



MANAGEMENT OF SHIPWRECKS IN RIVERS AND ONNE PORT COMPLEXES OF RIVERS STATE

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Abstract

Shipwrecks present significant ecological, economic, and safety challenges, particularly in maritime regions with high shipping activity. This study investigated the management of shipwrecks in Nigeria's waterways, focusing on the risks they pose to the environment, marine safety, and coastal communities. It also explored the effectiveness of existing technologies, international cooperation, and local policies aimed at managing these wrecks. A quantitative research method using questionnaire and purposive sampling technique, was used to collect data from 12 key maritime stakeholders from the Ports in Rivers State. Findings from the study respondents revealed that abandoned shipwrecks obstructed shipping lanes (66.7%), damaged fishing gear (91.6%), pose environmental hazards, and are potential hubs for illegal activities. Available technologies for managing shipwrecks include Sonar and acoustic sensors (100%), Remote Operated Vehicles (ROVs, 66.7%), Diving and underwater exploration technologies (91.7%). The research underscores the importance of robust local and international public-private partnerships and collaborations, training and capacity-building programmes, Technology transfer and knowledge

sharing amongst others for shipwreck assessment and management, and to mitigate the associated risks. The need for improved regulatory frameworks, stakeholder engagement, and technological advancements for effective shipwreck management in Nigeria have been highlighted.

Keywords: Shipwreck, Marine Pollution, Risk Assessment, Marine Environmental Hazards, Salvage operations

1.0: INTRODUCTION

Shipwrecks represent a significant issue in maritime contexts, defined as the abandonment, sinking, or grounding of vessels in navigable waters such as rivers, seas, or harbors. In the Nigerian context, particularly in Rivers State, the prevalence of shipwrecks poses critical challenges to navigation safety, environmental protection, and economic development. Nigeria's waters have become a dumping ground for abandoned and derelict vessels and the people living on the coastline say the unserviceable vessels abandoned by local and international shipping companies are making their lives hard. The issue is so complicated that NIMASA has produced an 8-page document, dealing with problem vessels and structures to the coastal waters in Nigeria, as well as the much more detailed technical staff guide on the problem of the removal of vessels and structures (Elenwo and Akankali, 2015). In spite the Federal government contract for the removal of shipwrecks in Nigerian waterways (Ofurumazi et al. 2023), and the low level of shipping activities a number of shipwrecks subsist in the surrounding waterways of the Rivers Ports. Marine pollution from sunken vessels is predicted to reach its highest level this decade, with over 8,500 shipwrecks at risk of leaking approximately 6 billion gallons of oil (IUCN, 2023).

In the last decades, the sea has become the centre of attention as a result of environmental hazards from marine pollutants in the maritime environment (Abowei *et al.*, 2011). Lately, plastic has gathered all this attention due to two principal reasons. The first factor refers to the enormous quantity of this material in the sea: more than 5.25 trillion plastic particles – approximately, 268,940t (Eriksen et al., 2014). The second factor relate to rapid energy revolution which has driven transportation in the maritime industry. In the 1940s, diesel replaced coal as the energy source, furthering the development of the shipping industry (Harlaftis, 2020). Today, the volume of cargo transported by ships has increased sharply to more than 90%

(Abowei *et al.*, 2011; Liu et al., 2021). However, this rapid developments and revolution over the last couple decades in the transportation of cargos to facilitate global trade through the world's maritime industry has posed huge ecological threats to the marine environment around the world. For this reason, the International Maritime Organization, world governments, and associated monitoring agencies must work together to prevent pollution and develop international standards to guide actions and prioritize resources. However, inadequate data and international cooperation implies that action may come too late to prevent serious harm to communities, coastal economies, wildlife populations, and ecosystems.

In Nigeria, regulatory institutions such as the Nigerian Port Authority (NPA) and Nigerian Maritime Administration and Safety Agency (NIMASA) have been put in place to respond to all matters dealing with maritime security and the protection of marine resources. In the Lagos and Bonny pilotage areas, channel management companies, under a Joint Venture arrangement with the Nigerian Port Authority, ensure that wrecks are removed to keep the channels as wreck-free as possible (Abdulkadir & Mashood, 2021). Against the backdrop of public concern and need for mitigating policies, the shipping industry has strived actively to curtail the negative environmental effects arising from the shipping sector (Helen et al., 2016). For now, it is not clear how shipwrecks affect human activities and the environment, the effectiveness of actions taken to remove shipwrecks in the Rivers port complexes and the technologies available for the management of shipwreck in the area, hence the need for this study.

Findings from this research will contribute data to maritime knowledge on management of shipwrecks in Nigeria and the need for improved regulatory guidelines and procedures are expected to be brought to fore in this research. It is hoped that this will further serve as a significant help to NIMASA in developing new guidelines for the management of shipwrecks in the Nigeria maritime waterways. Finally, this research will show the successful impacts of cooperation between government, local communities and international organizations in the management of shipwrecks and the conservation of the marine environment in Nigeria.

The aim of this research is to seek ways to manage the incidents on Shipwrecks in Rivers and ONNE ports all in Nigeria. The specific objectives are to:

1. Assess the risks associated with shipwrecks operations in Rivers and Onne ports in Nigeria.
2. Determine how international and local co-operations and communications can be improved to respond more effectively in Rivers and Onne ports in Nigeria.
3. Assess available technologies on locating shipwreck operations in Rivers and Onne ports in Nigeria.

2.0: MATERIALS AND METHODS

2.1: The Study Area

The seaports in Rivers State, including Rivers Port Complex and Onne Port Complex, are located in the South-South Region of Nigeria. Maritime economic activities in the complex include exporting palm oil, palm kernels, timber, coal, tin and columbite from the surrounding area, as well as petroleum from fields in the eastern Niger River delta. These economic activities make both ports an interesting study area for the investigation of the management of shipwrecks in Nigeria. The Rivers port complex, once an active hub of vast maritime economic activities is currently operating at a low level of its full capacity in the aftermath of militant insurgency in the late 1990s, which disrupted commercial activities, led to insecurity, and caused a decline in shipping operations.

2.2: Data Collection Method

The study applied a quantitative research method using structured questionnaire and adopting a purposive sampling technique to obtain the relevant data from key stakeholders. The sampled population were different maritime stakeholders including experienced seafarers and staff members who work in the offshore departments of the Nigerian Ports Authority (NPA) and the Nigerian Maritime Administration and Safety Agency (NIMASA) in Rivers and Onne Port Complexes in Rivers State, Nigeria. Survey questionnaires were distributed to 12 respondents to collect primary data based on their expertise, role, and relevance to the research topic. Based on the objectives of the study, the questionnaire was divided into 3 sections and the tool was

designed on Likert scale range, i.e., 1(strongly agree), 2(agree), 3(undecided), 4(disagree) and 5(strongly disagree).

3.0: DATA ANALYSIS

The study quantitative data was analysed with MS Excel version 2019 to generate descriptive percentage and frequency distribution tables.

4.0: RESULTS AND DISCUSSION

4.1: Demographic Characteristics of the Sample Population

The study data indicated that most of the respondents were male (66.7%). With respect to the age distribution, study data shows that the majority of respondents (58.3%) were between 36-45 years, followed by 33.3% below 25 years. All respondents had a tertiary level of education (100%). There was an even distribution of job roles amongst the respondents assessed in the study, namely seafarers, NPA staff, and NIMASA staff. Additionally, 50% of respondents had over 5 years of experience, and 33.3% had 1-5 years of experience.

Table 4.1: Demographic Statistics

Category	Variable	Frequency	Percentage (%)
Gender	Male	8	66.7
	Female	4	33.3
Age (Years)	Below 25	4	33.3
	26 - 35	1	8.3
	36 - 45	7	58.3
Level of education	Tertiary school level	12	100
Job Description	Seafarers	4	33.3
	Hydrological Office, NPA	4	33.3
	Environmental Management	4	33.3
	Department, NIMASA		
Years of Service	1 - 5 Years	6	50
	6 - 10 Years	4	33
	15 - 20 Years	2	17

Source: Field Survey (2024)

Table 4.2: Adverse effects of Shipwreck on the marine environment

RESEARCH QUESTIONS	N	SA	A	U	D	SD
Obstruction of shipping lanes	12	8 66.7%	3 25.0%	1 8.3%	-	-
Damage to fishing gear or aquaculture equipment	12	4 33.3%	7 58.3%	1 8.3%	-	-
Leakage of oil or hazardous substances from the wreck	12	7 58.3%	4 33.3%	-	1 8.3%	-
Hiding place for pirates and criminals	12	6 50.0%	5 41.7%	-	1 8.3%	-
Impact on jetties, piers, seawalls, or other coastal structures	12	3 25.0%	5 41.7%	2 16.7%	2 16.7%	-
Hazard to swimming, diving, boating, or other recreational activities	12	6 50.0% (21.71 - 78.29%)	6 50.0% (21.71 - 78.29%)	-	-	-
Risk of accidents or collisions	12	11 91.7%	1 8.3%	-	-	-
Delays in ship movements	12	1 8.3%	9 75.0%	1 8.3%	-	1 8.3%
Closure of port facilities	12	1 8.3%	4 33.3%	5 41.7%	2 16.7%	-
Congestion of port facilities	12	1 8.3%	9 75.0%	2 16.7%	-	-

The results concerning the adverse effects of shipwrecks are presented in Table 4.2. show that 66.7% of respondents strongly agreed that abandoned wrecks block shipping lanes. From the study, 58.3% agreed, and another 33.3% strongly agreed that abandoned wrecks damage fishing gear or aquaculture equipment. In terms of environmental risks, 58.3% of respondents strongly agreed that shipwrecks pose a threat of oil spills or hazardous substance leaks. Moreover, 91.7% of respondents strongly agreed that shipwrecks present a high risk of accidents and collisions. On security Implications of Shipwrecks results indicated that 50% of respondents strongly agreed

that shipwrecks can be used as a launching pad for piracy or illegal activities. Responses regarding the potential for shipwrecks to be used for smuggling were more varied, with 25% strongly agreeing, 25% agreeing, and 25% undecided.

Table 4.3: Stakeholders engagement in technological innovation for shipwreck management

RESEARCH QUESTIONS	N	SA	A	U	D	SD
Public-private partnerships and collaborations	12	5 41.7%	7 58.3%	-	-	-
Stakeholder consultations and engagement forums	12	4 33.3%	8 66.7%	-	-	-
Training and capacity-building programs	12	3 25.0%	9 75.0%	-	-	-
Technology transfer and knowledge sharing	12	6 50.0%	5 41.7%	1 8.3%	-	-
Inclusive and participatory decision-making processes	12	3 25.0%	8 66.7%	-	1 8.3%	-
Sharing of expertise and resources	12	6 50.0%	6 50.0%	-	-	-
Collaboration on research and development	12	5 41.7%	6 50.0%	1 8.3%	-	-
Improved capacity building and training	12	4 33.3%	6 50.0%	2 16.7%	-	-
Enhanced global standards and best practices	12	7 58.3%	4 33.3%	1 8.3%	-	-
Development of new technologies and innovations	12	8 66.7%	4 33.3%	-	-	-
Improved data collection and analysis	12	5 41.7%	7 58.3%	-	-	-
Enhanced knowledge sharing and collaboration	12	5 41.7%	7 58.3%	-	-	-
Identification of best practices and global standards	12	4 33.3%	8 66.7%	-	-	-

Source: Research Data

The results from the stakeholder engagement in technological innovation (Table 4.3) indicate that public-private partnership was highly rated at 41.7%, while stakeholder consultations received a higher rating of 58.3%. Participants showed strong agreement (75.0%) towards training and capacity-building programs, with a 91.7% agreement to technology transfer and knowledge sharing. Furthermore, 91.7% agreed to inclusive and participatory decision-making processes. In the study on how international cooperation can enhance shipwreck management in Nigeria, the results indicated that 50.0% of respondents either agreed or strongly agreed that sharing expertise and resources would improve shipwreck management. Furthermore, 50.0% strongly agreed on the importance of collaboration in research and development. Also, 50.0% of the respondent strongly agreed to the need for capacity building and training. Although 16.7% were undecided, 58.3% agreed, and another 33.3% strongly agreed that adopting enhanced global standards and best practices would be beneficial to shipwreck management. The majority of respondents (66.7%) strongly agree that the development of new technologies and innovations is pivotal for improving international cooperation in this field. Furthermore, there is a very strong consensus among respondents (100%) that improved data collection and analysis can significantly enhance international cooperation. Moreover, the identification of best practices and global standards is also considered crucial for improving international cooperation, with the majority (66.7%) agreeing and a significant portion (33.3%) strongly agreeing.

Table 4.4: Available technologies for assessing or locating shipwrecks in Nigeria

RESEARCH QUESTIONS	N	YES	NO
Sonar and acoustic sensors	12	12 100%	-
Remote-operated vehicles (ROVs) and autonomous underwater vehicles (AUVs)	12	8 66.7%	4 33.3%
Satellite imaging and geospatial analysis	12	9 75.0%	3 25.0%
Diving and underwater exploration technologies	12	11 91.7%	1 8.3%
Advanced navigation and mapping systems	12	10 83.3%	2 16.7%

Source: Research Data

In evaluating the use of technologies available for assessing and locating shipwrecks (Table 4.4), all respondents (100%) unanimously agreed on the effectiveness of sonar. Additionally, 66.7% supported the use of Remote-operated vehicles (ROVs) and autonomous underwater vehicles (AUVs). With respect to the use of satellite imaging and geospatial analysis, 75.0% of respondents endorsed these technologies, while 25.0% disagreed. For diving and underwater exploration technologies, 91.7% were in favor, while 8.3% disagreed. Similarly, 83.3% of participants agreed on the usefulness of advanced navigation and mapping systems, although 16.7% expressed reservations. Furthermore, 83.3% of the respondents agreed on the value of advanced navigation and mapping systems.

Discussion

A review of the study data indicated that most of the respondents were male (66.7%). This is in line with the gender distribution in the maritime industry especially port facilities which is known to be a male dominated (Crozet, 2024), but different from fisheries sector which is female dominated. The presence of females (33.3%) adds diversity to the opinion of the study respondents, ensuring that both male and female perspectives were considered. With respect to the age distribution, study data shows that the majority of respondents (58.3%) were between 36-45 years, followed by 33.3% below 25 years. The observed high youth population (33.3%) amongst the respondent is at variance with the data of 15% amongst all maritime workers presented by Crozet (2024). This skew towards the youthful age group (less than 25 years) suggests an improvement in the workforce, with implications for a better future in the sector. All respondents had a tertiary level of education (100%), indicating that they had sufficient knowledge to understand the technical aspects of the study and provide informed responses. This strengthens the reliability of the data, as educated participants are likely to have a better understanding of the shipwreck issues. There was an even distribution of job roles amongst the respondents assessed in the study, namely seafarers, NPA staff, and NIMASA staff. This diversity ensures a balanced perspective from different stakeholders involved in port operations and shipwreck management. Additionally, 50% of respondents had over 5 years of experience,

and 33.3% had 1-5 years of experience. This implies that most respondents have extensive experience in maritime operations, further supporting the reliability of the data collected.

The results concerning the adverse effects of shipwrecks are presented in Table 4.2. show that 66.7% of respondents strongly agreed that abandoned wrecks block shipping lanes. This finding is consistent with previous research (Dijk, 2023), which highlights navigational hazards as a key impact of shipwrecks, especially in busy maritime zones. Shipwrecks not only obstruct important shipping routes but also create serious risks for vessels, particularly in Nigeria's maritime industry, where heavy oil-related traffic in Rivers State heightens the likelihood of accidents (Abdulkadir and Mashood, 2021). These hazards also disrupt maritime trade, adversely affecting the local economy. From the study, 58.3% agreed, and another 33.3% strongly agreed that abandoned wrecks damage fishing gear or aquaculture equipment. This aligns with previous studies, which note that wrecks can block access to fishing areas and harm marine life due to pollution, leading to further economic challenges for fishing communities (Firth et al., 2013; Firth, 2018 cited in Mat, 2025). This issue is especially relevant in coastal regions like Rivers State, where fishing is a key economic activity. These results underscore the significant safety risks posed by abandoned wrecks, particularly concerning obstruction of shipping lanes, risk of collisions, and damage to maritime infrastructure and equipment. In terms of environmental risks, 58.3% of respondents strongly agreed that shipwrecks pose a threat of oil spills or hazardous substance leaks. This consensus aligns with Akintoye (2017), who points out that such leaks can lead to significant environmental harm, contaminating marine ecosystems, damaging fisheries, and causing long-term degradation. Moreover, 91.7% of respondents strongly agreed that shipwrecks present a high risk of accidents and collisions. This supports the literature's emphasis on the danger posed by collisions with wrecks, which can lead to fatalities, property damage, and environmental harm, particularly when hazardous materials are involved (Esposito, 2018).

On security Implications of Shipwrecks results indicated that 50% of respondents strongly agreed that shipwrecks can be used as a launching pad for piracy or illegal activities. The observed results of 91.7% compares with the results of Abiodun (100% - 2023) on the implication of shipwrecks for piracy and other criminal activities. The Gulf of Guinea, where

Nigerian waters are located, is until recently a high-risk area for piracy, and the presence of wrecks exacerbates this problem (Ukeje, 2016). Furthermore, wrecks may be used for smuggling operations, increasing the security risks to the region's ports and coastal communities. Responses regarding the potential for shipwrecks to be used for smuggling were more varied, with 25% strongly agreeing, 25% agreeing, and 25% undecided. This wide range of responses suggests differing opinions on whether shipwrecks are commonly used for smuggling. These findings also indicate the potential for shipwrecks to facilitate illegal activities like piracy and smuggling, which could disrupt port operations and diminish investor confidence. The problem of insecurity arising from maritime piracy and its potential adverse effects impact the industry. Insecurity increases the industry's losses to high international insurance rates, thereby eroding the capital industry that could be expended in technology to increase efficiency (Lloyd et al., 2020 cited in Ikpogu, 2021).

The results from the stakeholder engagement in technological innovation (Table 4.3) indicate that public-private partnership was highly rated at 41.7%, while stakeholder consultations received a higher rating of 58.3%. Participants showed strong agreement (75.0%) towards training and capacity-building programs, with a 91.7% agreement to technology transfer and knowledge sharing. Furthermore, 91.7% agreed to inclusive and participatory decision-making processes. The observed trends in the results underscore the belief of the respondents on the importance of collaboration for technological innovation in shipwreck management. The responses indicate a clear consensus on the vital role of engaging stakeholders through partnerships, training, and consultations for improving shipwreck management. This result aligns with the literature's emphasis on the importance of collaborative efforts between the public and private sectors to tackle the financial and logistical challenges associated with wreck management (Osobajo, *et al.*, 2021). These partnerships are particularly beneficial in resource-constrained environments like Nigeria, where the cost of wreck removal can be prohibitive for the government alone (Okorie, 2021).

In the study on how international cooperation can enhance shipwreck management in Nigeria, the results indicated that 50.0% of respondents either agreed or strongly agreed that sharing expertise and resources would improve shipwreck management. Furthermore, 50.0% strongly

agreed on the importance of collaboration in research and development. Also, 50.0% of the respondent strongly agreed to the need for capacity building and training. Although 16.7% were undecided, 58.3% agreed, and another 33.3% strongly agreed that adopting enhanced global standards and best practices would be beneficial to shipwreck management. These results therefore support the argument of Akabogu and Associates (2017), that Nigeria must engage with the international maritime community to benefit from shared knowledge and resources.

The survey results indicate a strong consensus among respondents regarding the crucial role of research and development (R&D) in enhancing international cooperation in shipwreck management. The majority of respondents (66.7%) strongly agree that the development of new technologies and innovations is pivotal for improving international cooperation in this field. Furthermore, there is a very strong consensus among respondents (100%) that improved data collection and analysis can significantly enhance international cooperation. Similarly, respondents emphasized the importance of knowledge sharing and collaboration for international cooperation, with all the respondents either agreeing or strongly agreeing, and no respondents disagreeing or being undecided. Moreover, the identification of best practices and global standards is also considered crucial for improving international cooperation, with the majority (66.7%) agreeing and a significant portion (33.3%) strongly agreeing. Overall, the survey results indicate that research and development R&D, particularly through technological innovation, data collection, collaboration, and the identification of best practices, can significantly improve international cooperation in shipwreck management (Abdulkadir & Mashood, 2021).

In evaluating the use of technologies available for assessing and locating shipwrecks (Table 4.4), all respondents (100%) unanimously agreed on the effectiveness of sonar. Additionally, 66.7% supported the use of Remote-operated vehicles (ROVs) and autonomous underwater vehicles (AUVs). With respect to the use of satellite imaging and geospatial analysis, 75.0% of respondents endorsed these technologies, while 25.0% disagreed. For diving and underwater exploration technologies, 91.7% were in favor, while 8.3% disagreed. Similarly, 83.3% of participants agreed on the usefulness of advanced navigation and mapping systems, although 16.7% expressed reservations. Despite some differing opinions, there was strong overall support for these technologies, highlighting their effectiveness in shipwreck assessment in Nigerian

waters. All respondents (100%) affirmed that sonar and acoustic sensors are highly effective for assessing wrecks. Furthermore, 83.3% of the respondents agreed on the value of advanced navigation and mapping systems, which reinforces the literature by Simpson & Wilson (2016), stating that Geographic Information Systems (GIS) are instrumental in locating shipwrecks and evaluating their impact on navigation and environmental safety. These technologies are increasingly being used to enhance the management and removal of wrecks in Nigeria.

The findings from this study provide compelling evidence that shipwrecks pose safety and security risks to Nigerian waterways, particularly concerning collisions, piracy, and smuggling. Utilizing advanced technologies such as sonar and ROVs is crucial for assessing these wrecks. Additionally, there is strong support for public-private partnerships and international cooperation to enhance shipwreck management.

CONCLUSION

The management of shipwrecks in Port Harcourt, Rivers State requires a multifaceted approach that involves government agencies, private sector organizations, local communities, and international partners and the deployment of relevant technologies as confirmed by the findings from this study. Some of the effective strategies includes: improved data collection and analysis, training and capacity-building programs, stakeholder consultations and engagement forums, use of advanced navigation and mapping systems, collaboration on research and development etc. These strategies and policies could as well be practiced around all the seaports in Nigeria, in order to help sustainably manage the incidents of shipwrecks.

Based on the findings and conclusions of this study, the following recommendations are made to improve the management of shipwrecks in Port Harcourt:

1. Develop a comprehensive database of shipwrecks in Port Harcourt, including their location, size, and potential environmental impacts.

2. Utilize sonar and acoustic sensors, ROVs and AUVs, satellite imaging and geospatial analysis, diving and underwater exploration technologies, and advanced navigation and mapping systems to monitor and assess shipwrecks.
3. Conduct stakeholder consultations and engagement forums to raise awareness and gather input on shipwreck management.
4. Adopt enhanced global standards and best practices for shipwreck management.

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