e-ISSN:2582-7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 7, Issue 11, November 2024

INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.521

6381 907 438 6381 907 438 ijmrset@gmail.com www.ijmrset.com

© 2024 IJMRSET | Volume 7, Issue 11, November 2024| DOI: 10.15680/IJMRSET.2024.0711003

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Spatial Map Flood Vulnerability Matrix of Communities in the Greater Port Harcourt

Ogboeli G. P. N., Chilaka, S. N., Abam, T. K. S., Onwuteka, J.N.

Institute of Geoscience and Environmental Management, Rivers State University, Port Harcourt, Nigeria [1-3]

Department of Applied Ecology and Biology, Rivers State University of Science and Technology,

Port Harcourt, Nigeria[4]

ABSTRACT: The Greater Port Harcourt Area (GPHA) in Nigeria is not an exception to the fact that flooding is still one of the most serious environmental issues that urban regions face globally. In order to evaluate the flood susceptibility of communities in the Greater Port Harcourt Area—a region distinguished by low-lying terrain, high rainfall intensity, fast urbanization, and poor drainage infrastructure—this study creates a Spatial Map Flood susceptibility Matrix (SMFVM). In order to identify and evaluate communities according to their vulnerability to flood threats, this study combines hydrological data, land use patterns, socioeconomic variables, and geographical analysis. In order to assess the relative risk of flooding in various locations, the vulnerability matrix takes into account variables including terrain, proximity to bodies of water, historical flood data, drainage capacity, and socioeconomic circumstances. Using Geographic Information System (GIS) techniques, a comprehensive spatial map that graphically depicts the region's flood risk is produced. According to the findings, low-lying parts of Port Harcourt, coastal zones, settlements along the Bonny River, Borokiri, Diobu, and Port Harcourt Town are all at the most danger, as are fast urbanizing districts with poor drainage systems. Furthermore, Obio-Akpor's settlements—particularly those in Abuloma, Alese, Egbelu, Eneka, Rukpokwu, Rumuomasi, and Rumuokoro—are extremely susceptible to floods because to their inadequate drainage systems and urban expansion. In its conclusion, the report offers suggestions for specific flood risk reduction tactics, such as better urban planning, more infrastructure, and greater flood readiness for high-risk regions. For urban planners, legislators, and disaster management organizations striving to increase flood resilience and sustainability in the Greater Port Harcourt Area, this study provides insightful information.

KEYWORDS: Flood vulnerability, spatial mapping, flood risk, Greater Port Harcourt, GIS, urban resilience, climate change, flood mitigation

I. INTRODUCTION

One of the most urgent environmental and socioeconomic problems that communities worldwide face is flooding. Because to its geographic, climatic, and socioeconomic features, the Greater Port Harcourt Area (GPHA) in Nigeria is a particularly vulnerable area (Emoh & Ume, 2013). The Niger Delta's GPHA is vulnerable to coastal and riverine flooding, which is made worse by a confluence of factors like excessive rainfall, poor drainage systems, growing urbanization, and the effects of climate change. Policymakers, urban planners, and environmental managers are growing more concerned about this vulnerability, particularly as the area is growing and changing. The degree to which a community is susceptible to flood-related destruction is known as flood vulnerability. This depends on a number of variables, such as the geography of the area, the distance from bodies of water, the quality of the constructed infrastructure, and socioeconomic circumstances that affect people's capacity to adjust to or recover from flooding (Adelekan, 2010). Spatial maps, which enable the visual representation of flood risks across various places, are an essential tool for comprehending and mitigating flood vulnerability. A Spatial Map Flood Vulnerability Matrix (SMFVM) offers a methodical framework for evaluating the relative flood hazards that various communities in the Greater Port Harcourt Area confront in this regard.

One tool for assessing and ranking the flood susceptibility of communities in a particular area is a Spatial Map Flood susceptibility Matrix (SMFVM). Usually, the matrix contains a variety of criteria, including: Areas with low elevation are more likely to experience floods, especially those that are located close to rivers or other bodies of water (Emoh &

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Ume, 2013). Being Close to Water Bodies: Flooding from both riverine and coastal sources is more likely to occur in communities close to rivers, estuaries, and the ocean. Land Use and Infrastructure: Severe flooding is more likely to occur in built-up regions with inadequate drainage systems and informal settlements (Oruonye, 2016). Rainfall Intensity: Particularly in locations with inadequate drainage, flooding risks may be made worse by heavy rainfall and the effects of climate change (Adelekan, 2010). Flood Events in the Past: Floods in the past are a reliable indicator of an area's susceptibility. Communities with a history of flooding are probably going to be more susceptible going forward. Based on these factors, the SMFVM assigns a flood risk score to each community, which is subsequently mapped to graphically depict high, medium, and low vulnerability zones. The Greater Port Harcourt area's flood vulnerability matrix and the main variables affecting flood hazards are examined in this study.

II. MATERIAL AND METHOD

Location and extent

The Niger Delta is a vast network of rivers, wetlands, and coastal areas that includes the Greater Port Harcourt area. The actual Port Harcourt is situated where the Bonny and Port Harcourt rivers converge. Low-lying marshes, swamps, and floodplains that are vulnerable to flooding are features of the geography, especially during the rainy season (April to October) and in years with large tidal surges (Udo, 1970). With densely inhabited places like Port Harcourt's city center and less developed outlying areas like Oyigbo, Okrika, Ogu–Bolo, Obio–Akpor, Ikwerre, Etche, and Eleme local government areas, the GPHA encompasses a broad spectrum of urban, peri-urban, and rural areas. Its size is around 1,900 km² (734 mi²), and as of 2009, it has a population of 2 million. Poor drainage infrastructure, uncontrolled urban growth, and climate change-induced increases in sea level and rainfall intensity all contribute to the region's susceptibility to flooding (Adelekan, 2010, Ogboeli et al 2023). The planned metro area will be built through extensive plans that implement and enforce rules for infrastructure development and service delivery aimed at raising people's standard of living and overall well-being.

The new metro region is anchored by the Port of Onne, Port Harcourt City, and Port Harcourt International Airport. The Greater Port Harcourt City Development Authority (GPHCDA) was established on April 2, 2009, with the passage of Greater Port Harcourt City Development Authority Law No. 2 of 2009. Developing the new Greater Port Harcourt Master Plan (2008) metropolitan area and supporting the master plan's implementation are among its responsibilities.

Geo-Processing of Imageries

The groups of landsat satellite symbolisms of the inquiry space of way 189 and line 056, way 189 and line 057, way 188 and line 056, and way 188 and line 057 will be combined to form a single band symbolism for each scene. For additional study, the scenes were then blended using mosaicked measurement. While the investigation region's height or guidance was established using the Shuttle Radar Topographic Mission (SRTM) symbolism, the mosaicked symbolism will be cut using the Greater Port Harcourt shapefile to provide an unambiguous boundary for the investigation territory. The FAO/UNESCO World Soil Map (1973) served as the basis for the dirt guide. Nonetheless, the networks and stream networks were sourced from the world facilitate framework (WGS 84) in ArcGIS 10.5 by georeferencing the geographical guide. The study area's land use guide was derived from the symbols, while the geographical guide provided information on seepage, street, and network organization.

Vulnerability Criteria

In this investigation, positioning strategies for the weakness elements rooted in Saaty's (1980) Analytical Hierarchy Process (AHP) were employed. AHP is a dynamic, multi-measures technique that offers a methodical way to evaluate and control the effects of multiple factors, such as different amounts of independent or dependent, subjective, and quantitative data (Bapalu and Sinha, 2006). Since each measure map was given a proportionate amount of weight, positioning strategy will be taken into account, since basis loads are typically discussed throughout the conference cycle with decision- or commanders (Lawal et al, 2011). The request for the leader's inclination contains every practical regulation in the placement technique. To create measure esteems for each assessment unit, each element was assigned a weight based on its projected relevance in creating flooding.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Land use Map

The land use/cover map will be made using the satellite symbolisms. The controlled order technique was obtained by grouping the neighboring symbols using the MAXLIKE (Maximum Likelihood Algorithm) module. The area in square kilometers of each category of land use was processed. The primary land uses found were marsh woods/thick forest, farmland/light backwoods, mangroves, waterbodies, and developed areas.

Proximity to stream channels (Drainage) and Community Map

The trash organization's vector data, which establishes the area's proximity to waterway channels and networks, was digitalized using ArcGIS 10.5 from the research area's geographic guide.

Elevation or Relief Map

The rising map was created using SRTM height data from 30-kilometer frames. Using the shapefile limit of the inquiry region, the raster data was geo-handled and sliced for additional analysis.

Soil surface Map

The soil texture map was sourced from the FAO/UNESCO World Soil Map. Depending on the main soil types, such as regosol, fluvisol, gleysol, and ferrasol, the soil texture grades were fine, silty/topsoil, sand, coarse, and ferrasol.

GIS Analysis and Generation of Vulnerability Maps

"High weakness, moderate weakness, and low weakness" were used to describe soil surface guidance, rise or help, land use, and proximity to stream channels (seepage).

Reclassification dependent on land use types

Farmland/light timberland, mangrove, developed region, waterbodies, and bog backwoods/thick forests are the five land use types found in the examination area. The bog backwoods/thick woodland and farmland/light timberland were renamed to direct weakness on the land use map, while the developed region, mangrove, and waterbodies were reclassified to high weakness.

Reclassification dependent on waste organization

Rings of 500, 1000, and 1500 meters were created as impact zones from the dynamic canal channels as part of a buffering strategy to arrange the trash. One thousand meters was considered a moderate weakness, 1500 meters a low weakness, and 500 meters a high weakness.

Reclassification dependent on rise

The rising map will also be renamed as follows: low weakness will be defined as 178 meters or greater, moderate weakness as 89.01 to 178 meters, and extreme weakness as 10.00 to 89.00 meters.

Reclassification dependent on soil surface

The soil strength map will be solved using the soil surface of Greater Port Harcourt. The four types of dirt that were recognized were sand, fine/mud, coarse, and silty/soil. According to Duncan and Wright (2005), soil strength files are crucial for determining how stable soil and slopes are. The ability of a soil to withstand the stresses and strains connected with common ring cases, such as increased pore pressure, breaking, growing, improving of slicken sides, filtering, enduring, undermining, and cyclic stacking, may also be ascertained using them. The terms coarse and sand were changed to low weakness, silty/soil to direct weakness, and fine/dirt to high weakness.

Final Flood Vulnerability Map

The weakness level upsides of 3, 2, and 1 were deferentially allocated to strong weakness, moderate weakness, and low weakness. This will be carried out in order to rank the constituents or elements of each significant flooding-causing cause. These features made it possible to overlay the maps of land use weakness, waste organization weakness, rise weakness, and soil surface weakness using UNION MODULE. "High weakness," "moderate weakness," and "low weakness" were then used interchangeably. The output of this guide was regarded as the flood vulnerability guide for Greater Port Harcourt. geographical inquiry will be utilized to identify the geographical degree (square kilometer) of each level of weakness and to ascertain which degrees of weakness each local region fell into.

© 2024 IJMRSET | Volume 7, Issue 11, November 2024| DOI: 10.15680/IJMRSET.2024.0711003

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Vulnerability in Greater Port Harcourt

Landuse/Land Cover

The sensitivity ratings assigned to each land use in Greater Port Harcourt were used to determine how susceptible the land use map was to floods. Table 1, Figure 1, and Figure 2 describe the various land use types that were seen along with their corresponding geographic coverage. The thick vegetation was found to have the highest geographical expanse (953.26 km^2), followed by the accumulation area (453.62). Additionally, the study revealed that there were 283.01 km^2 of waterbodies, 405.50 km^2 of farmlands and sparse vegetation, and 430.78 km^2 of freshwater swamps and riparian areas. The area with high flood vulnerability encompassed 29.16 percent of its geographical coverage, whereas the zone with moderate flood susceptibility covered 33.10 percent (Table 2).

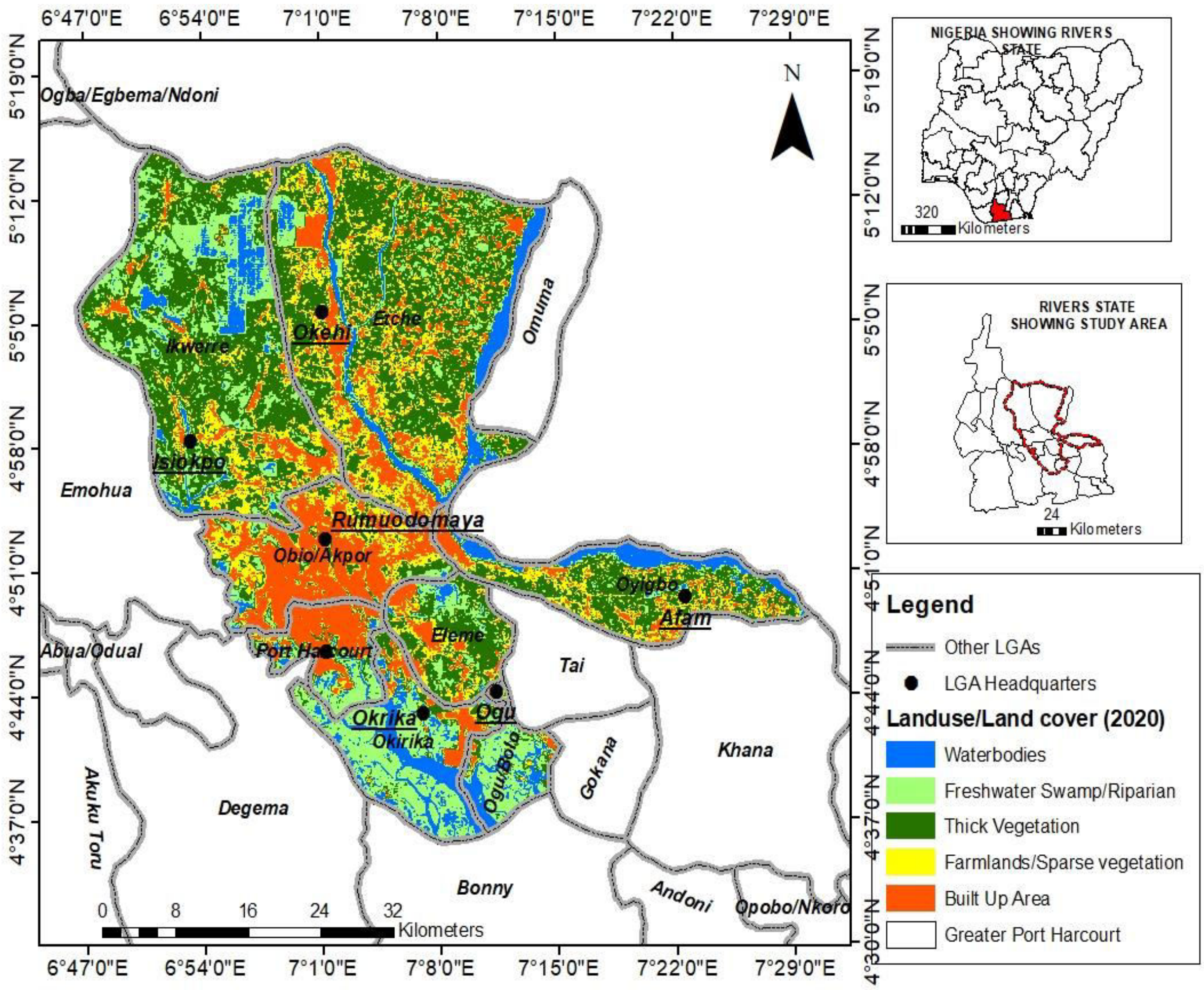

Figure 1: Landuse/ Land cover of the Study Area

© 2024 IJMRSET | Volume 7, Issue 11, November 2024| DOI: 10.15680/IJMRSET.2024.0711003

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

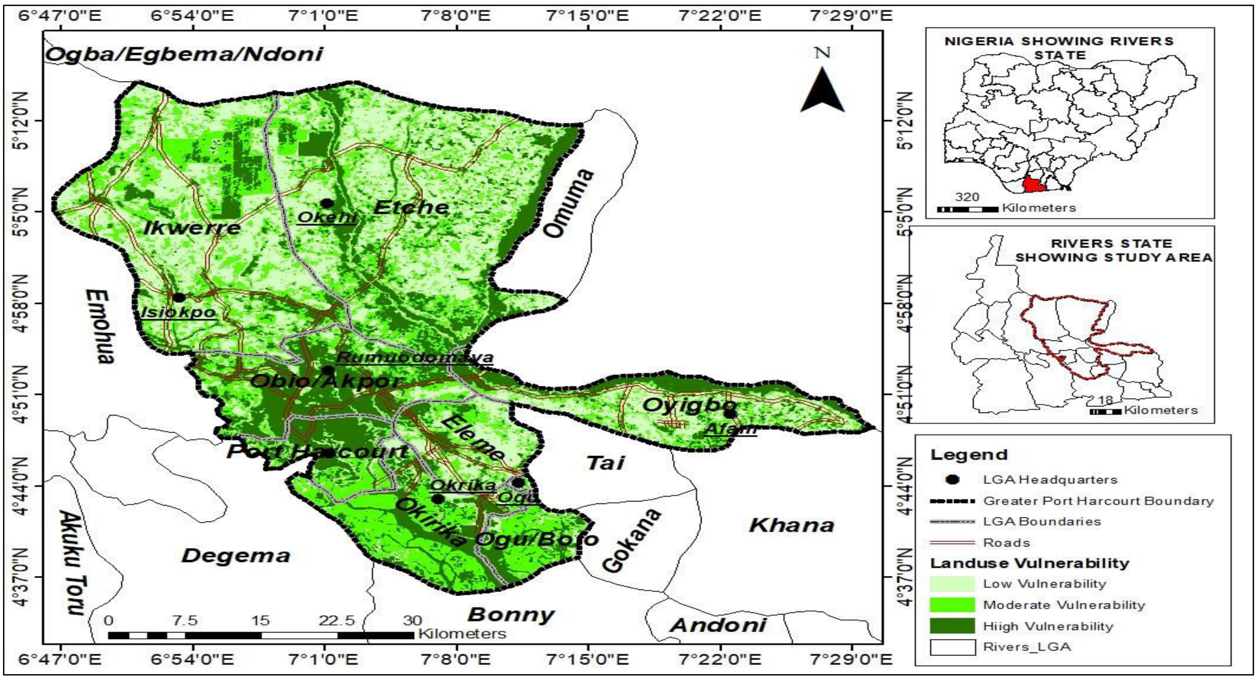

Figure 2: Landuse/Land cover Vulnerability

Table 1: Landuse/Land cover of the Study Area

Landuse/Land cover	Spatial Extent (sq km)	Percentage (%)	Vulnerability Rank	Vulnerability Interpretation
Waterbodies	283.01	11.20	3	High
Freshwater Swamp/Riparian	430.78	17.05	2	Moderate
Thick Vegetation	953.26	37.74	1	Low
Farmlands/Sparse vegetation	405.50	16.05	2	Moderate
Built Up Area	453.62	17.96	3	High
Total	2526.17	100.00		

Table 2: Landuse/Land cover Vulnerability

Landuse Vulnerability Rank	Spatial Extent (sq km)	Percentage (%)
Low	953.26	37.74
Moderate	836.68	33.10
High	736.63	29.16
Total	2526.17	100.00

Soil Texture Vulnerability

Table 3, Figures 3, 4, and 5 describe the research region's soil texture vulnerability to flooding. The study found that clay loam covered 7.09% of the area and sandy loam covered 17.80%. Additionally, sandy covered just 70.07% and fine silty covered 5.04%. This proved that the majority of the soil in the study area was sandy. Low vulnerability accounted for 70.07% of soil texture flood risk, moderate vulnerability for 22.84%, and severe vulnerability for 7.09%.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

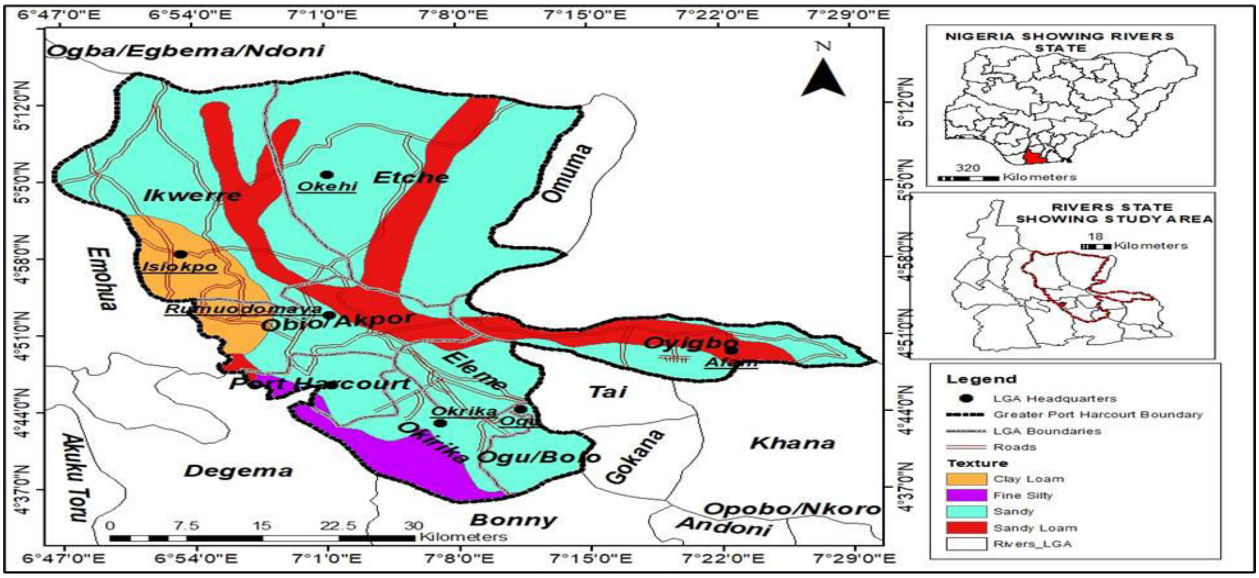

Figure 3: Soil Texture of Greater Port Harcourt

Table 3: Soil Texture of Greater Port Harcourt

Soil Texture	Spatial Extent (sq km)	Percentage (%)
Sandy Loam	449.68	17.80
Clay Loam	179.09	7.09
Sandy	1770.07	70.07
Fine Silty	127.19	5.04
Total	**2526.02**	**100.00**

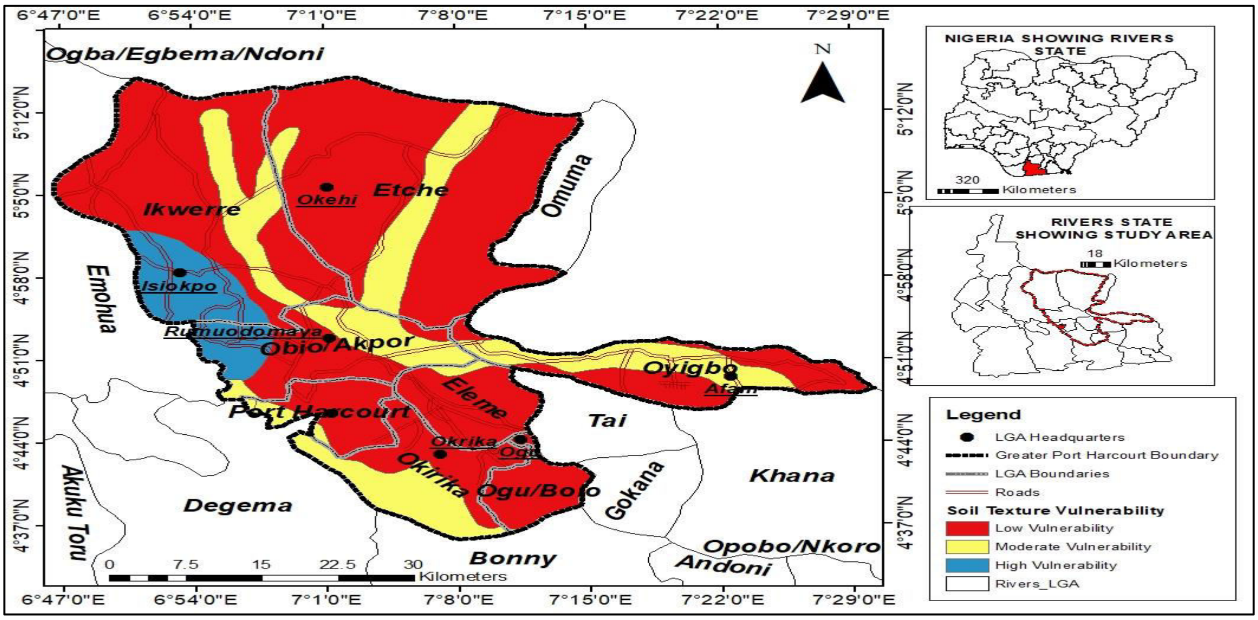

Figure 4: Soil Texture Vulnerability of Greater Port Harcourt

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Table 4: Soil Texture Vulnerability of Greater Port Harcourt

Soil Texture Vulnerability	Spatial Extent (sq km)	Percentage (%)
Low	1770.07	70.07
Moderate	576.86	22.84
High	179.09	7.09
Total	**2526.02**	**100.00**

Proximity to Active River Channel

The region closest to the active river channel was 402.93 square meters, or 37.57% of the entire study area, as shown in Figure 5 and Table 5. At 1000 meters, the area closest to the active river channel was 33.42%, and at 1500 meters, it was 29.01%. Therefore, the river proximity vulnerability covered 29.01% of the weakly susceptible regions, 33.42% of the moderately sensitive areas, and 37.57% of the highly vulnerable areas, as can be shown in Figure 6 and Table 6.

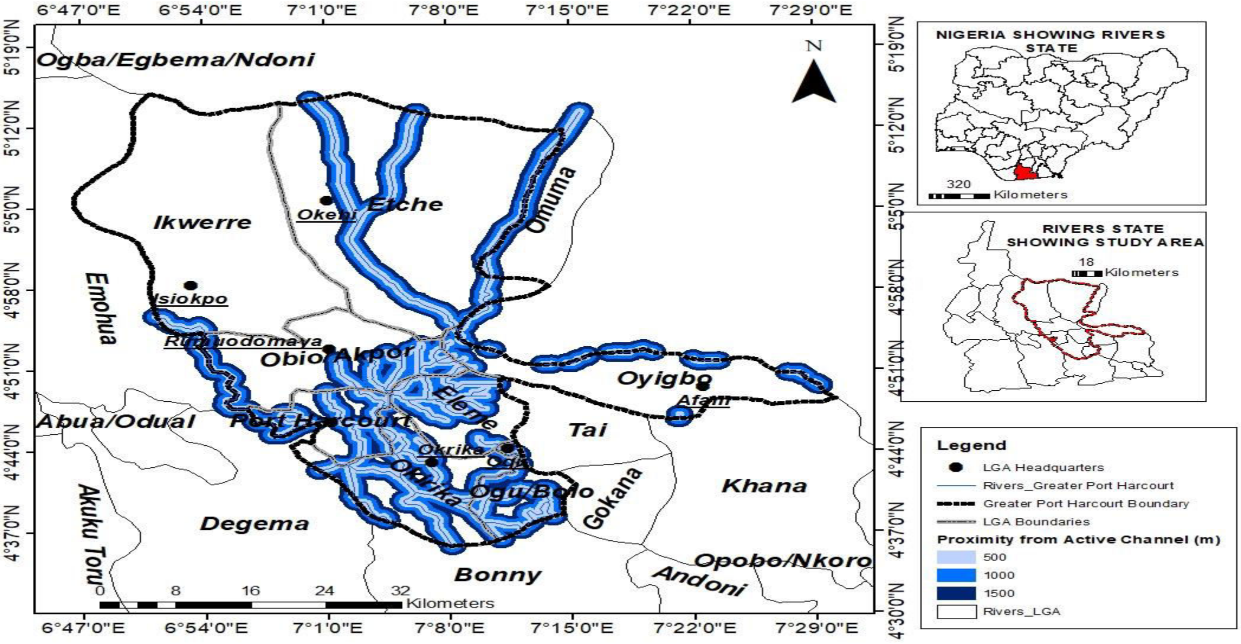

Figure 5: Proximity to Active Channel

Table 5: Proximity to Active Channel

River Proximity (m)	Spatial Extent (sq km)	Percentage (%)
500	402.93	37.57
1000	358.38	33.42
1500	311.16	29.01
Total	**1072.47**	**100.00**

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

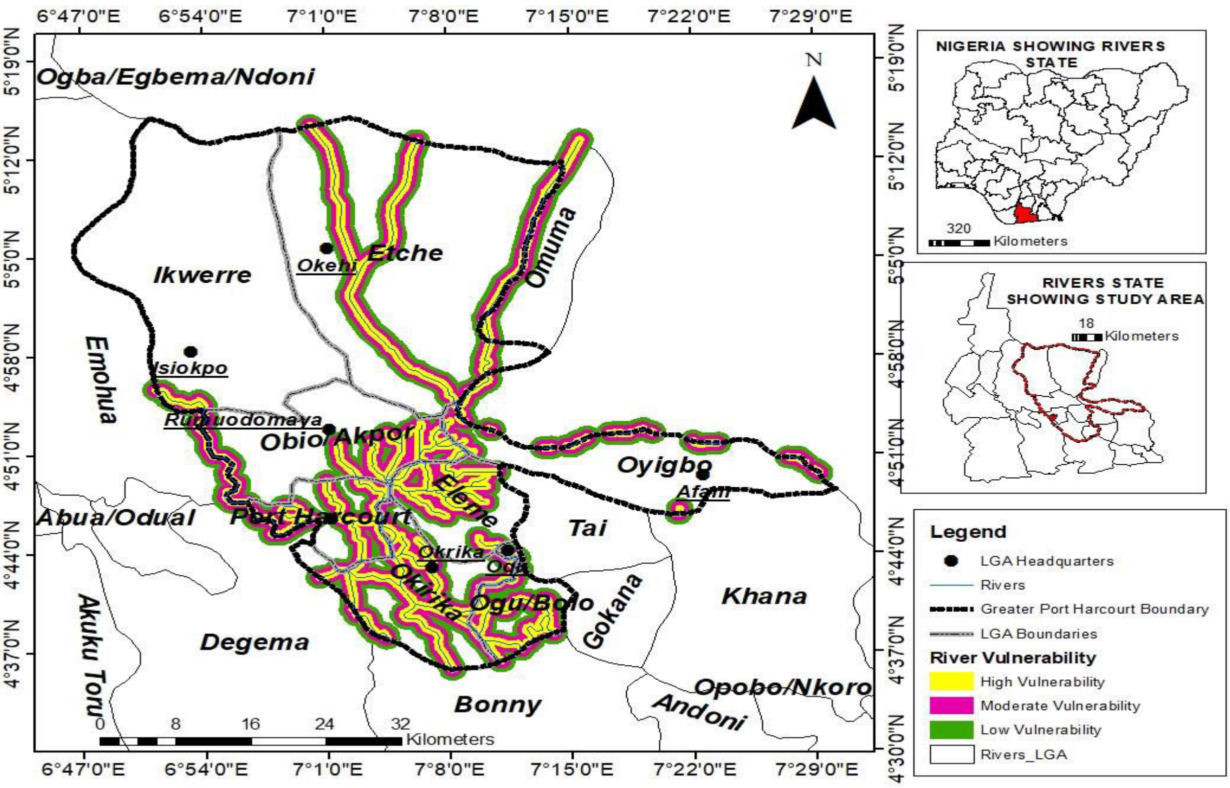

Figure 6: Flood Vulnerability based on Proximity to River Channel

Table 6: Proximity to River Channel Vulnerability

River Proximity Vulnerability Rank	Spatial Extent (sq km)	Percentage (%)
Low	311.16	29.01
Moderate	358.38	33.42
High	402.93	37.57
Total	**1072.47**	**100.00**

Flood Vulnerability Map based on Elevation

The elevation of Greater Port Harcourt ranged from 1 to 64 meters. Furthermore, it is shown that 395.18 square kilometers, or 15.91% of the entire study area, were covered by the elevation range of 1 to 12 meters; 16.65% by 12.1 to 21 meters; 20.42 by 21.1 to 29 meters; 20.88% by 29.1 meters to 38 meters; 20.57 by 38.1 meters to 48 meters; and 5.58% by 48.1 meters to 64 meters. The flood risk level is thus shown as a function of elevation in Table 8 and Figure 8, where 32.55% of the regions are categorized as low susceptibility, 41.30% as moderate vulnerability, and 26.15% as very vulnerable.

© 2024 IJMRSET | Volume 7, Issue 11, November 2024| DOI: 10.15680/IJMRSET.2024.0711003

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

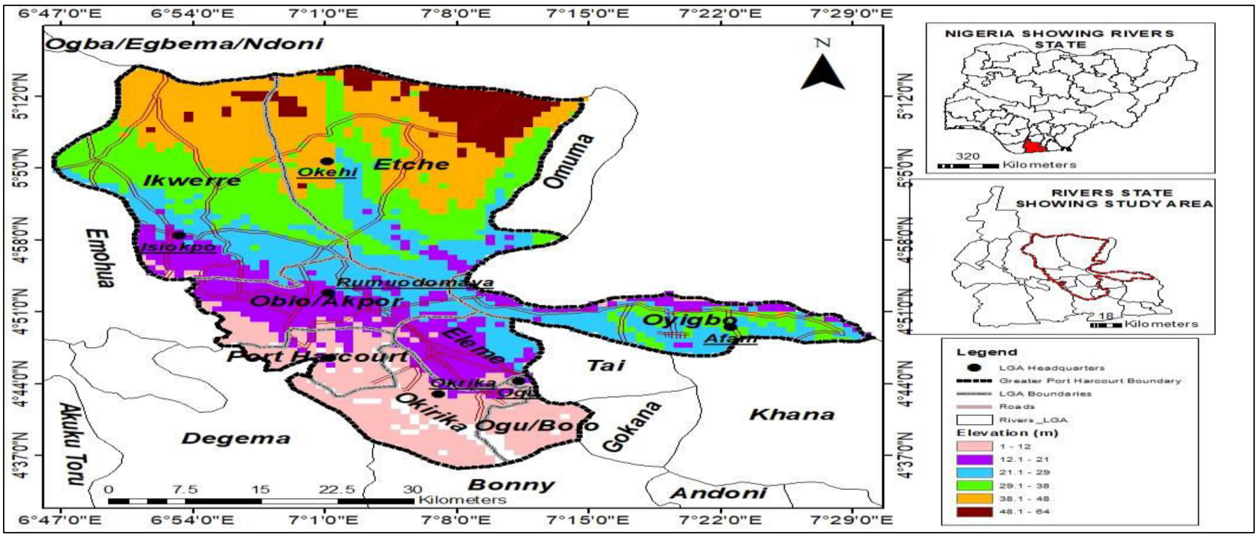

Figure 7: Elevation of the Study Area

Table 7: Elevation of the Greater Port Harcourt

Elevation (m)	Spatial Extent (sq km)	Percentage (%)	Vulnerability Rank	Vulnerability Interpretation
1-12.0	395.18	15.91	3	High
12.1-21.0	413.55	16.65	3	High
21.1-29.0	507.43	20.42	2	Moderate
29.1-38.0	518.68	20.88	2	Moderate
38.1-48.0	511	20.57	1	Low
48.1-64.0	138.59	5.58	1	Low
Total	2484.43	100.00		

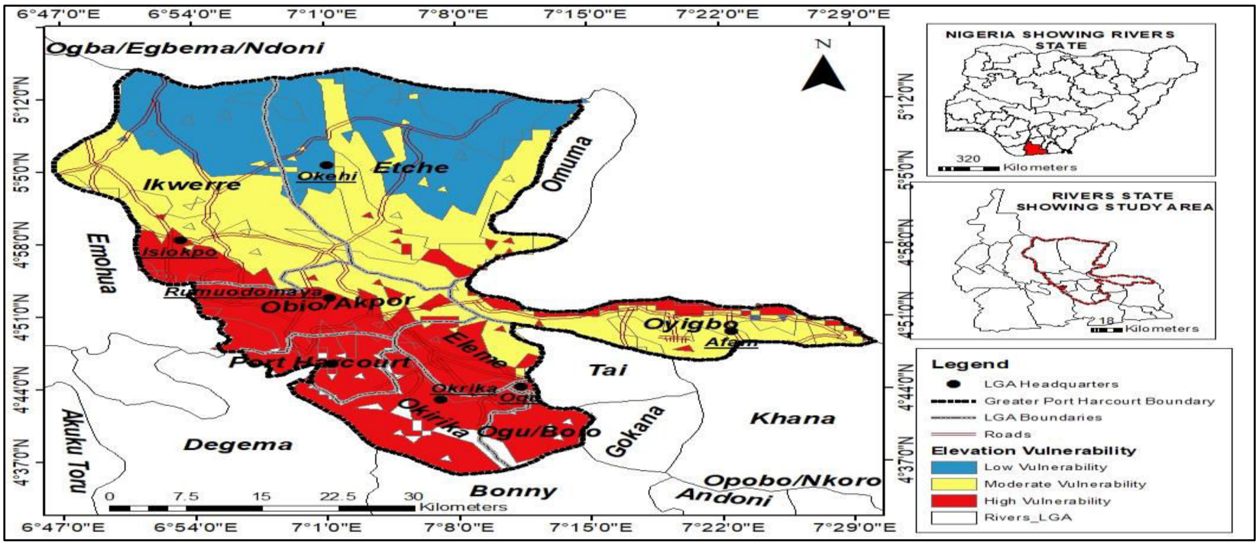

Figure 8: Elevation vulnerability of the Study Area

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Table 8 Elevation vulnerability of the Greater Port Harcourt

Elevation Vulnerability Rank	Spatial Extent (sq km)	Percentage (%)
Low	808.74	32.55
Moderate	1026.1	41.30
High	649.59	26.15
Total	2484.43	100.00

Flood Vulnerability Map based on Percent Rise

The findings of the percent rise study for the larger Port Harcourt area are displayed in Table 9 and Figure 9. In contrast, 4.89% covered areas between 0.543% and 0.784%, 1.71% covered areas between 0.785% and 1.143%, 17.51% covered areas between 0.238% and 0.367%, 10.65% covered areas between 0.368% and 0.542%, and 33.79% covered the entire area by percent rise between 0% and 0.10%. In Greater Port Harcourt, 6.59% of all regions were categorized as low susceptibility, 28.16% as moderately sensitive, and 62.25% as highly vulnerable based on the percentage increment in flood risk (Figure 10; Table 10).

Table 9: Percent Rise of Greater Port Harcourt

Percent Rise (%)	Spatial Extent (sq km)	Percentage (%)	Vulnerability Rank	Vulnerability Interpretation
0-0.130	723.12	33.79	3	High
0.131-0.237	673.13	31.45	3	High
0.238-0.367	374.77	17.51	2	Moderate
0.368-0.542	227.85	10.65	2	Moderate
0.543-0.784	104.63	4.89	1	Low
0.785-1.143	36.49	1.71	1	Low
Total	2139.99	100.00		

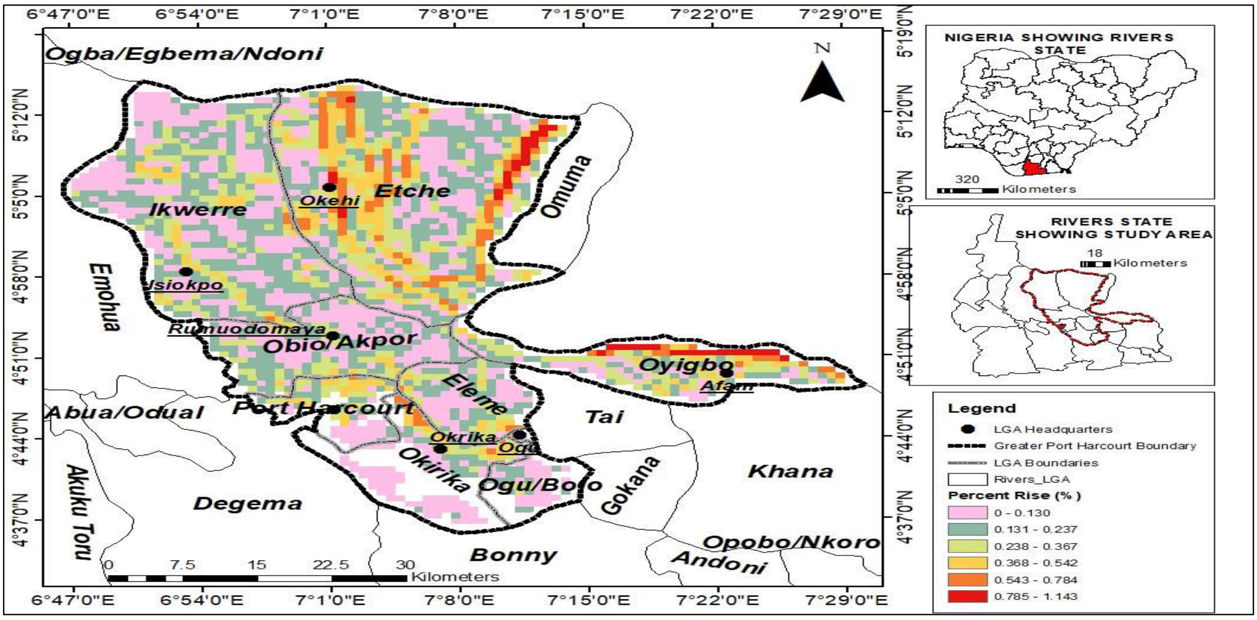

Figure 9: Percent Rise of Greater Port Harcourt

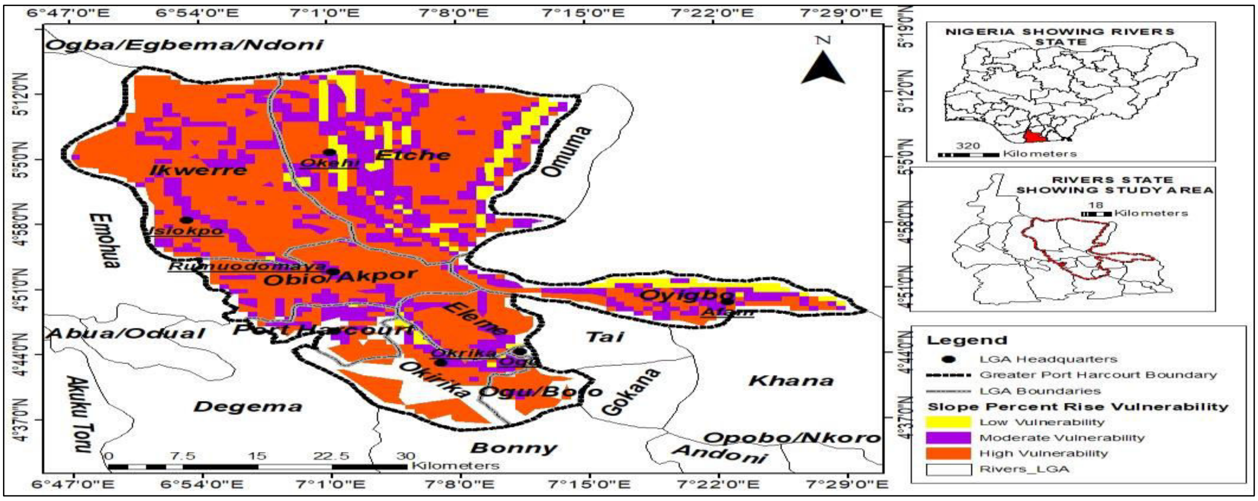

Figure 4.10: Flood Vulnerability based on Percent Rise

Table 10: Slope Percent Rise Vulnerability

Slope Percent Rise Vulnerability Rank	Spatial Extent (sq km)	Percentage (%)
Low	141.11	6.59
Moderate	602.63	28.16
High	1396.25	65.25
Total	2139.99	100.00

Final Flood Vulnerability of Greater Port Harcourt

539.15 sq km, or 21.25% of the total study area, were low flood susceptibility areas; 1147.41 sq km, or 45.23 percent, were moderately vulnerable areas; and 850.02 sq km, or 33.51%, were very vulnerable areas. These numbers show Greater Port Harcourt's ultimate flood susceptibility. This suggests that more places in the study area were deemed to be moderately or very susceptible to flooding.

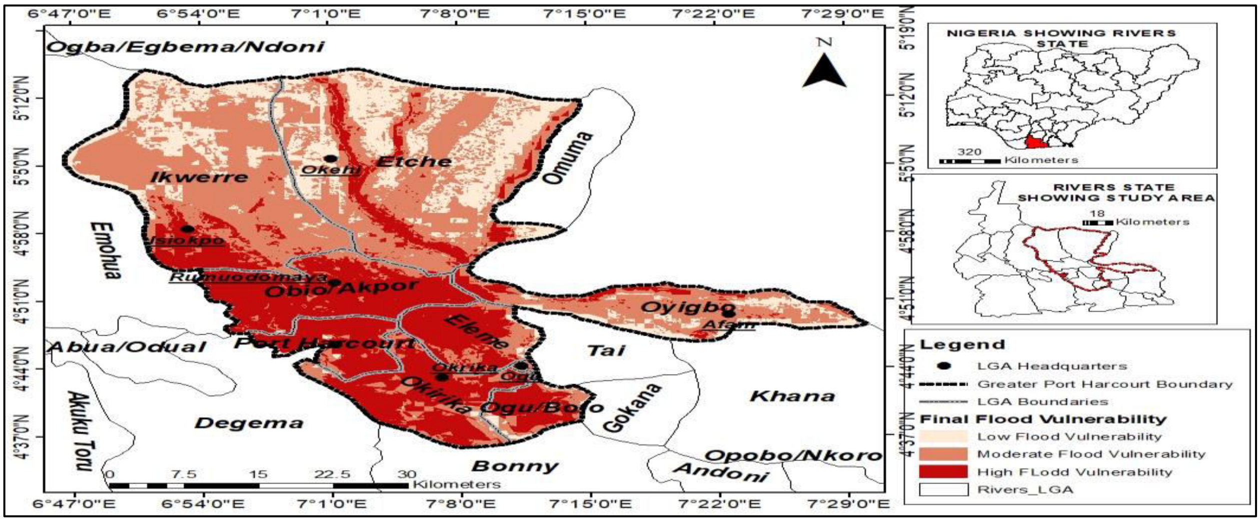

Figure 11: Final Flood Vulnerability Levels in Greater Port Harcourt

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Table 11: Final Flood Vulnerability Levels of Greater Port Harcourt

Final Flood Vulnerability	Spatial Extent (sq km)	Percentage (%)
Low	539.15	21.25
Moderate	1147.41	45.23
High	850.02	33.51
Total	2536.58	100.00

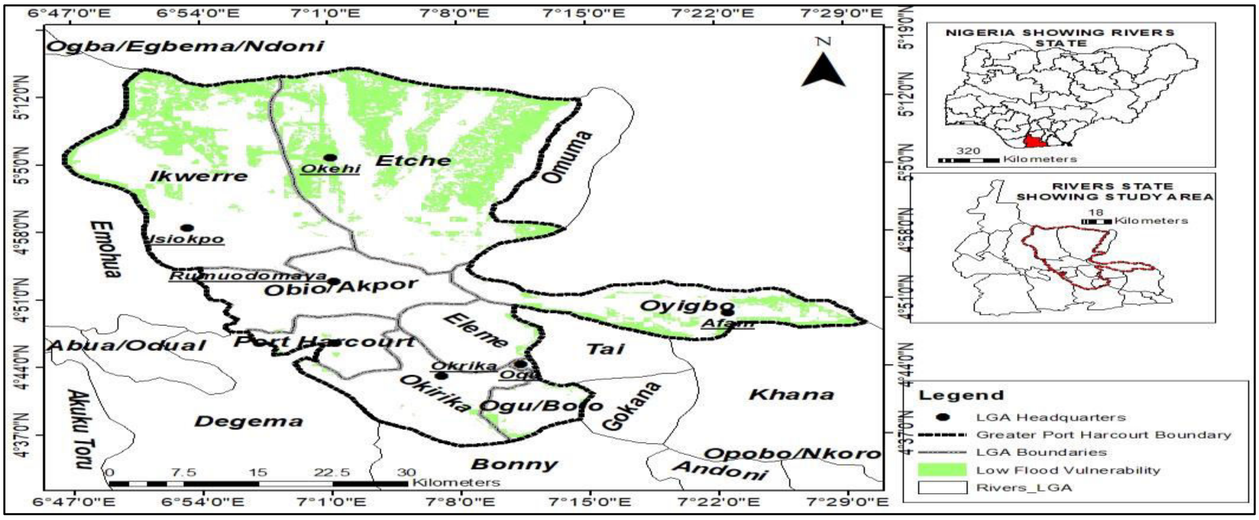

Figure 12: Low Flood Vulnerability Only in Greater Port Harcourt

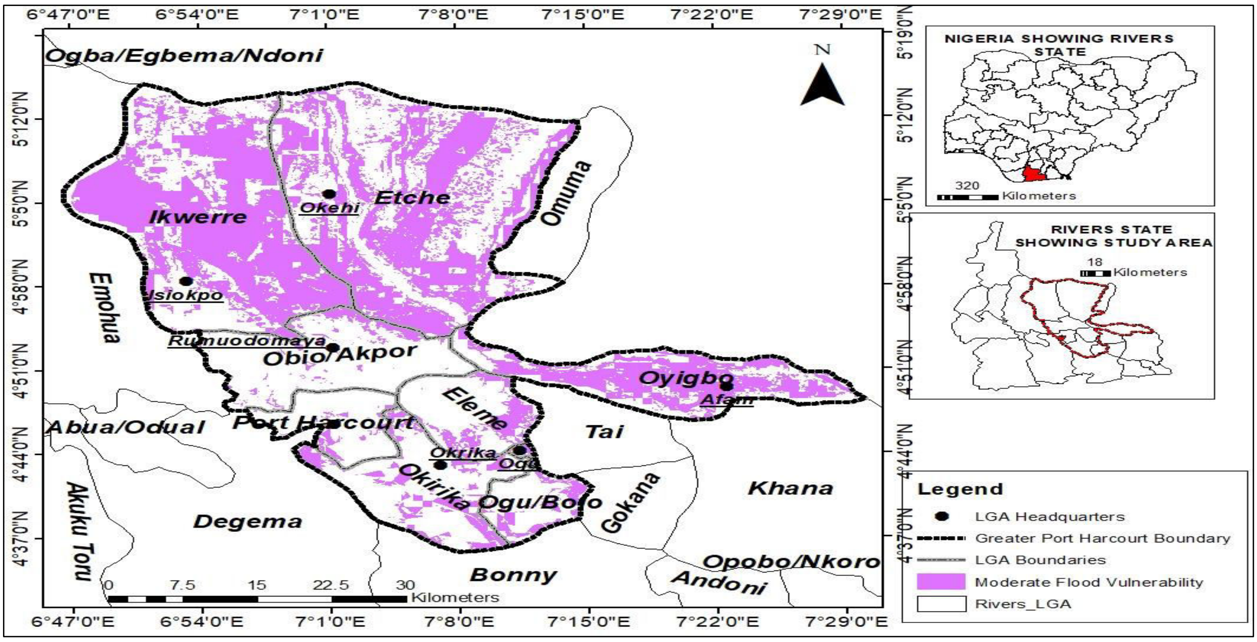

Figure 13: Moderate Flood Vulnerability Only in Greater Port Harcourt

© 2024 IJMRSET | Volume 7, Issue 11, November 2024| DOI: 10.15680/IJMRSET.2024.0711003

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

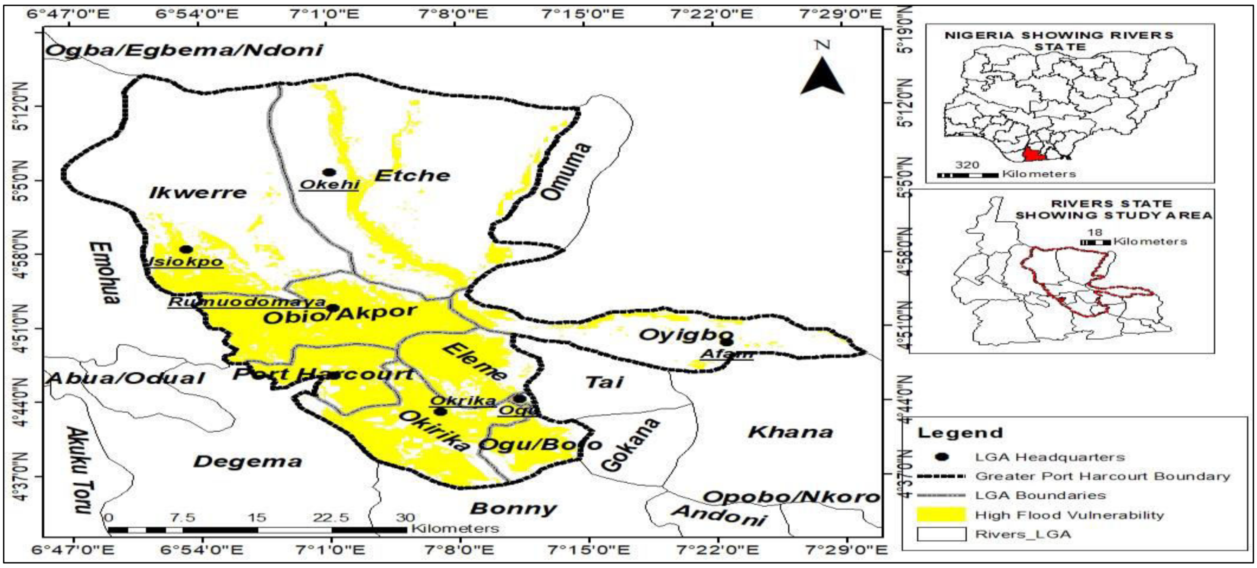

Figure 14: High Flood Vulnerability Only in Greater Port Harcourt

Number of Towns in Different Flood Vulnerability Zones

The cities or localities in the different flood risk zones are listed in Table 12. In the research region, 220 places were included. The results indicate that, of all the settlements, 13.64% were situated in a low-risk flood zone, 29.55% in a moderately vulnerable zone, and 56.82% in a high-risk zone. Abara, Afam, Egburu, Obite, and Odufor were among the villages in low-risk flood zones; Abuloma, Akpadjo, and Eneka were among the communities in high-risk regions; while Abiama, Agwa, Egwi, Elele, and Mgbuosimini were among the villages in moderate-risk areas.

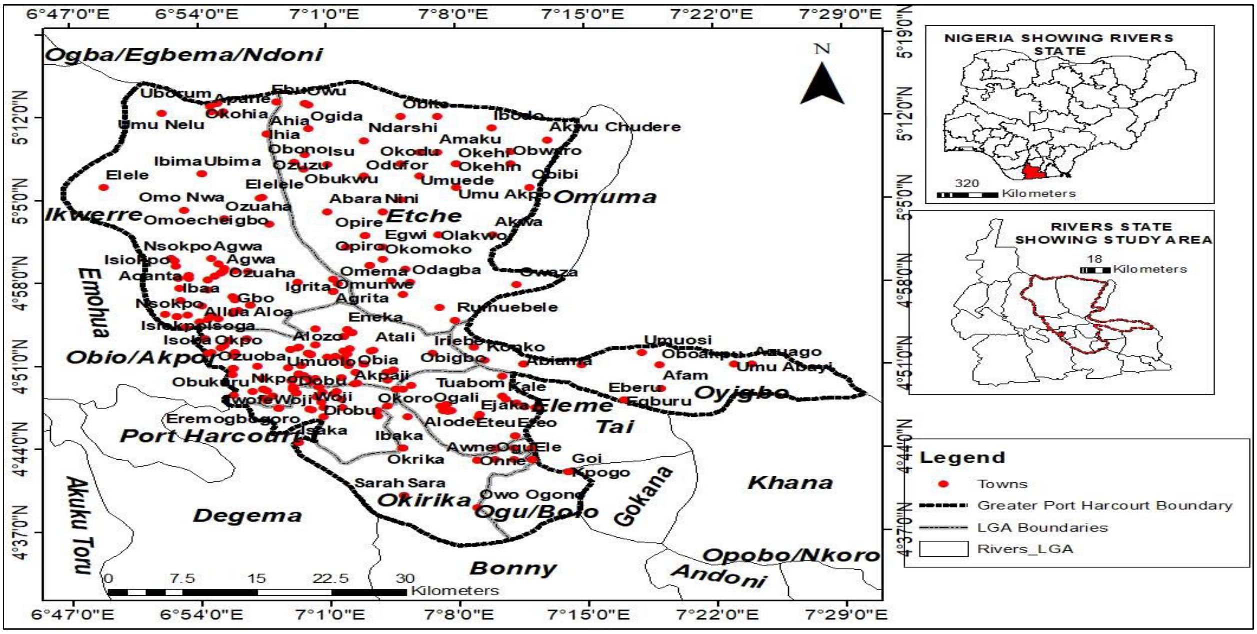

Figure 15: Towns in Greater Port Harcourt

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

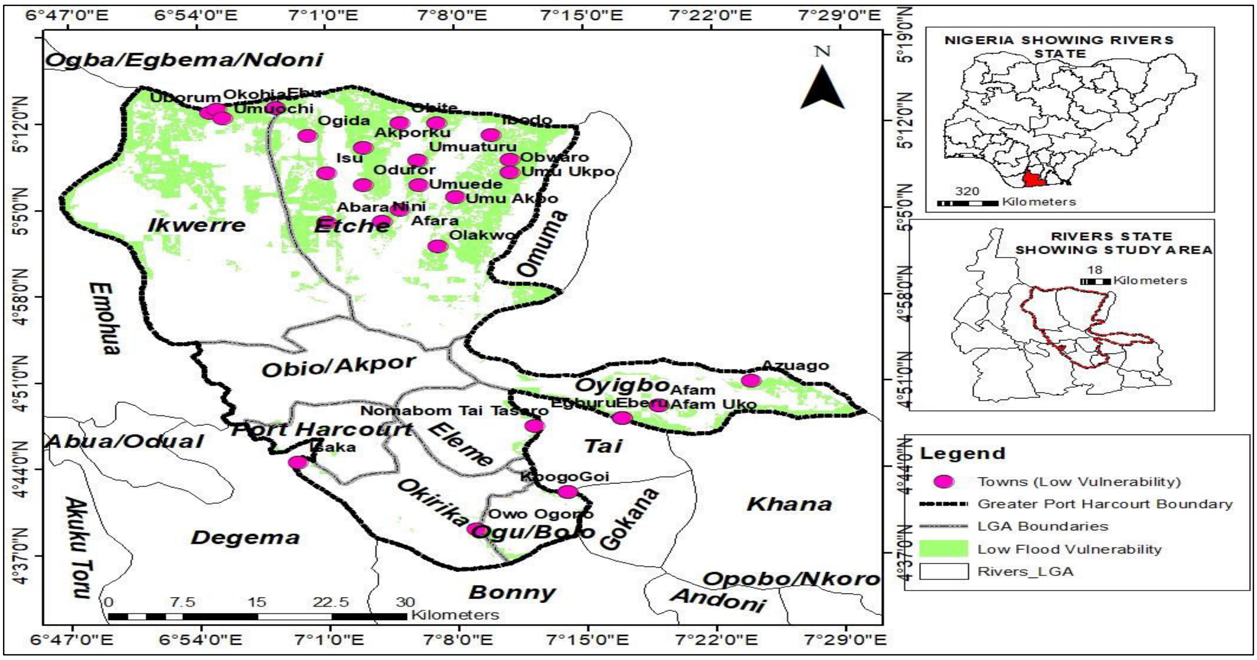

Figure 16: Towns found in Low Flood Vulnerability Zones

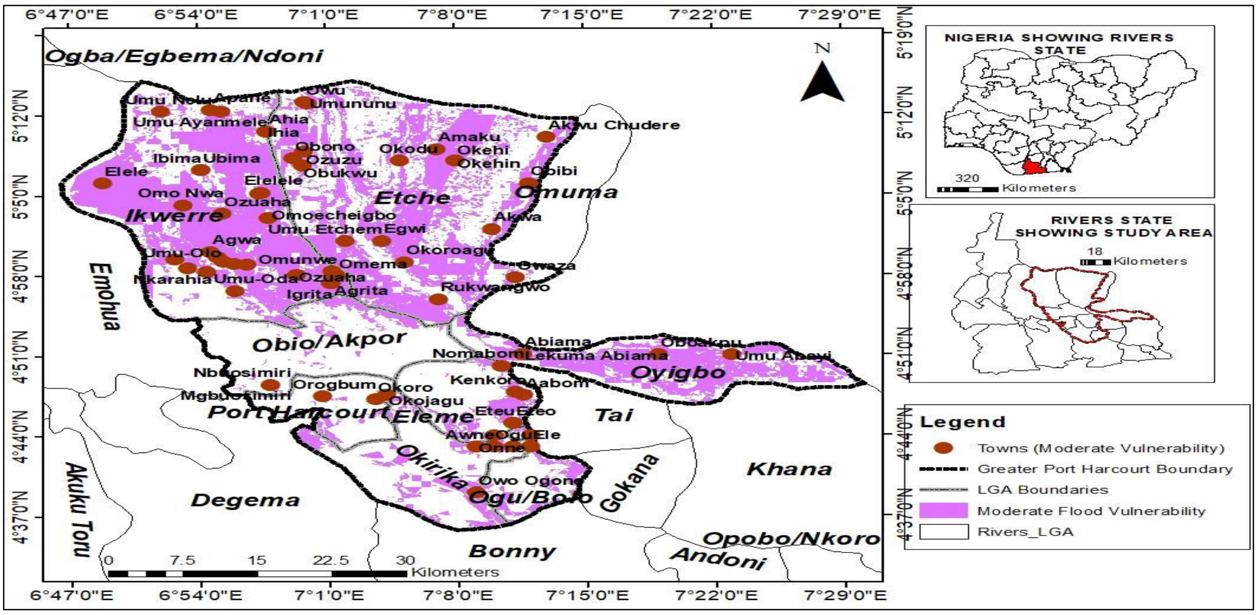

Figure 17: Towns found in Moderate Flood Vulnerability Zones

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

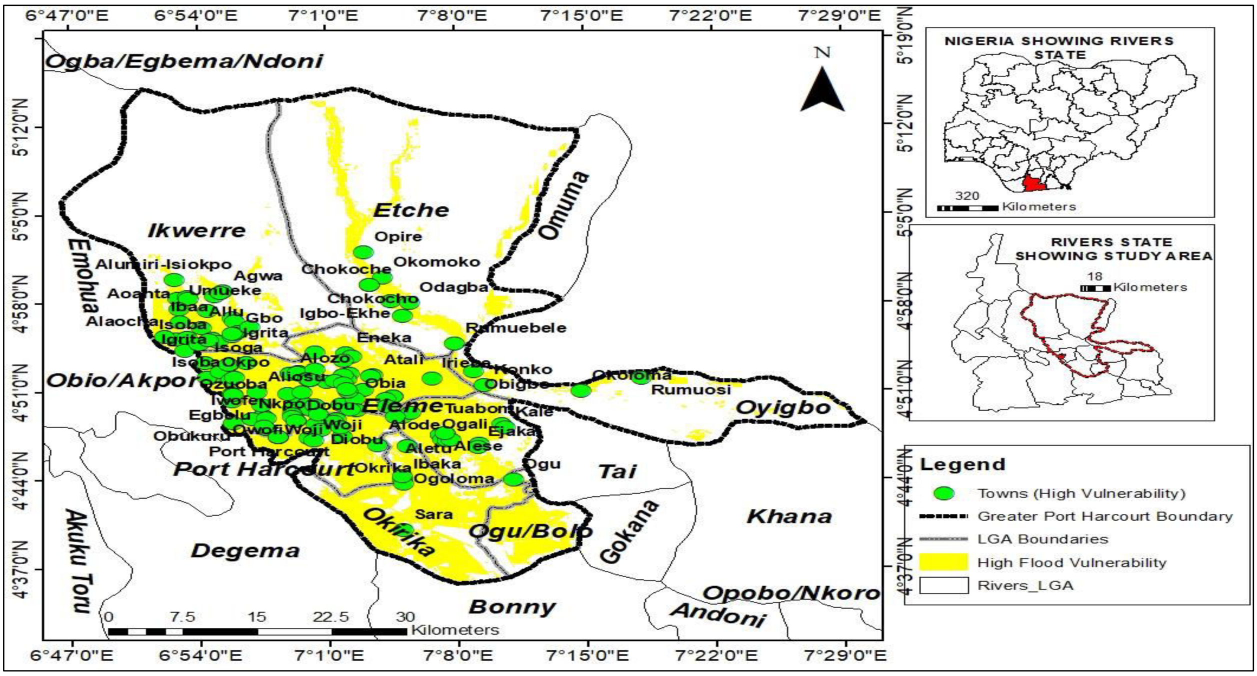

Figure 18: Towns found in High Flood Vulnerability Zones

Table 12: Summary of the Number of Towns in Different Flood Vulnerability Zones

Flood Vulnerability Levels	Frequency	Percentage (%)
Low	30	12.55
Moderate	68	28.45
High	141	59.00
Total	239	100.00

III. CONCLUSION

The Greater Port Harcourt area's coastline and riverside communities are most vulnerable to flooding. These include communities close to the Bonny River and other tidal inlets, like Port Harcourt Town, Borokiri, and Diobu. Furthermore, Obio-Akpor's settlements—particularly those in Abuloma, Alese, Egbelu, Eneka, Rukpokwu, Rumuomasi, and Rumuokoro—are extremely susceptible to floods because to their inadequate drainage systems and urban expansion. Low elevation, high population density, poor drainage, and regular rainfall all put these locations at risk. Rapid development and the region's poor stormwater management systems make it challenging to control flooding, which can cause significant damage during tidal surges or severe rains (Oruonye, 2016).

Eleme, Oyigbo, and portions of the Ikwerre Local Government Area are among the semi-rural and peripheral districts of Greater Port Harcourt that are somewhat vulnerable to floods. These places are close to wetlands and floodplains, which puts them at serious risk even though they are not right on the riverbanks. Seasonal flooding also occurs in several of these places, particularly during periods of intense precipitation. Land use change (such as deforestation and agricultural growth) makes these places more vulnerable to flooding, even if the infrastructure is typically less developed than in more urbanized areas.

Some higher elevations in the Greater Port Harcourt area, especially those that are not near rivers or swamps, are less likely to flood; areas like portions of Choba and Trans-Amadi Industrial Layout are less likely to flood, though localized flooding can still occur occasionally due to heavy rainfall; these areas are frequently distinguished by superior drainage infrastructure, which reduces the risk of flooding during moderate rains.

The Greater Port Harcourt area's flood exposure matrix highlights how complicated flood risk is in this ecologically delicate and quickly urbanizing area. Poorly designed metropolitan areas with insufficient drainage systems are also extremely vulnerable, although communities along rivers, estuaries, and coastal areas are most at risk. Implementing comprehensive urban planning solutions, such as improved drainage infrastructure, floodplain zoning, and disaster preparedness initiatives, is crucial to reducing these hazards. Reducing the region's vulnerability to flooding would also require tackling the effects of climate change and protecting ecosystems like wetlands and mangroves.

REFERENCES

1. Adelekan, I. O. (2010). Vulnerability of Nigerian coastal communities to flooding: Implications for climate change adaptation strategies. The Geographical Journal, 176(3), 211-220.
2. Emoh, F. I., & Ume, O. (2013). Flooding and urbanization in Nigeria: A case study of the Port Harcourt metropolis. Nigerian Journal of Social Sciences, 21(2), 78-89.
3. Oruonye, E. D. (2016). Flooding and urban resilience in the Greater Port Harcourt Area: A spatial analysis. Environmental Management and Sustainable Development, 5(2), 11-19.
4. Udo, R. K. (1970). The Niger Delta: The land and people of the Nigerian coastal plain. In R. K. Udo (Ed.), Nigeria's Land and People (pp. 89-103). University of Port Harcourt Press.
5. Ogboeli, G. P., Iyama, W. A & Onuegbu W. (2023). Incidences and Trend of Marine Accident Fatalities in Various River Routes Connecting the Major Sea Ports of Nigeria. International journal of research and innovation in applied science (ijrias), 8(4): 109-122.
6. Lawal B.A., Arokoyo E.O. and Odeyemi S.O. (2011), Erosion Control on Ahmadu Bello Way in Ilorin using Storm Drain Pipes, Epistemics in Science, Engineering and Technology, 1(3), 148-154.
7. Duncan, J.M. and Wright, S.G. (2005) Soil Strength and Slope Stability. John Wiley & Sons Inc.

INTERNATIONAL JOURNAL OF

MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com