanation of a wider socio-technical context responsible for the rise in causal mechanisms of major maritime accidents in recent years is left unexplained.

It is obvious that most of the mishaps along the Bonny waters is caused by the risk factors identified in this study as indicated in Table 4. According to Onwuegbuchunam (2013), the key to preventing marine vessel accident caused by human related factors or others is to identify the types of risk factors, and then apply relevant intervention to check those factors in the future. Furthermore, many operators undertake such efforts internally, and the IMO and industry trade groups have also made significant advances in developing prevention programs that address human factors. Nevertheless, there is room for improvement, both in terms of preventive initiatives and the metrics used to gauge their effectiveness (Onwuegbuchunam, 2013).

IV. Conclusion and Recommendations

Vessels are seen to be exposed to high risk level of hazards resulting to fatality, vessel destruction, environmental pollution, financial loss to both, the vessels owner and the nearby local communities, loss of job, infrastructure damage, explosion, injury and deaths among others. Therefore, evaluating the risk of accidents at sea is fundamental and requires utmost attention by stakeholders including the maritime industry, government, IMO to take necessary action so that from the design to the operation stage these risks are properly taken into account and addressed. Recommendations such as constant sensitization of all stakeholders (commuters, operators and regulators) on the importance of safety, increased education and training of boat operators, effective implementation of safety rules and regulations by relevant authorities, provision of advanced technology systems and life saving equipment were proposed for minimization of maritime disasters on passenger vessels.

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