

FACTORS INFLUENCING COASTAL HAZARD VULNERABILITY AND MITIGATION STRATEGIES IN THE NIGER DELTA REGION, NIGERIA

By

Daukere, B.E.* and Ifabiyi, I.P.

Department of Geography and Environmental Management, University of Ilorin, Nigeria

*Corresponding Author's Email: dauksenies2010@gmail.com

ABSTRACT

Globally, coastal communities are increasingly vulnerable to coastal hazards due to a combination of natural and physical factors as well as social and economic systems. As a result, this study employed a parallel convergent mixed-methods research design to examine the factors influencing coastal hazards and mitigation strategies in Nigeria's Niger Delta. Data were acquired from questionnaire, key informant interviews (KIIs) and focus group discussions (FGDs). Percentages were used to analyze the quantitative data and the KIIs and FGDs were manually transcribed to preserve linguistic tones that were done in Pidgin English and local dialects. The findings of the study revealed that 55.32% and 50.43% of the respondents, respectively, viewed that population growth and anthropogenic activities such as oil exploration, deforestation etc. are the major factors increasing coastal vulnerability, while 84.21% support shoreline protection and 87.27% endorse early warning systems as the mitigating measures. Respondents' perspectives from the interviews further contextualized the causes of coastal hazards to include inadequate government planning, poor infrastructure that requires urgent community calls for integrated conservation and resilience-building measures. Therefore, the study recommends that integrated mitigation strategies that combines ecological restoration, adaptive infrastructure, and enhanced community participation with effective governance be prioritized to reduce coastal hazards vulnerability in the study area.

Keywords: Coastal Vulnerability, Disaster resilience, Ecosystem degradation, Mangrove restoration, Urbanization, Niger Delta

INTRODUCTION

Coastal regions worldwide, many known for their valuable natural resources, have long faced natural and human induced challenges due to their unique geography. For instance, the Niger Delta is characterized by low elevation, mangrove habitats, and complex river systems that is vulnerable to erosion, flooding, and saltwater intrusion among others (Week & Wizer, 2020; Aransiola et al., 2024). Moreover, human activities, such as oil exploration, deforestation, and unplanned urbanization pattern, have continued to worsened the risks of coastal hazards thereby accelerating issues like erosion rates (Ogba & Utang, 2007; Ogbonna et al., 2020). As Nwankwoala and Okujagu (2021) observed, the Niger Delta Region (NDR) is faced with multiple repeated environmental hazards and disaster risk that continue to undermine infrastructural development thereby deepening poverty.

Coastal hazards refer to the risks that both the people and nature face along coastlines from natural events like storms and flooding, as well as human actions, which can cause damage to homes, ecosystems, and livelihoods. This vulnerability is shaped by interacting physical, demographic, and socio-economic factors (Biswas & Nautiyal, 2023). Physical exposure depends on geographic characteristics such as proximity to shorelines, elevation, and land-use change (Collins, 2008; Contestabile & Vicinanza, 2020), while socioeconomic and demographic dimensions such as income, education, occupation, age, and housing tenure influence awareness and adaptive capacity (Adetunji & Oyeleye, 2018; Sofyan et al., 2024). Importantly, Kim et al. (2025) added that social vulnerability is rooted in systemic inequalities and limited resource access which often outweighs physical exposure in determining disaster impacts. Therefore, understanding this complex interplay is essential for developing effective mitigation strategies in order to reduce risks and build resilience from coastal hazards.

Vulnerability is not a fixed condition, and coastal vulnerability has various definitions because it is viewed differently across disciplines. It may focus on physical and natural systems, social and economic systems, or both combined (Bukvic et al., 2020; Dike et al., 2024). The vulnerability to coastal hazards in the NDR, therefore, is profoundly shaped by its unique landscape, which is characterized by mangroves, rivers, estuaries, and floodplains. These features drive the dynamic environmental processes such as flooding, erosion and accretion, sea-level rise, and oil spills among others. Folorunsho et al. (2023) examined the salient issues of coastal hazards in Nigeria and found that 30% of the population experience coastal hazards including coastal erosion, storm surges, floods, land subsidence, and pollution affecting the socio-economic activities of coastal areas but their study underemphasize socio-economic and community factors impacting adaptive capacity. Ogba and Utang (2007) and Hart (2024) highlighted infrastructure disruption due to terrain complexity but did not consider governance and socio-political influences on mitigation.

In Macao, China, Zhang et al. (2024) assessed coastal vulnerability and climate change adaptation pattern and found that 19% of the people in the study area are highly exposed to coastal hazards. Deb et al. (2024) applied the Coastal Vulnerability Index to assess physical risks and found that 25.9% of Banshkhali, Chakaria, Maheshkhali, and Cox's Bazar Sadar experienced high to very high vulnerability to multiple coastal hazards. While these prior studies identify key coastal hazards, they underemphasize socio-political context and community perspectives essential for effective vulnerability assessment in the Niger Delta, necessitating integrated analysis of influencing factors within its unique environmental and socio-political setting.

Building on this, Zabbey et al. (2021) emphasize local knowledge in monitoring environmental, especially biodiversity changes in the NDR. Their findings revealed that there is the need to involve multiple stakeholders, in monitoring and reporting changes in coastal land and seascape yet note limited integration into formal vulnerability assessments. Similarly, studies by Lalancette and Charles (2022) and Shi et al. (2020) identified insufficient community engagement and governance analysis in hazard management. Additionally, Bello and Nwaeke (2023) and Daukere and Ifabiyi (2025) stressed the impact of organized crime and environmental degradation in the Niger Delta. Their findings revealed that the illicit activities such as oil theft and illegal oil refining lead to widespread oil spills, water and air pollution, and destruction of marine ecosystems, thereby worsening climate vulnerabilities. Despite this, these studies do not

integrate how these socio-environmental crime impacts the physical hazard experienced in the Niger Delta and how they should be mitigated.

Collectively, the studies overemphasize the physical aspects of coastal hazards while devoting insufficient attention to factors such as government support, regulation of anthropogenic activities like oil exploration, shoreline protection, and resilience building that influence vulnerability, alongside community-informed mitigation strategies. Against this backdrop, this study aims to examine the factors influencing coastal hazards and mitigation strategies in Nigeria's Niger Delta. The objectives are to assess residents' perspectives on vulnerability drivers and community views on mitigation approaches.

THE STUDY AREA

The study area is located between latitudes 4°10'36"N to 7°0'32"N and longitudes 4°53'58"E to 9°32'18"E. (Figure 1). The research area covers the states of Akwa Ibom, Bayelsa, Delta, Cross River, and Rivers. These states are part of Nigeria's nine states of the NDR, collectively account for 25% of the national population and are characterized by low-lying swampy terrain with extensive mangrove forests and dense river networks, all of which heighten vulnerability to coastal hazards such as erosion, flooding, and oil spills (Eyoh & Okwuashi, 2016; Aransiola et al., 2024). Moreover, anthropogenic activities like oil exploration and deforestation, combined with socioeconomic inequalities, exacerbate hazard risks. The study area hosts the major oil infrastructures that amplify environmental degradation, and face severe erosion that is impacting fishing and farming livelihoods (Amangabara & Onyewuchi, 2021; Ekeu-wei & Ekeu-wei, 2024; Nanadeinboemi et al., 2024). The area dense river networks like the Forcados River mouth furthers exemplifies the interplay of natural and human-induced coastal risks, where erosion rates reach 10–25 meters annually (Ogba & Utang, 2007).

Consequently, focusing on the five states is crucial because they are on the frontline of both climate-driven coastal hazards, such as sea-level rise, storm surges, and more frequent extreme weather events, and human-driven hazards. In this context, factors like government support, regulation of activities such as oil exploration, shoreline protection, and resilience-building measures play a critical role in shaping vulnerability and informing effective mitigation strategies (Dike, et al., 2024).

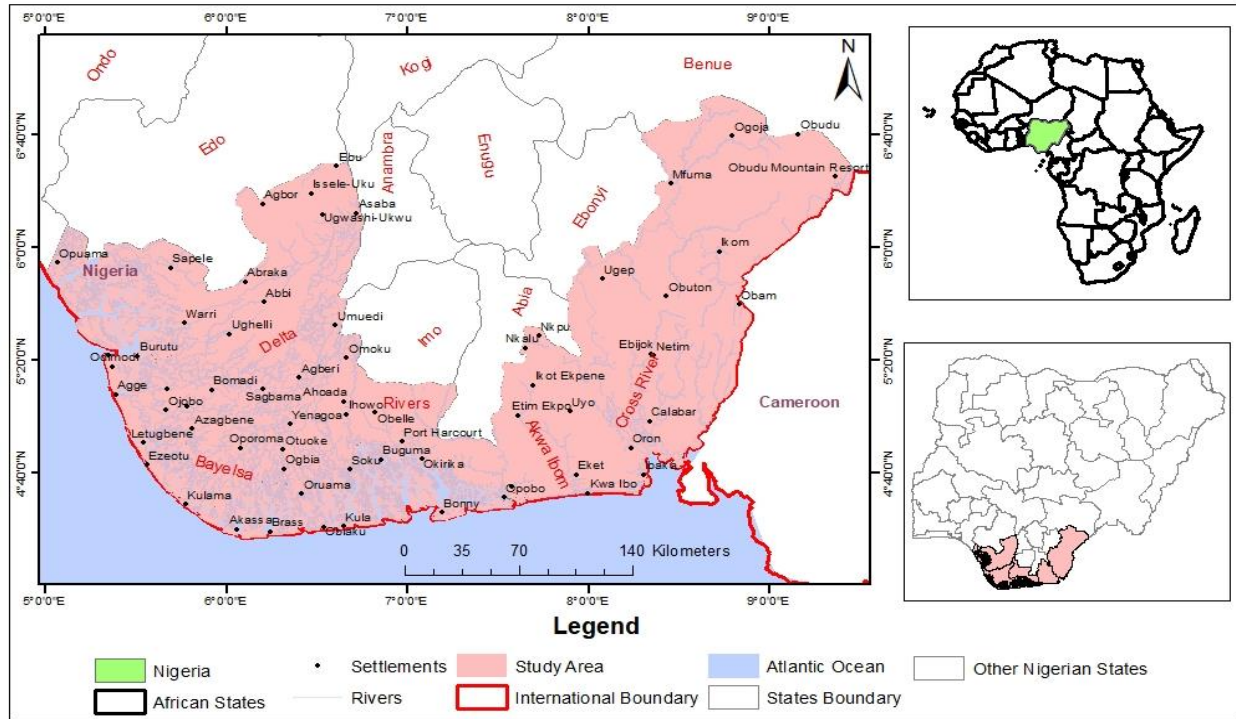


Figure 1: The Study Area

Source: Adapted from the Administrative Map of Nigeria

MATERIAL AND METHODS

In this study, data were collected from both primary and secondary sources for methodological objectivity. Specifically, a structured questionnaire was used to acquire data on factors influencing vulnerability to coastal hazard and mitigation strategies employed by the residents of the study area. In addition, Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) were conducted to provide a deeper context to vulnerability drivers and mitigation measures commonly used in the study area. Table 1 shows the data types, sources, and methods employed in this study. Furthermore, data on the population of the study area was acquired from the National Bureau of Statistics (2011) which was used to define the population size and subsequently used to determine the appropriate sample size of the study area.

Importantly, parallel convergent mixed-methods design was employed in this study to triangulate quantitative data such the factors influencing coastal hazards, mitigating capacity with qualitative narratives on the coastal hazard vulnerability, adaptive capacities and the strategies used by residents to mitigate the issues to enhance the depth and reliability of the findings. Consequently, this study used this method by leveraging the strengths of both quantitative and qualitative methods that provided a comprehensive community insight, efficient data collection that enhanced the validation of the findings. This study used this method in line with those of Areia et al. (2023), who employed a similar mixed-methods framework to investigate an evidence-based indicator approach to examine factors contributing to social vulnerability to coastal flooding in Portugal. Therefore, this approach is well-suited to comprehensively examine the coastal hazard vulnerability and community mitigation perspectives in the Nigerian context.

Table 1: Data Types, Sources and Methods Employed in the Study

S/ No	Data Type / Variable	Source	Measurement Scale	Analytical Techniques	Methods
1	Factors influencing coastal hazard vulnerability	Questionnaire, KIIs & FGDs	Categorical (Yes/No/Do not know/answer) and Qualitative narrative	Frequency analysis on categorical data; thematic analysis and grounded theory coding of KII/FGD narratives for vulnerability drivers.	Systematic sampling across 19 coastal LGAs; questionnaire administration at LGA headquarters and communities.
2	Perspectives on mitigating coastal hazard	Questionnaire, KIIs & FGDs	Categorical (Yes/No/Do not know/answer) and Qualitative narrative	Frequency analysis; content analysis and thematic coding of KII/FGD transcripts for mitigation strategies.	Systematic sampling across 19 coastal LGAs; Purposive sampling of 10 interlocutors for KIIs; FGDs in Rivers and Bayelsa states for terrain-specific insights.
3	Adaptive capacities	Questionnaire, KIIs & FGDs	Qualitative narrative	Triangulation through parallel convergent mixed-methods design integrating questionnaire data with thematic analysis of KII/FGD narratives.	Purposive sampling of 10 interlocutors for KIIs; FGDs in Rivers and Bayelsa states.
4	Population Data	National Bureau of Statistics (2011)	Quantitative	Population proportion calculations for sample size determination using Newman's formula.	Secondary data source, population projections (2006-2024).
5	Sampling size considerations	Population projection, Yamane's formula	Quantitative	Yamane's (1967) formula application with 3.5% confidence level on projected populations (2006–2024).	Application of Yamane's formula using population projections.

This study used purposive sampling method to select the 19 littoral LGAs across Bayelsa, Akwa Ibom, Delta, Cross River, and Rivers States. As also noted by Adetunji & Oyeleye (2018) and Oloyede et al. (2022), the Littoral LGAs were selected because they are directly exposed to both climate-driven and human-induced coastal hazards, making them critical areas for understanding vulnerability and resilience in the Niger Delta. Within these LGAs, LGA headquarters were purposively chosen to reflect community heterogeneity, while simple random sampling was used to select additional communities (Forupa, Agge, Okpoma, Ikot Offiong, Ogulagha, Ayama, Akede, Harrys Town) in LGAs with ≥ 40 questionnaires. Subsequently, systematic random sampling method was used to administer 817 copies of questionnaire to residents aged 16 and above in a predetermined sequence. Depending on the community size, every *n*th house from the starting point was selected until the target number was reached. For buildings with multiple households, a random number table was used to select one household to participate.

To capture diverse and informed perspectives across the five states, purposive sampling was employed to select 10 key interlocutors, two per state, for KIIs. It prioritized experienced stakeholders (e.g., government officials, environmental experts) with broad regional oversight of coastal hazards and mitigation efforts in the NDR, rather than LGA-specific representation, to ensure balanced state-level insights without overburdening logistics. Questionnaires, however, were administered across all 19 LGAs to quantify localized vulnerability perceptions at the community scale. This approach was also applied by Areia et al. (2023), who used purposive KIIs (limited experts per region) alongside broader questionnaire surveys in Portuguese coastal areas for multi-scale risk assessment. In addition, FGDs were conducted in Rivers and Bayelsa States. It was limited to these states because they exemplify the Niger Delta's most vulnerable littoral zones due to their low-lying, flood-prone landscapes with extensive estuaries, mangroves, and riverine systems, than other states, that amplify flooding, erosion, and saltwater intrusion (Adetunji & Oyeleye, 2018; Adeyefa et al., 2023). Thus, respondents' insights into these dynamics were essential, as they clarify how such features influence hazard manifestation and community resilience in the Niger Delta.

The sample size for this study was calculated using Yamane's (1967) formula based on population projections (2006–2024) with a 3.5% margin of error to balance precision and feasibility, resulting in 817 respondents (see Table 2). This level was deliberately chosen over the more common 5% margin, which would have yielded only around 400 respondents, to provide greater geographic and demographic coverage which is important for capturing the complex socio-environmental dynamics of the high-risk coastal zones. As emphasized by Dada et al. (2021), a smaller margin of error enhances representativeness and the reliability of findings, which is essential for informing effective policy interventions in vulnerable coastal communities.

The content analysis on the data collected via KIIs and FGDs were done by first manually transcribing the data. Manual transcription was used to preserve linguistic nuances because most of the respondents spoke in either Pidgin English or their local dialects which if software like Nvivo could not ensure contextual accuracy. The study was guided by grounded theory. The process categorized perspectives on vulnerability drivers of coastal hazards, and mitigation strategies in the Niger Delta, with codes derived from themes such as terrain characteristics, blame attribution, and socioeconomic drivers of vulnerability. Thematic analysis identified

patterns linking low elevation, hydro-meteorological factors (e.g., rainfall, sea level rise), and anthropogenic activities to flood risks (Ntor et al., 2024), and socioeconomic indicators.

Table 2: Sample Size by Local Government Areas of the Study Area

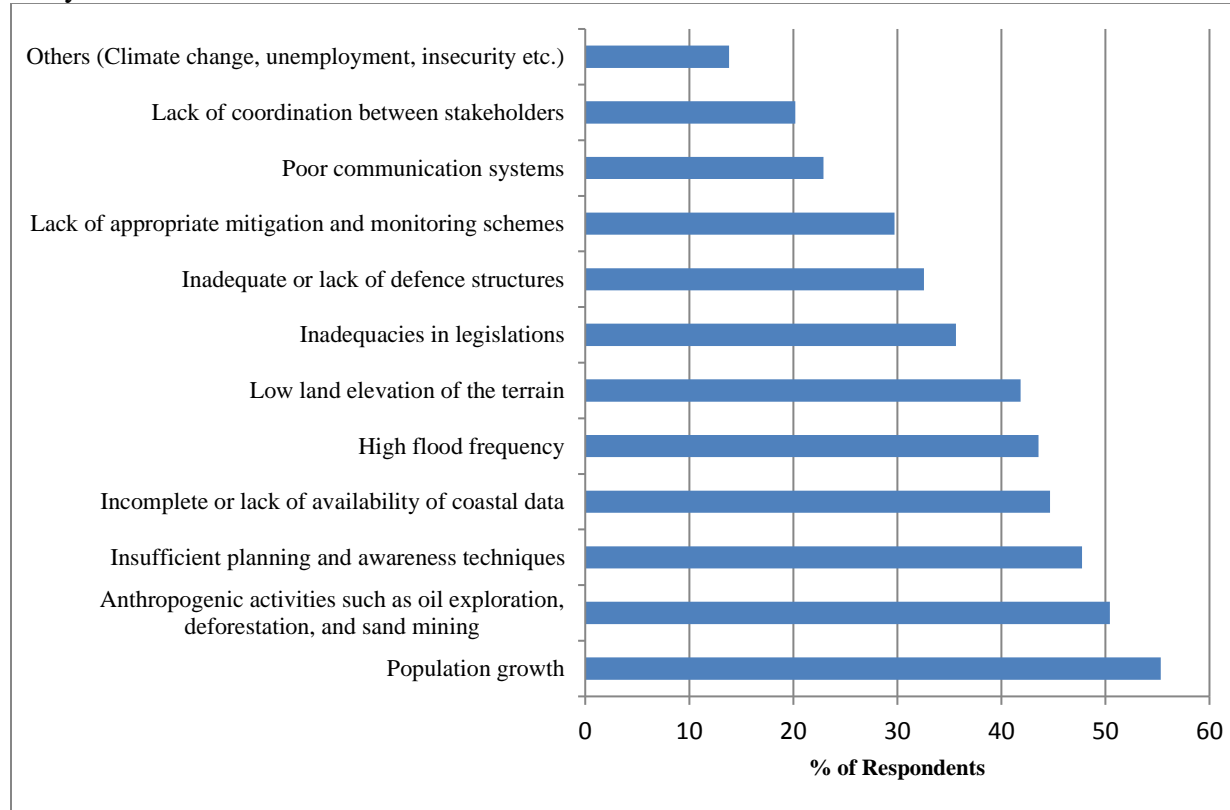
S/No	State	LGA	2006 Population	2024 Population	Sample Size
1		Mbo	102,173	164,703	27
2		Udung Uko	53,060	85,533	14
3	Akwa Ibom	Oron	87,209	140,581	23
4		Eastern Obolo	59,970	96,672	16
5		Ibena	74,840	120,642	20
6		Southern Ijaw	321,808	518,754	85
7	Bayelsa	Ekeremor	269,588	434,576	71
8		Brass	184,127	296,813	48
9		Calabar South	191,515	308,722	50
10	Cross River	Akpabuyo	272,262	438,886	72
11		Bakassi	31,641	51,005	8
12		Warri South West	116,538	187,859	31
13	Delta	Burutu	207,977	335,259	55
14		Warri North	136,149	219,472	36
15		Andoni	217,924	351,293	57
16		Degema	249,467	402,141	66
17	Rivers	Akuku Toru	161,103	259,698	42
18		Bonny	214,983	346,553	56
19		Opobo/Nkoro	152,833	246,367	40
Total			3,105,167	5,005,529	817

The analysis contextualized findings with existing literature on coastal vulnerability in order to reveal consistencies in community perceptions of terrain-related hazards and mitigation dynamics. By iteratively refining codes and themes, the study highlighted the interplay between coastal hazards and adaptive capacities, underscoring the need for integrated mitigation strategies addressing both physical and social drivers of risk.

RESULTS AND DISCUSSION

Factors Influencing Vulnerability to Coastal Hazards

Figure 2 displays the results of the factors influencing vulnerability to coastal hazards in the study area.



Note: Each bar sums up to 100% of respondents

Figure 2: Factors Influencing Vulnerability to Coastal Hazards in the Study Area

The findings indicate that respondents perceive multiple, interrelated factors as driving vulnerability to coastal hazards in the NDR, with clear implications that vary across states and coastal settings. For instance, findings revealed that population growth (55.32%) emerged as the most frequently mentioned factor which reflects the rapid demographic expansion in coastal LGAs of the NDR, where urbanization, youth bulges, and high dependency ratios intensify pressure on land, housing, and services, thereby heightening exposure to flood-prone and erosion-threatened areas which could indirectly fuel unemployment, crime, and informal settlements in hazardous locations. This findings agree with those of Neumann et al. (2015), which demonstrated that rapid population increase intensifies pressure on coastal resources, exacerbating environmental degradation and socio-economic challenges in vulnerable coastal zones. As noted in FGDs:

I have observed a significant number of new developments with buildings around me, unlike in the past. These developments have led to the degradation of vital natural ecosystems, such as vegetation and farmlands, which are crucial for shoreline protection and other economic activities our people engage in. Now, erosion don increase than before too (FGD, Rivers state).

Other respondents further highlighted how population-driven urban expansion disrupts traditional livelihoods:

Indeed, we can observe degradation and encroachment on our agricultural land, freshwater sources, including the mangrove. This is primarily due to the new development we see going on in our communities including the establishment of new institutions in Aleibiri and Toru-Owa as well as the completion of Sagbama and Ekeremor road, which has disrupted traditional livelihoods that rely on farming and fishing that has resulted in encroachment on agricultural land and vital freshwater sources ((IDI/Male/Married/43years/Bayelsa State).

Many of our people are now working in precarious non-farm employment as a result of our farms moving farther away. In addition, improper drainage systems lead to waste and debris building up and polluting the streets during the rainy season, and rivers in our communities exacerbate environmental contamination. This problem is increasing because of development we see happening around us, the speed was not like in the 70s/80s (IDI/Female/Married/64years/Cross Rivers State).

In many fast-growing urban communities in the study area, this demographic pressure has translated into unplanned coastal development, conversion of wetlands, and occupation of low-lying floodplains, which amplifies coastal hazard impacts and complicates evacuation and response during extreme events.

Closely following population growth, the findings revealed that 50.43% of respondents agreed that anthropogenic activities such as oil exploration, deforestation, and sand mining influence coastal hazards vulnerability. These findings corroborate with studies in the NDR where oil exploration leads to spills, mangrove destruction, and erosion (Aransiola et al., 2024); furthermore, deforestation fragments habitats and weakens natural barriers (Folorunsho et al., 2023); similarly, unregulated sand mining exacerbates shoreline retreat and flooding (Amangabara & Onyewuchi, 2021; Afolabi & Darby, 2022). Consequently, this has created fertile ground for militant groups such as Movement for the Emancipation of the Niger Delta (MEND) and Niger Delta Avengers (NDA), emerging as significant actors in regional conflict (Ikporukpo, 2018). Many of the interlocutors noted that:

From what I've seen and experienced, things like oil exploration, cutting down trees including "Okpopa" (*Irvingia gabonensi*, known as wild African mango or bush mango) tree for planks, and sand mining have really messed up our environment and livelihoods. Some of my brothers' houses had been "swallowed" by water. This has made flooding and erosion worse, destroying people's homes and farms. With their livelihoods gone, many folks are left struggling and desperate, which sadly pushes some into stealing oil, vandalizing pipelines, or even kidnapping. It's heartbreaking, but these actions are often just ways they try to survive in such tough times (IDI/Male/Married/64years/Bayelsa State).

This narrative thus underscores how resource extraction and livelihood practices differ spatially across the NDR, directly modifying the coastal environment. For instance, in heavily industrialized corridors, oil and gas infrastructure, dredging, and canalization not only accelerate

shoreline instability, wetland loss, and land subsidence, but also together with sand mining and mangrove clearance strongly alter sediment budgets and natural buffers, thereby increasing susceptibility to storm surges and tidal flooding. Moreover, these practices as revealed in Figure 2 often co-occur with insufficient planning and awareness (47.74% of the respondents) as well as incomplete coastal data availability (44.68%) which indicate that even when communities recognize changing coastal hazard patterns, formal planning systems and evidence-based decision-making still lag behind. Furthermore, many of our interlocutors noted that limited hazard mapping, fragmented monitoring, and weak extension services compel residents to rely on experiential knowledge rather than structured early warning and land-use guidance, which in turn contributes to settlement in at-risk locations and maladaptive responses. For example, an FGD in Ekeremor vividly captured these impacts:

We have experienced oil spills a while back that spread to our community; some people claim that we currently have oil in our community (Ekeremor) then because of the oil that collected around that secondary school without realizing it was coming from upland. And this has impacted significantly on crops, particularly the three-month crops we normally plant, such as potatoes, tomatoes, okra, and garden eggs. Fishing yields have drastically declined, and crops often fail prematurely due to pollution and sometimes we are forced to harvest our crops prematurely due to flooding caused by inadequate drainage systems along the newly constructed roads (FGD, Ekeremor).

Hydro-physical conditions remain central but are clearly mediated by human actions. For instance, findings revealed that 43.57% and 41.86% of the respondents, respectively, believed that high flood frequency and low land elevation of the terrain influence vulnerability. This findings reflect the intrinsic susceptibility of deltaic environments, especially along river mouths and estuaries in the study area, where backwater effects, sea-level rise, and intense rainfall combine to produce recurrent inundation. However, respondents' emphasis on these factors alongside anthropogenic drivers suggests that natural low elevation becomes more hazardous when drainage channels are blocked by poorly planned construction, oil-field infrastructure, or inadequate urban drainage, and when protective ecosystems such as mangroves, are degraded. These findings are corroborated by Adeyefa et al. (2023), who linked unregulated sand mining and oil infrastructure to accelerated erosion rates exceeding 15–25 meters annually in the Niger Delta. Thus, physical setting and human modification interact: the same low-lying terrain in less disturbed stretches of Cross River State, for example, may experience lower impacts where vegetative buffers remain intact and settlement densities are lower.

Institutional and governance-related weaknesses were also prominent in the response pattern. For instance, findings in Figure 2 revealed that 35.62% and 32.56% of the respondents noted the existence of inadequacies in legislations and inadequate or lack of defence structures, respectfully. These findings highlight the presence of gaps in both the regulatory framework and the physical protection measures that should reduce risk. These findings align with those of Angnuureng et al. (2025), who showed that global coastal erosion is intensifying while reliance on seawalls and other hard-engineering measures is declining in favour of nature-based solutions. Across the NDR, building codes, shoreline setback regulations, and environmental impact assessments are often weakly enforced, while hard-engineering defences such as sea walls, revetments, and embankments are either absent, poorly maintained, or spatially limited to

high-profile assets like oil facilities and major transport corridors. This results in uneven protection whereby some urban and industrial zones enjoy relatively robust defence structures while many rural fishing and farming communities in creeks or barrier islands remain largely unprotected, reinforcing geographic disparities in vulnerability within and between states. A number of respondents in the FGDs at Bonny Island and Ekeremor expressed the following views:

We don't plan and this exacerbate coastal vulnerability, where oil spills and deforestation degrade mangrove buffers against storm surges and erosion, leaving communities exposed to frequent tidal flooding in low-lying areas like Forcados and Bonny. Yes, we have seawalls in some communities but part of it is damaged because of floods. And it has never been fixed. So, our people rely on informal warnings (e.g., town criers) and experience. Our people respond to hazards as they happen because of the absence of structured evacuation protocols (in Nigeria), despite recurring hazards (FGD, Bonny and Ekeremor).

Another respondent added:

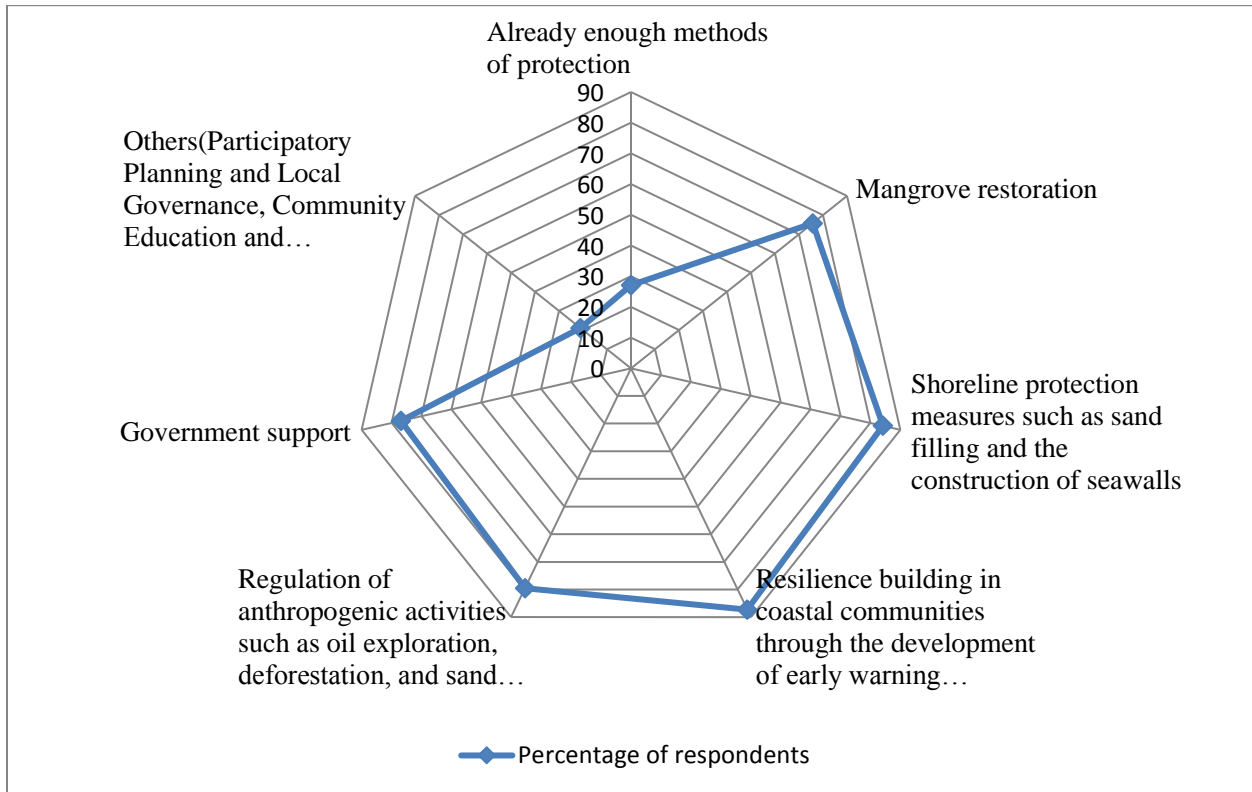
“It is unfortunate that our big men no dey help us in Nigeria”—poor drainage systems is our major issue, lack of sea wall..., trapping floodwaters and worsening flood risks. If rain falls, it will carry dirt and trash from uphill right into our homes, leaving our front yards messy and dirty (IDI/Female/Married/63years/Cross River State).

In furtherance, findings of the study revealed that 29.74% and 22.89% of the respondents, respectively, noted that lack of appropriate mitigation/monitoring schemes and poor communication systems influence coastal vulnerability. This findings highlight the existence of major weaknesses in governance and information flow across the Niger Delta's coastal states in addressing coastal hazards. These findings align with those of Ndimele et al. (2024), who found that urban sprawl and poor drainage systems in Lagos trap floodwaters, worsening tidal flooding and pollution. Formal early warning systems for floods and storm surges are often rudimentary, with limited community-based monitoring or effective use of mobile and local communication channels, so warnings may not reach remote riverine settlements in time.

In addition, respondents' emphasis on weak coordination between stakeholders (20.2% of the respondents) points to fragmented mandates among government agencies, oil companies, and local actors which leads to overlapping responsibilities, delayed responses, and uneven implementation of shoreline protection or resettlement. Finally, the “Others” category (13.83%), which includes climate change, unemployment, and insecurity, shows that residents perceive coastal hazard vulnerability not only as an environmental issue but as embedded within broader socio-economic and security dynamics. Together, these governance gaps significantly amplify residents' vulnerability to coastal hazards.

Community Perspectives on Mitigating Vulnerability to Coastal Hazards

Figure 3 displays the findings of the respondents' views on mitigation approaches in the study area.



Note: Each dot sums up to 100% of respondents

Figure 3: Spider Diagram of Perspectives on Mitigating Vulnerability to Coastal Hazards

The findings in Figure 3 highlight a compelling and urgent demand from respondents for enhanced shoreline protection and resilience-building strategies to address escalating coastal hazards in the Niger Delta. Notably, 84.21% of the respondents emphasized the necessity of constructing sea walls and reinforcing coastal barriers. This consensus reflects widespread community recognition of the increasing vulnerability of the coastline to erosion, flooding, and related environmental threats. Respondents articulated their concerns clearly, underscoring the imperative for immediate and sustained intervention measures to safeguard livelihoods, infrastructure, and ecosystems in this highly sensitive region. These results align with those of Tourlioti et al. (2021), where residents of Mytilene, Lesbos Island, Greece understand coastal erosion's impact and know defenses like sand nourishment, groins, and breakwaters, favouring volunteering and awareness efforts over financial contributions for coastal protection. One of my interlocutors stated, thus:

We need shoreline protection structures to safeguard our communities from coastal erosion, storm surges, and tidal flooding. Many of our communities have no sea wall and most of our houses have gone (IDI/Female/Married/33years/Rivers State).

This findings align with ongoing initiatives like the Niger Delta Development Commission (NDDC)'s contracted projects in Ogheye and Aja-Udaibo (Delta State), which began in May 2025 to stabilize eroded coastlines and counter ocean surges ravaging riverine settlements (Nesta, 2025). Geotechnical studies like Amangabara and Onyewuchi (2021), who corroborate the necessity of integrating mangrove restoration and adaptive infrastructure, as sediment disruption from oil infrastructure and unregulated sand mining exacerbates erosion rates exceeding 15–25 meters annually, a trend observed in Forcados and Bonny, where shoreline loss threatens livelihoods.

As shown in Figure 3, 87.27% of respondents support resilience-building strategies such as early warning systems and emergency response plans, as crucial for addressing gaps in coastal hazard preparedness. For instance, residents' reliance on informal warnings (e.g., town criers) during floods highlights the lack of structured protocols, despite frequent tidal flooding in low-lying areas (Oyegun et al., 2016). These findings align with Ogba and Utang, (2007), who stress that community involvement in planning enhances the efficacy of resilience measures. However, systemic challenges persist, including government neglect in infrastructure planning and data limitations for adaptive strategies. For example, most respondent across the study area expressed poor drainage systems that trap floodwaters, worsening flood risks, while degraded mangroves reflect the failure to integrate ecological restoration into governance frameworks. Addressing these issues requires prioritizing multi-sectoral governance and community-led conservation, as advocated in vulnerability frameworks for Nigeria's climate-sensitive coastlines.

Furthermore, the emphasis on mangrove restoration (75.76%) and regulating anthropogenic activities (79.56%) reflects a growing awareness of the ecological aspects of coastal management. The community's support for these initiatives indicates recognition of the interconnectedness between environmental health and human safety. This perspective is supported by Nkwunonwo et al. (2024) that underscores the importance of sustainable practices in mitigating flood risks, suggesting that restoring natural ecosystems can provide vital services such as flood regulation and habitat preservation in Ogun State, Nigeria. The findings suggest that communities are not only aware of immediate protective measures but also advocate for long-term ecological solutions that can enhance their resilience against coastal hazards.

The findings in Figure 3 further revealed that 76.87% of the respondents advocate that government support is an important factor in addressing coastal vulnerabilities in the Niger Delta. A respondent emphasized:

I am confident that if the federal government partners with the state government to provide adequate compensation and support for damaged lands and waters, most individuals involved in violent clashes, protests, and conflicts, which often further degrade the environment, will calm down. This was evident with the introduction of the Presidential Amnesty Programme (IDI/Male/Separated/42years/Delta State).

This narratives align with Saha et al. (2024), who emphasize that effective governance is vital for reducing vulnerability by strengthening community resilience and addressing livelihood challenges. However, systemic gaps remain, as demonstrated by the National Action Plan (NAP) for Nigeria's coastal zone, which, despite focusing on ecosystem remediation, pollution control,

and sustainable resource use, has yet to be implemented. For example, the NAP's initiatives such as the Coastal Ecosystem Resources Center and mangrove conservation projects, essential for stabilizing eroded coastlines, have not materialized, highlighting institutional inertia and mismanagement of funds like the Ecological Fund (Ogbonna et al., 2020).

From the FGDs conducted, perspectives on mitigating vulnerability to coastal hazards consistently highlighted negligence from the government and poor infrastructural development. Participants emphasized that the lack of government engagement with oil-bearing communities fuels local resentment. They noted that poor infrastructure, unemployment, and environmental degradation contribute to maritime crimes and illegal activities, further degrading the environment. To address these challenges effectively, participants stressed the need for collaboration between government agencies, oil companies, and community leaders. In alignment with the aforementioned insights, the following summarizes additional explanations and highlights regarding the perceived perspectives on mitigating vulnerability to coastal hazards in the study area:

To mitigate these challenges, it is crucial for government authorities to implement effective environmental management strategies that address water pollution and support sustainable fishing practices. By fostering a healthier marine ecosystem, the local economy can thrive and benefit from both fishing and other related activity. Addressing these environmental issues will not only enhance economic opportunities but may also contribute to reducing criminal activities linked to resource scarcity and environmental degradation (FGDs in Bonny and Ekeremor).

Nigeria's fragmented environmental governance (demonstrated by the activities of Federal Ministry of Environment, NESREA, and NDDC) lacks integrated coastal management, unlike Bangladesh/India's centralized authorities. The Coastal Zone Management Division cannot enforce land-use/pollution controls, while the Ecological Fund misallocates resources, diverting funds from mangrove restoration. The respondent's reference to the PAP highlights the potential of compensation schemes to reduce conflict and environmental degradation. By addressing land loss and livelihood disruptions, such programmes could incentivize communities to adopt sustainable practices, such as mangrove replanting or ecotourism, instead of destructive coping mechanisms. However, this requires transparent governance, as noted in Ogbonna et al. (2020), who stress that community engagement and trust-building are essential for effective policy implementation

However, it is noteworthy that only 21.08% of respondents indicated support for additional solutions like participatory planning and community education programmes. This low figure raises concerns about the extent to which local voices are included in decision-making processes, which is critical for ensuring that mitigation strategies are culturally relevant and effectively implemented. This finding suggests that while there is strong support for existing measures, there may be gaps in involving local populations in governance structures that affect their lives. Other studies emphasize the necessity of participatory approaches to disaster risk management, arguing that marginalized communities often lack representation in planning processes, which can exacerbate their vulnerability. Therefore, enhancing community participation in governance and decision-making could complement existing strategies and lead to more effective mitigation of coastal hazards in the Niger Delta.

CONCLUSION

The study highlights that coastal hazards in the Niger Delta, including flooding, coastal erosion, and environmental pollution, are driven by several intertwined factors. Rapid population growth and anthropogenic activities such as oil exploration, deforestation, and sand mining have severely degraded the ecosystems, undermined traditional livelihoods, and elevated hazard risks. Moreover, inadequate drainage, poor urban planning, weak governance, and socio-economic challenges like unemployment increase the region's vulnerability to these hazards. Community perspectives underscore the need for strengthened shoreline protection, ecological restoration, and greater government support to address these risks effectively. Therefore, adopting integrated and inclusive mitigation strategies that actively involve key stakeholders, including community leaders, is crucial for building resilience and promoting sustainable development in the NDR.

Based on these findings, three major recommendations emerge:

1. The Federal Ministry of Environment, in collaboration with state ministries and agencies such as the NDDC and NESREA, should lead integrated coastal zone management initiatives by prioritizing infrastructure improvements and mangrove restoration.
2. Local government authorities and community-based organizations in the Niger Delta should be empowered by the state government through training and resources to implement participatory governance models that integrate community knowledge and promote inclusive decision-making for effective coastal hazard mitigation and resource management.
3. The Federal and state governments should implement socio-economic development programmes to target jobs creation in sectors such as renewable energy, eco-tourism, sustainable agriculture, and fisheries, coordinated with environmental policies that will reduce reliance on environmentally harmful activities and promote sustainable livelihoods and poverty alleviation in vulnerable coastal communities of the study area.

REFERENCES

- Adetunji, M. A., & Oyeleye, O. I. (2018). Effects of Coastal Hazards on Residential Location and Relocation in Nigeria. *International Journal of Geography and Regional Planning Research*, 3(1), 9–21.
- Adeyefa, A. O., Odekunle, T. O., & Adesina, F. A. (2023). Assessing the Physical Vulnerability of the Coastal Area of Nigeria to Climate Change. *Journal of Atmosphere and Oceanography Environment*, 11(1), 1–14. <https://doi.org/10.18686/jaoe.v11i1.9294>
- Afolabi, M., & Darby, S. (2022). Spatial and Temporal Variations in Shoreline Changes of the Niger Delta during 1986 – 2019. *Coasts*, 2, 203–220.
- Amangabara, G. T., & Onyewuchi, O. M. (2021). Morphological Changes along the shoreline of the arcuate Niger Delta from Parts of Delta State to Akwa Ibom State between 1986 and 2016. *Ghana Journal of Geography*, 13(1), 221–235.
- Angnuureng, D. B., Charuka, B., Almar, R., Dada, O. A., Asumadu, R., Agboli, N. A., & Ofosu, G. T. (2025). iScience Review Challenges and lessons learned from global coastal erosion protection strategies. *ISCIENCE*, 28(4), 112055. <https://doi.org/10.1016/j.isci.2025.112055>
- Aransiola, S. A., Zobeashia, S. S. L. T., Ikhumetse, A. A., Musa, O. I., Abioye, O. P., Ijah, U. J. J., & Maddela, N. R. (2024). Niger Delta Mangrove Ecosystem: Biodiversity, Past and Present Pollution, Threat and Mitigation. *Regional Studies in Marine Science*, 75(October), 1–9. <https://doi.org/10.1016/j.rsma.2024.103568>
- Areia, N. P., Tavares, A. O., & Costa, P. J. M. (2023). Public perception and preferences for coastal risk management: Evidence from a convergent parallel mixed-methods study. *Science of the Total Environment*, 882, 163440. <https://doi.org/10.1016/j.scitotenv.2023.163440>
- Bello, A. T., & Nwaeke, T. (2023). Impacts of Oil Exploration (Oil and Gas Conflicts; Niger Delta as a Case Study). *Journal of Geoscience and Environment Protection*, 11, 189–200. <https://doi.org/10.4236/gep.2023.113013>
- Biswas, S., & Nautiyal, S. (2023). A review of socio-economic vulnerability: The emergence of its theoretical concepts, models and methodologies. *Natural Hazards Research*, 3, 563–571. <https://doi.org/10.1016/j.nhres.2023.05.005>
- Bukvic, A., Rohat, G., Apotsos, A., & Sherbinin, A. De. (2020). A Systematic Review of Coastal Vulnerability Mapping. *Sustainability*, 12, 2822.
- Collins, T. W. (2008). The Political Ecology of Hazard Vulnerability: Marginalization, Facilitation and the Production of Differential Risk to Urban Wildfires in Arizona’s White Mountains. *Journal of Political Ecology*, 15(1), 21–43.
- Contestabile, P., & Vicinanza, D. (2020). Coastal Vulnerability and Mitigation Strategies: From Monitoring to Applied Research. *Water*, 12(2594), 1–7.
- Dada, O. T., Ojo, D. B., Popoola, A. S., Adebara, T. M., & Oladele, B. G. (2021). Variability of

- sense of place in Nigerian coastal communities. *Geographical Research*, 1–13. <https://doi.org/10.1111/1745-5871.12470>
- Daukere, B. E., & Ifabiyi, I. P. (2025). Socio-environmental factors and organized criminal networks influencing maritime crime dynamics in Nigeria's Niger Delta. *Environmental Challenges*, 20, 101263.
- Deb, D., Hasan, M., Uddin, M. M., Das, M. K., & Hasan, M. (2024). Coastal vulnerability assessment to multi hazards in the exposed coast of Southeastern Coastal Region of Bangladesh. *Regional Studies in Marine Science*, 73, 103484.
- Dike, E. C., Amaechi, C. V., Beddu, S. B., Weje, I. I., Ameme, B. G., Efevbokhan, O., & Oyetunji, A. K. (2024). Coastal Vulnerability Index sensitivity to shoreline position and coastal elevation parameters in the Niger Delta region, Nigeria. *Science of the Total Environment*, 919(January), 170830. <https://doi.org/10.1016/j.scitotenv.2024.170830>
- Ekeu-wei, B. F., & Ekeu-wei, I. T. (2024). *Crude Oil Spillage in the Niger Delta - Causes , Impact and Detection Approaches Crude Oil Spillage in the Niger Delta — Causes .* <https://doi.org/10.20944/preprints202408.0329.v1>
- Eyoh, A., & Okwuashi, O. (2016). Spatial and Temporal Evaluation of Land Use/Land Cover Change of the Niger Delta Region of Nigeria from 1986-2016. *International Journal of Geoinformatics and Geological Science*, 4(1). <https://doi.org/10.14445/23939206/ijggs-v4i2p103>
- Folorunsho, R., Salami, M., Ayinde, A., & Gyuk, N. (2023). The Salient Issues of Coastal Hazards and Disasters in Nigeria. *Journal of Environmental Protection*, 14, 361–372. <https://doi.org/10.4236/jep.2023.145021>
- Hart, A. O. (2024). *Oil Exploration, Water Quality and Public Health in Bonny and other Niger Delta Communities* (Issue November). Sunrise Publishers, Port Harcourt.
- Ikporukpo, C. O. (2018). From Adaka Boro to the Niger Delta Avengers: The Dynamics and Management of the Revolt in Nigeria's Niger Delta. *International Journal of African and Asian Studies*, 43, 35–48.
- Kim, K., Kang, J., & Hwang, C. (2025). Identifying Indicators Contributing to the Social Vulnerability Index via a Scoping Review. *Land*, 14(263), 1–23.
- Lalancette, A., & Charles, A. (2022). Factors influencing hazard management by municipalities: The case of coastal communities. *Global Environmental Change*, 73, 102451. <https://doi.org/10.1016/j.gloenvcha.2021.102451>
- Nanadeinboemi, O., Uju, M., Christopher, C., Hakeem, O., & David, D. (2024). Environmental and Health Influences of Crude Oil Spills in Niger Delta, Nigeria: Case Study Oporoma Community. *Journal of Health and Environmental Research*, 10(2), 29–40. <https://doi.org/10.11648/j.jher.20241002.11>
- National Bureau of Statistics. (2011). *National Bureau of Statistics: Annual Abstract of Statistics, 2011. Federal Republic of Nigeria.*

- Ndimele, P. E., Ojewole, A. E., Mekuleyi, G. O., Badmos, L. A., Agosu, C. M., Olatunbosun, E. S., Lawal, O. O., Shittu, J. A., Joseph, O. O., Ositimehin, K. M., Ndimele, F. C., Ojewole, C. O., Abdulganiy, I. O., & Ayodele, O. T. (2024). Vulnerability, Resilience and Adaptation of Lagos Coastal Communities to Flooding. *Earth Science, Systems and Society*, 4(July), 1–19. <https://doi.org/10.3389/esss.2024.10087>
- Nesta, T. (2025). NDDC Reportedly Awards Shore Protection Jobs For Two Itsekiri Riverine Communities. *Fresh Angle*.
- Neumann, B., Vafeidis, A. T., Zimmermann, J., & Nicholls, R. J. (2015). Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding - A Global Assessment. *PLoS ONE*, 10(3), e0118571. <https://doi.org/10.1371/journal.pone.0118571>
- Nkwunonwo, U. C., Tobore, A., & Nwaka, O. C. (2024). Ecosystem-based approach to local flood risk management in Ogun State, Nigeria: Knowledge, and pathway to Actualisation. *Natural Hazards Research*, 4(3), 357–373. <https://doi.org/10.1016/j.nhres.2023.09.003>
- Ntor, C., Gobo, A. E., Yuodeowei, P. O., Akpodee, R. ., & Inyany, I. . (2024). Assessing River Flood Vulnerability in Niger Delta Coastal Communities: A Hydro-Meteorological Analysis. *IIARD International Journal of Geography & Environmental Management*, 10(11), 14–28. <https://doi.org/10.56201/ijgem.v10.no11.2024.pg14.28>
- Nwankwoala, H. O., & Okujagu, D. C. (2021). Review of Wetlands and Coastal Resources of the Niger Delta: Potentials, Challenges and Prospects. *Environment & Ecosystem Science*, 5(1), 37–46. <https://doi.org/10.26480/ees.01.2021.37.46>
- Ogba, C. O., & Utang, P. B. (2007). Vulnerability And Adaptations Of Nigeria's Niger Delta Coast Settlements To Sea Level Rise. *Strategic Integration of Surveying Services FIG Working Week 2007 Hong Kong SAR, China 13-17 May 2007, May 2007*, 1–15.
- Ogbonna, C., Albrecht, E., Ugochukwu, C., Nwajiuba, C., & Onyeneke, R. (2020). Climate Resilience in African Coastal Areas: Scaling Up Institutional Capabilities in the Niger Delta Region. In W. L. Filho (Ed.), *Handbook of Climate Change Resilience, Volume 1-4* (Vol. 1, pp. 29–49). Springer, Chma. https://doi.org/10.1007/978-3-319-93336-8_9
- Oloyede, M. O., Williams, A. B., Ode, G. O., & Benson, N. U. (2022). Coastal Vulnerability Assessment: A Case Study of the Nigerian Coastline. *Sustainability*, 14(2097), 1–21.
- Oyegun, C. U., Lawal, O., & Ogoro, M. (2016). Vulnerability Of Coastal Communities In The Niger Delta Region To Sea Level Rise. *Uest Journals Journal of Research in Environmental and Earth Science*, 2(8), 1–8.
- Saha, M. K., Biswas, A. A. A., & Faisal, M. (2024). Livelihood Vulnerability of Coastal Communities in Context of the Climate Change: A Index-Based Assessment. *World Development Sustainability*, 4(June 2022), 100152. <https://doi.org/10.1016/j.wds.2024.100152>

- Shi, P., Ye1, T., Wang, Y., Zhou, T., Xu, W., Du, J., Wang, J., Li, N., Huang, C., Liu, L., Chen, B., Su, Y., Fang, W., Wang, M., Hu, X., Wu, J., He, C., Zhang, Q., Ye, Q., ... Okada, N. (2020). Disaster Risk Science□: A Geographical Perspective and a Research Framework. *International Journal of Disaster Risk Science*, 11(4), 426–440. <https://doi.org/10.1007/s13753-020-00296-5>
- Sofyan, H., Rolanda, R., Hidayati, A., Syamsidik, & Oktari, R. S. (2024). Analysis of socio-economic factors affecting coastal community preparedness using structural equation modeling. *ITM Web of Conferences*, 67, 01051. <https://doi.org/10.1051/itmconf/20246701051>
- Tourlioti, P. N., Portman, M. E., Tzoraki, O., & Pantelakis, I. (2021). Interacting with the Coast: Residents' Knowledge and Perceptions about Coastal Erosion (Mytilene, Lesvos Island, Greece). *Ocean and Coastal Management*, 210, 105705 Contents.
- Week, D. A., & Wizer, C. H. (2020). Effects of Flood on Food Security, Livelihood and Socio-economic Characteristics in the Flood-prone Areas of the Core Niger Delta, Nigeria. *Asian Journal of Geographical Research*, 3(1), 1–17. <https://doi.org/10.9734/ajgr/2020/v3i130096>
- Yamane, T. (1967). *Statistics: An Introductory Analysis*. New York: Harper and Roxy.
- Zabbey, N., Kpaniku, N. C., Sam, K., Nwipie, G. N., Okoro, O. E., Zabbey, F. G., & Babatunde, B. B. (2021). Could community science drive environmental management in Nigeria's degrading coastal Niger delta? Prospects and challenges. *Environmental Development*, 37, 100571. <https://doi.org/10.1016/j.envdev.2020.100571>
- Zhang, Y., Ouyang, Z., Xu, C., Wu, T., & Lu, F. (2024). A multi-hazard framework for coastal vulnerability assessment and climate-change adaptation planning. *Environmental and Sustainability Indicators*, 21, 100327. <https://doi.org/10.1016/j.indic.2023.100327>