

Flood Vulnerability and Risk Assessment: A Case Study of Yenagoa and Its Environs, Bayelsa State, Nigeria.

Obenade Moses, Famurewa A. J. , and Gumus Seigha

Abstract - The perennial flooding in Bayelsa State and its attendant threats to life, property and socio-economic existence have been a major problem for the inhabitants and Government. This study was undertaken to assess the flood vulnerability and risks posed by it to Yenagoa and its environs, using Remote Sensing and GIS applications. The study covered 16 towns - 14 in Yenagoa Local Government Area, Opuama in Nembe and Ogbia in Ogbia Local Government Areas. It was discovered that all the towns covered were more vulnerable to flood with increasing severity in places with elevation ranging between 5-15.5m above sea level while places with elevation ranging between 15.5-26m above sea level were ranked as very highly vulnerable to flood based on standard procedures. The study area exhibited similar soil compositions like alluvial soil, silty clay, floodplain soil and others which combine with heavy annual rainfall pattern in the area to enhance flooding. Risk assessment of the study area showed that public utilities, services, business and commercial activities and general infrastructures were at a high risk of flood vulnerability due to their location in the nucleus of Yenagoa, known for high flood vulnerability. The outcome of this study provide relevant information useful for planning purposes by government and corporate bodies as well as their preparedness and response to flood in the State.

Key words: Flood, vulnerability, risk assessment, Yenagoa, GIS, Remote sensing, land-use, towns, soils, elevation, severity.

1.0 Introduction

Flooding is a natural process that can happen at any time in a wide variety of locations. Flooding from the sea and rivers is probably best known, but prolonged intense and localized rainfall can also cause sewer flooding, overland flow and ground water flooding. Different types of floods that occur in the Niger Delta have been identified, for example urban floods, flash floods, channel floods, back-swamp floods, and coastal inundation/tidal floods [2],[5]. The prevalent flood event that poses serious threat to life and property in most towns and communities in the Niger Delta is tidal floods. This occurs when the sea level rises to a critical height above the coastal lands with defenses especially during the raining season and at periods of astronomical spring tides and inundated settlements [1],[7]. It is an annual event affecting towns such as Port Harcourt, Yenagoa, Bonny, Amassoma, Buguma, Twon-Brass, Nembe, Otuoke, amongst others. Flooding has significant impacts on human activities; it can threaten people's lives, their property and environment. Assets at risk can include housing, transport and public service infrastructure, and commercial, industrial and agricultural enterprises. The health, social, economic and environmental impacts of flooding can cause significant and wide spread impact on the community [4].

There is a relationship between exposure to a flood hazard, risk, and vulnerability. Vulnerability is the measure of the capacity to withstand, resist, or recover from the impacts of a hazard in the long term as well as in the short term. Vulnerability depends upon many factors such as land use, extent and type of construction, contents and use, the nature of populations (mobility, age, health), and warning of an impending hazardous event and willingness and ability to take responsive actions. This means that within an identified flood hazard area there may be the same exposure or risk of flooding, but a wide range of vulnerability to the hazard [4].

The occupancy or use of flood-prone areas involves a degree of risk. Risk is exposure to an undesired event. It can be expressed in probability that the event will happen, often during a calendar year [4]. Therefore, it is in this light that this study was undertaken to assess flood vulnerability and risk in Yenagoa and its environs with a view to providing relevant information on land use dynamics that can be used for planning purposes and for determining the preparedness and response time of governments and corporate bodies to occurrence of flood disasters in Bayelsa State.

The author and 2nd co-author are Researchers with the National Centre for Technology Management (NACETEM), South-South Office, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria. While the 1st Co-author lectures in the department of Physical and Chemical Sciences, Elizade University, Ilara Mokin, Ondo State, Nigeria.

Author E-mail: obenade@yahoo.com, **Tel:** +234 8033183296

2.0 Study Area

The study area of Yenagoa and its environs comprise the following towns: Obogoro, Onopa, Yenagoa, Ovom, Amarata, Yenezue, Kpansia, Opeyenezie, Biogbolo, Opolo, Akaba, Azikoro, Okutukutu, Ekeki in Yenagoa Local Government Area; Opuama in Nembe Local Government Area; and Ogbia in Ogbia Local Government Area. Yenagoa is the State capital of Bayelsa State and is located in the south of the State at 4°55'29"N 6°15'51"E.

Yenagoa Local Government Area has an area of about 706 km² and a population of 353,344 according to the 2006 Census. Yenagoa is the traditional home of the Ijaw people. The Ijaw form the majority of the Bayelsa State and English is the official language, but the Epie/Atissa dialect is the most popular and widely spoken in Yenagoa.

Since attaining the status of State capital in 1996 there has been steady increase in population with corresponding pressure on housing, schools, health care, social services, recreation, and other infrastructural facilities and amenities, which have led to accelerated construction works and other developmental projects in the State.

Bayelsa State is a major oil and gas producing area and it contributes over 30 per cent of Nigeria's oil production. There are hundreds of oil wells and flow stations across the State. Oloibiri in Ogbia Local Government Area of the State is where oil was first struck in Nigeria in commercial quantity in 1956. The major agricultural activities of the people of Bayelsa State are fishing, farming (food and cash crops), palm wine tapping, lumbering, local gin making, palm oil milling, among others.

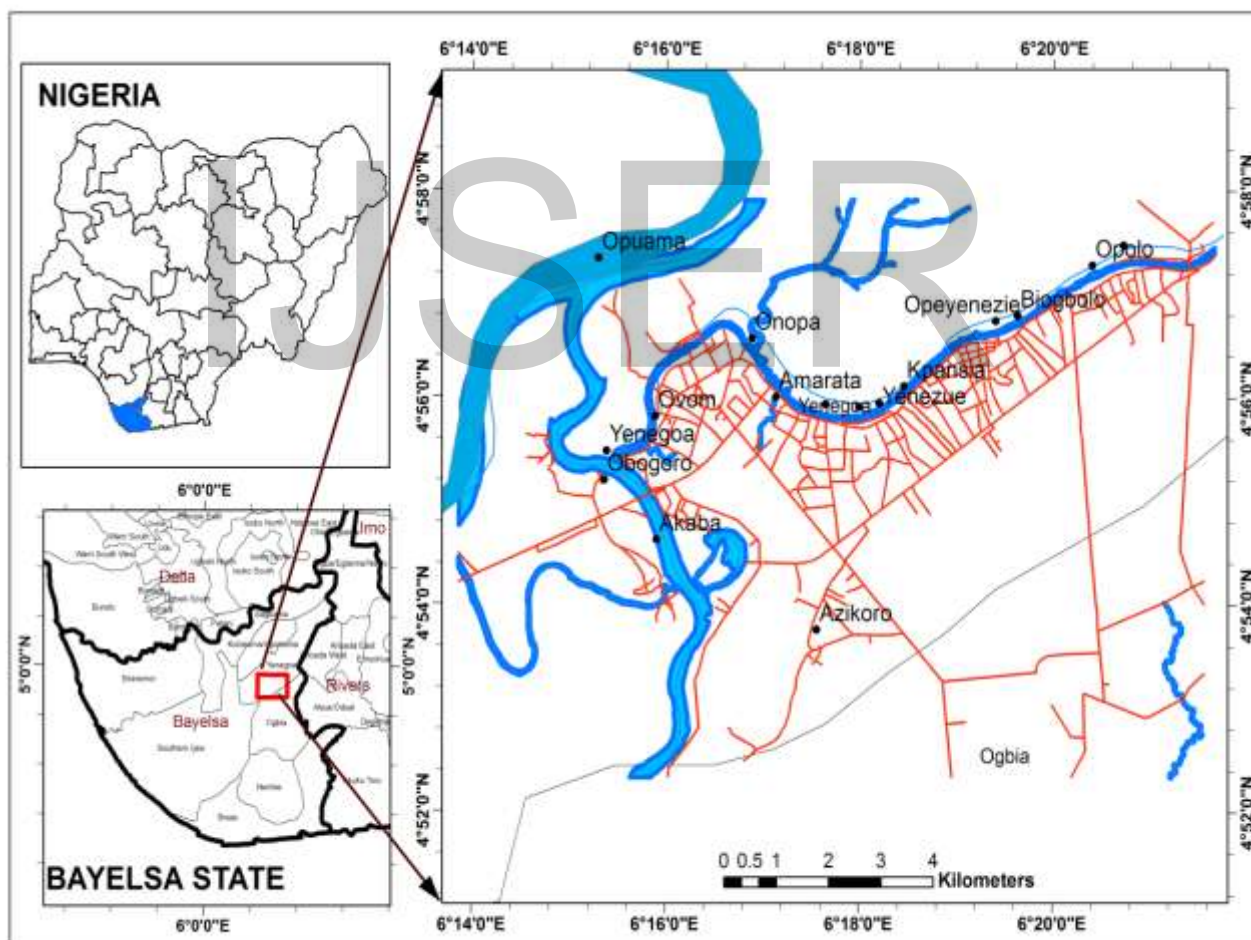


Fig.1: Map of the Study Area. Source: Author's Fieldwork

3.0 MATERIALS AND METHOD

Primary and secondary data sets were acquired for this study.

Primary data sets included the Reconnaissance Soil Map covering Yenagoa town and its environs. The soil map showed the various types of soil, the drainage network, vegetation types, settlement names and road network. The soil map was drawn to a scale of 1:50,000 and was obtained from the Office of the Surveyor General of Rivers State, Port Harcourt.

A high resolution satellite quick bird imagery with a resolution of 60cm covering the study area was acquired. The imagery was used for land use/land cover mapping of the study area.

Medium resolution Landsat Thematic Mapper (TM) at resolution of 28.5m imagery that covered. The imagery with path 189 and row 57 was acquired for years 1987 and 2002 and 2007 bands 4, 3, and 2 were selected. The data acquired from field observation consisted of ground-truthing and facility mapping.

Ground-truthing was carried out for the purposes of observing Hand Held GPS receiver coordinates of identified four points conspicuous on satellite imageries used as ground control points during geo-referencing. The Hand Held GPS was also used to obtain coordinates of potential facilities for relocation during flooding. These facilities included public primary and secondary schools; public health facilities, and other government promises that may not attract fees when used for evacuation purposes.

4.0 RESULTS

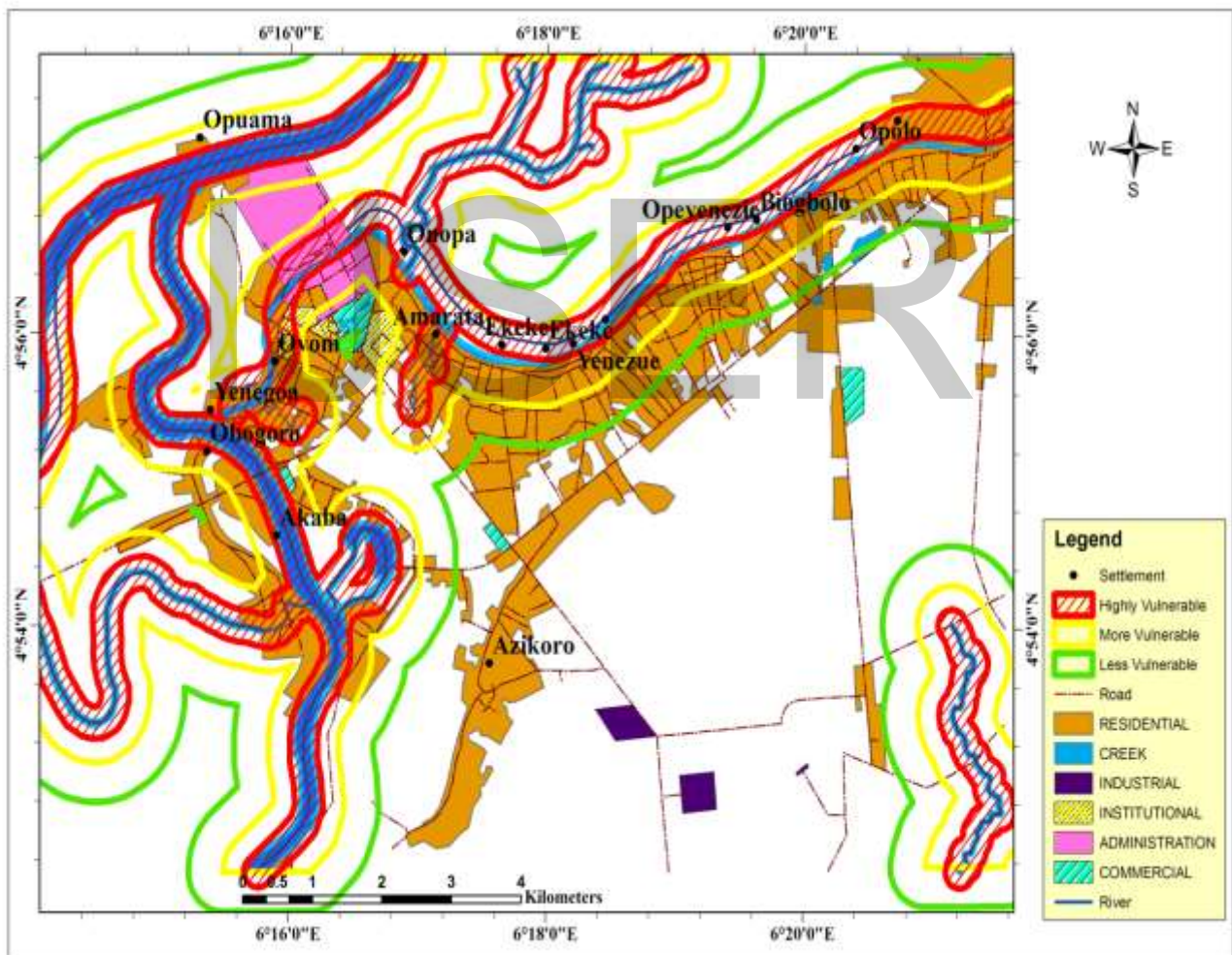


Fig. 2: Flood Risk Map of Yenagoa (Using LandSat Image). Source: Author's Fieldwork

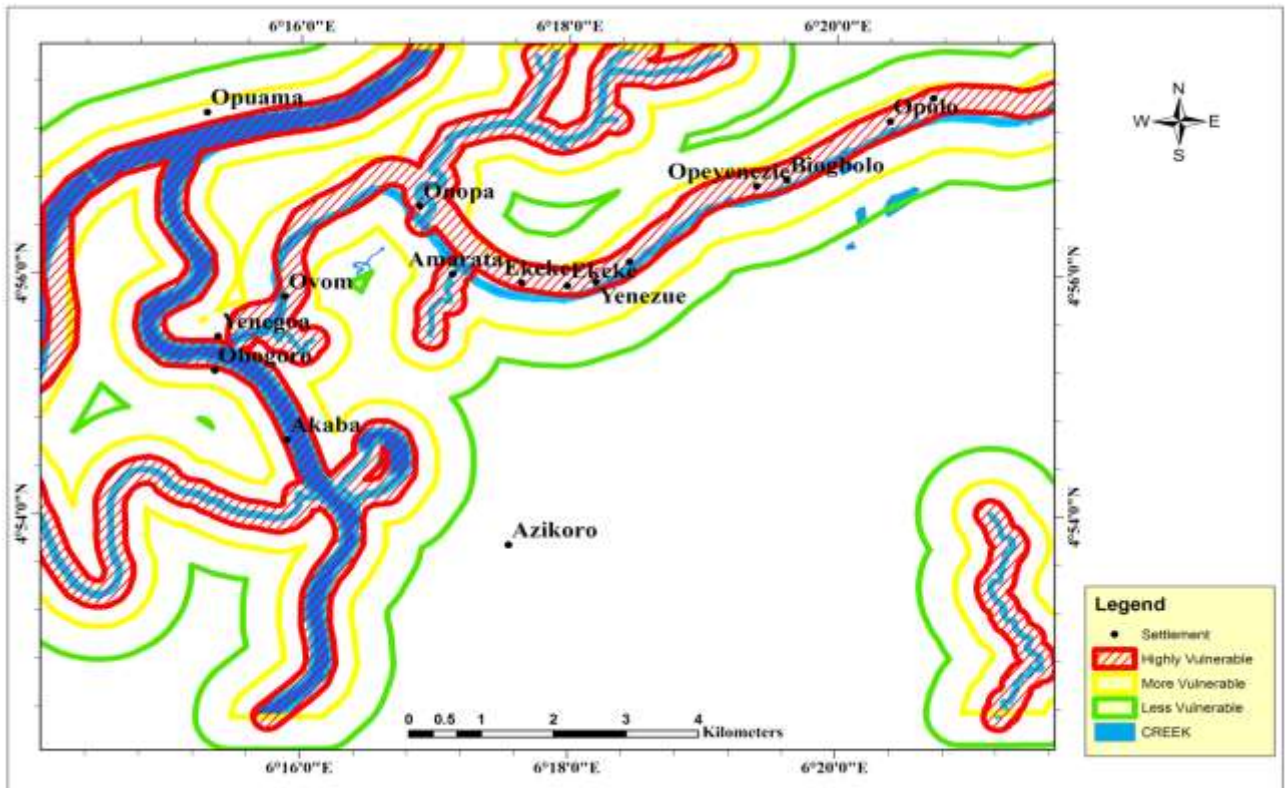


Fig.3: Flood Risk Map of Yenagoa (Using LandSat Image). Source: Author's Fieldwork

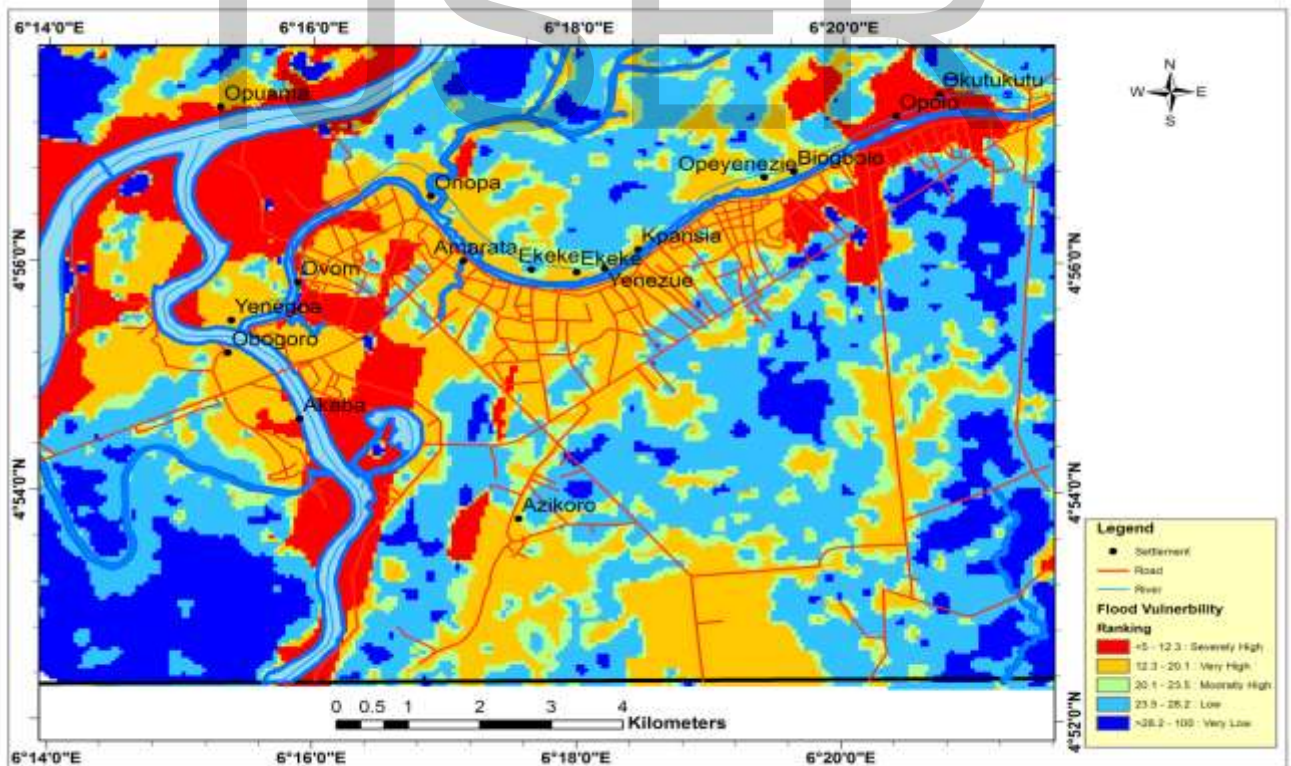


Fig. 4: Flood Vulnerability Map of Yenagoa (Using LandSat Image). Source: Author's Fieldwork

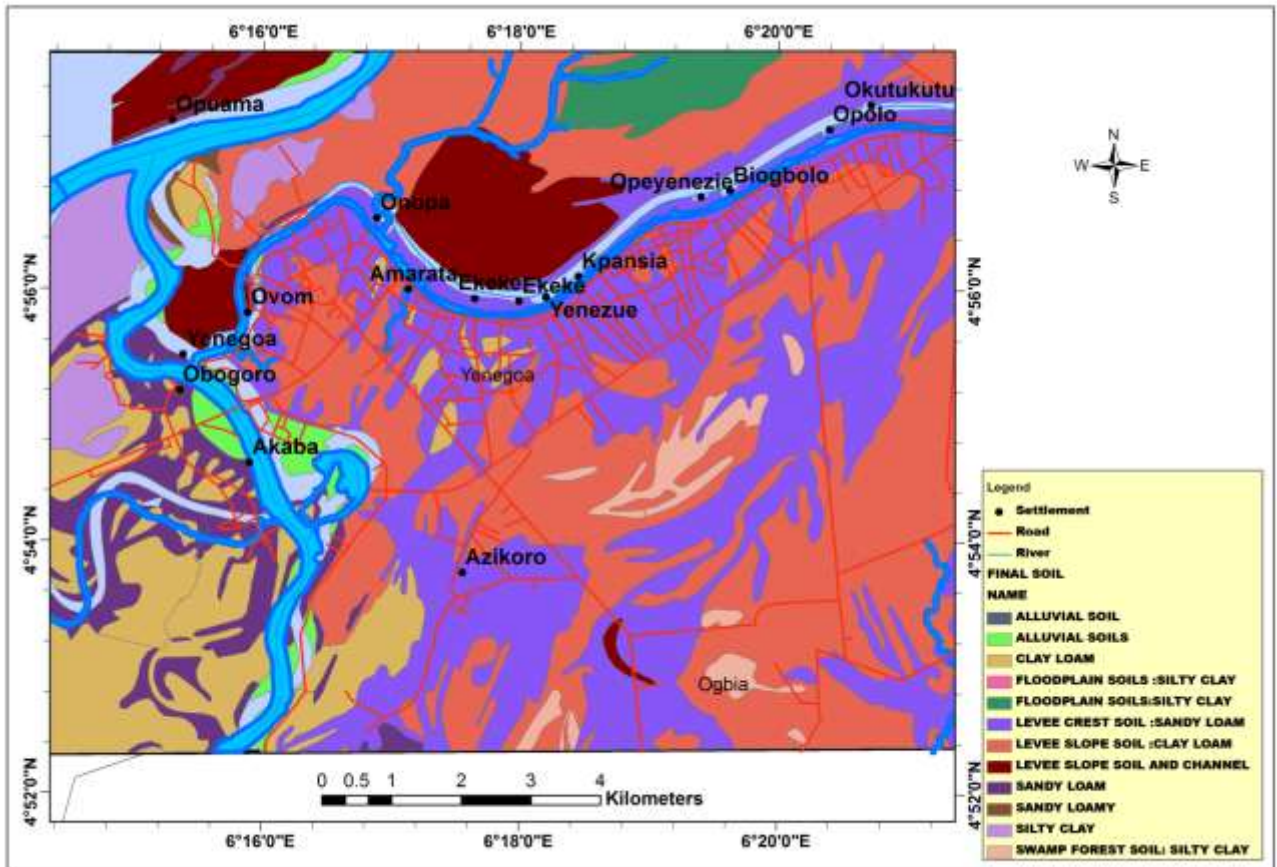


Fig.5: Soil Map of Yenagoa (Using LandSat Image), Source: Author's Fieldwork

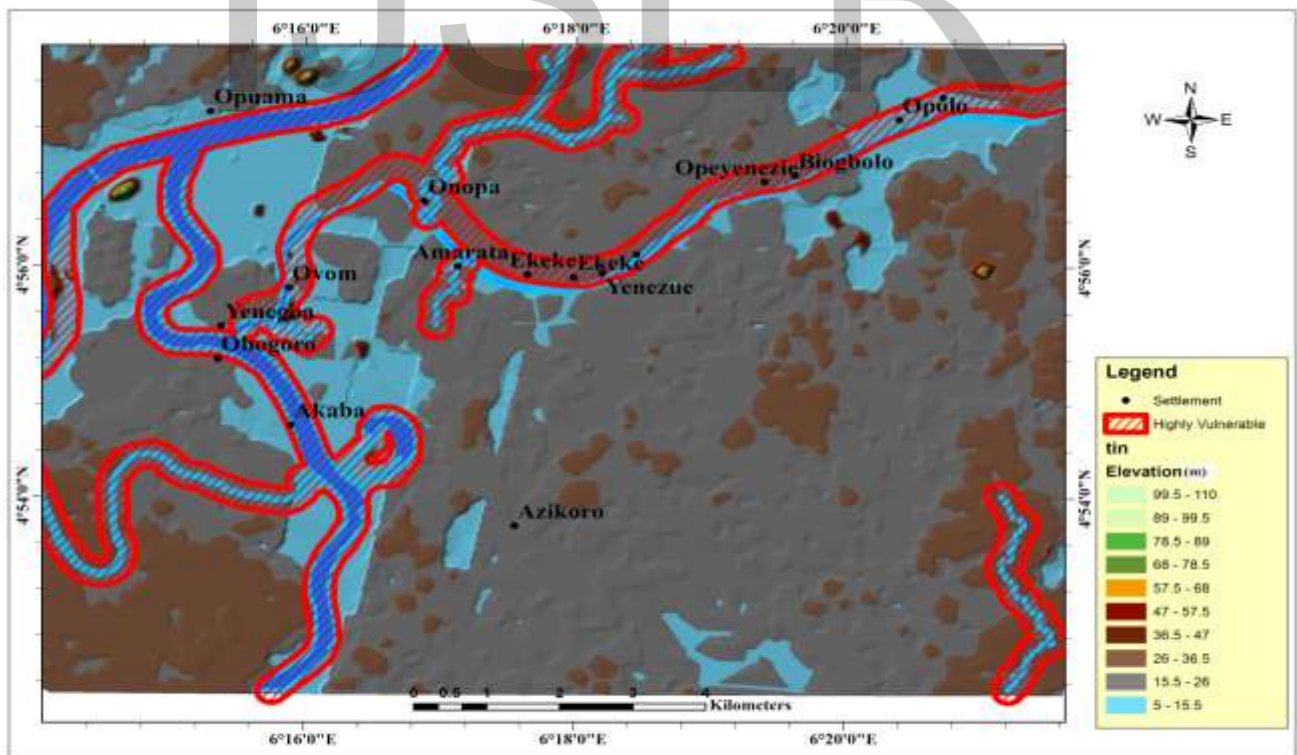


Fig.6: Elevation Map of Yenagoa (Using LandSat Image), Source: Author's Fieldwork

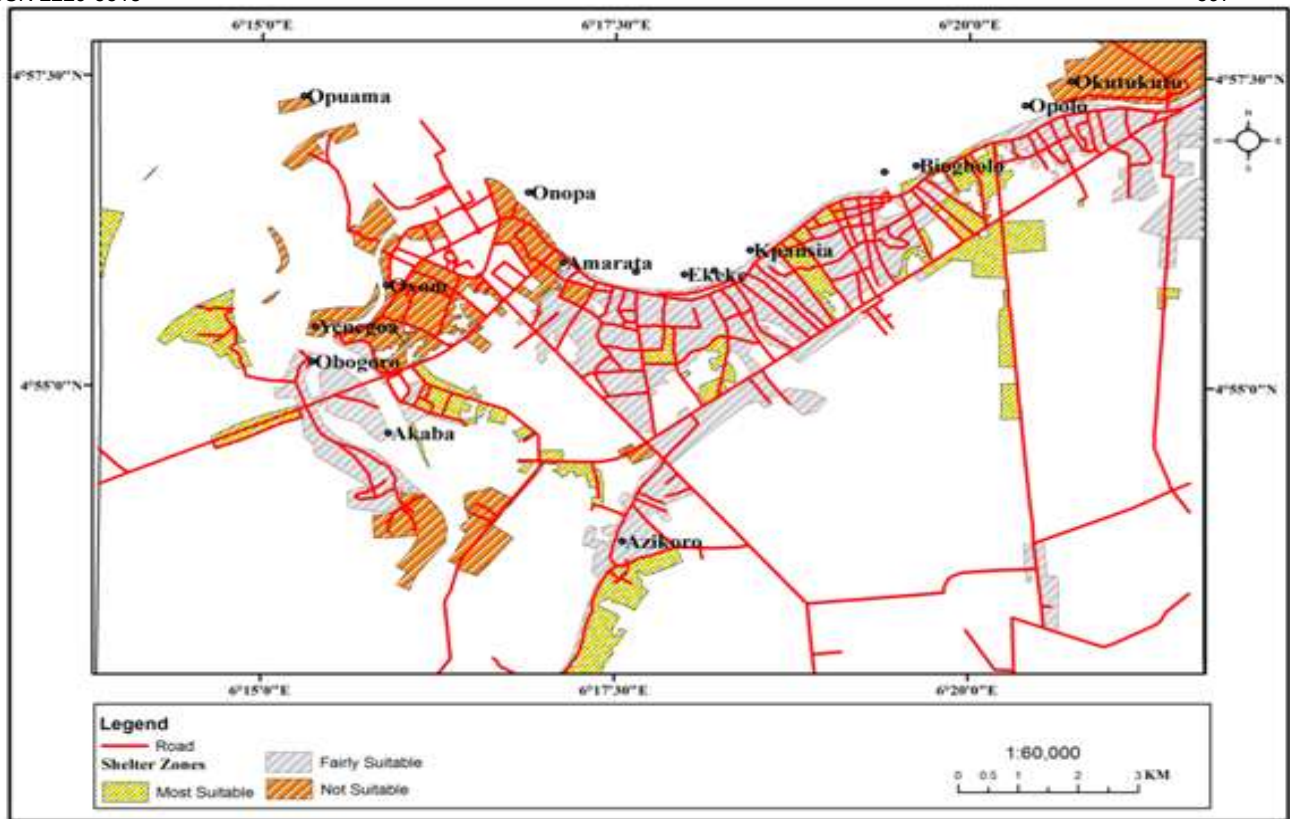


Fig. 7: Map of Suitably for Settlement (Using Landsat Image), Source: Author's Fieldwork

Table 1: Summary of Results

S/N	Settlement	Major Activity	Elevation (m)	Flood Vulnerability Ranking	Soil Type	Suitability for Settlement
1	Opuama	Residential	5-15.5	Severely high	Sandy loam	Not suitable
2	Yenagoa	Administration, Residential, Commercial	5-15.5	Very high	Floodplain soils, silty clay	Not suitable
3	Obogoro	Residential	15.5-26	Very high	Sandy loam	Fairly suitable
4	Onopa	Administration, Commercial, Residential	5-15.5	Very high	Alluvial soils	Not suitable
5	Ovom	Administration (Govt. House, Secretariat), Residential	5-15.5	Severely high	Levee slope soil & channel	Not suitable
6	Amarata	Administration (BYHA), Residential, Commercial	5-15.5	Severely high	Alluvial soils	Not suitable
7	Yenezue	Commercial, Residential	5-15.5	Very high	Alluvial soils	Not suitable
8	Kpansia	Commercial, Residential	15.5-26	Very high	Alluvial soils	Fairly suitable

9	Opeyenezie	Residential	15.5-26	Very high	Alluvial soils	Not suitable
10	Biogbolo	Commercial, Residential, Administration	15.5-26	Very high	Alluvial soils	Fairly suitable
11	Opolo	Commercial, Administration, Residential	5-15.5	Severely high	Alluvial soils	Fairly suitable
12	Akaba	Residential, Commercial	5.15.5	Severely high	Floodplain soils, silty clay	Fairly suitable
13	Azikoro	Commercial, Residential	15.5-26	Very high	Alluvial soils	Most suitable
14	Ekeki	Residential, Commercial	15.5-26	Very high	Alluvial soils	Fairly suitable
15	Okutukutu	Residential	5-15.5	Severely high	Alluvial soils	Not suitable
16	Ogbia	Industrial, Residential	15.5-26	Very high	Levee slope soil: clay loam	Fairly suitable

Source: Author's Fieldwork

5.0 Discussion

The major activities of towns in the study area include residential, commercial, administration and industrial among others. The Bayelsa State Government House, Judiciary Complex and State Secretariat are located at Ovum, Bayelsa State House of Assembly Complex at Amarata while most commercial banks are located around Amarata, Onopa, Yenezue, Ekeki and Kpansia. Therefore Onopa, Ovum, Amarata, Yenezue, Kpansia and Ekeki constitute the nucleus or nerve centre of Yenagoa town as the State capital.

From Table 1 above, it was observed that all the towns in the study area ranked very high in vulnerability assessment to flood, while Ovum, Amarata, Opolo, Akaba and Okutukutu in Yenagoa Local Government Area and Opuama in Nembe Local Government Area ranked severely vulnerable to flood. It was further observed that all settlements in areas ranging between 5-15.5m above sea level ranked severely vulnerable to flood while those between 15.5-26m above sea level ranked very high in vulnerability to flood and therefore not suitable for settlement.

The study area exhibited similar soil composition, which are mainly alluvial soils, floodplain soil, levee slope and channel soils, sandy loam, clay loam and silty clay as shown in Table 1.

5.0 Findings

The following findings were made by this study:

- (i) The existence of the three islands measuring between 68 – 89m above sea level. One is located across the river behind Ovum and Obogoro; another one across Biogbolo and Opolo, while the third is located near Opuama in Nembe Local Government Area as in Fig.6.
- (ii) Two large expanses of land measuring between 26 – 47m above the sea level located behind Akaba and Onopa were found as could be seen from Fig.6.

6.0 Conclusion and Recommendations

This study showed that all towns/settlements covered by this study were more vulnerable to flood with increasing severity of areas between 5-15.5m above sea level as seen in Table 1. There is high, potential risk to administration (governance, law-making, public service delivery, dispensation of justice, health care, etc), residential (building and housing/household properties), commercial activities, public utilities, roads – interrupting transport routes, sewage collection and disposal, trading ^[3], social services – schools, recreation, sports, and agriculture that are the major activities of the population in the study area.

The authors recommend that the Government of Bayelsa State should consider the two expanses of land and three highlands located outside Yenagoa metropolis for strategic planning and development purposes. Also, the

siting of sensitive projects including housing estates or projects in areas observed to be of high elevation, about 26⁵⁹⁹ – 47m above sea level observed in areas around Akaba, Onopa, Azikoro and Ogbia is recommended since they are less vulnerable to flood, pose less risk to life and property and will be most suitable for settlement.

References

1. Abams TKS (1995), "Floods in Niger Delta, the Case of Kaima". In Proceedings of the International Workshop in Natural Man-made Hazards in Africa. NMGS Publication. Pp. 119-130
2. Amangabara GT and Gobo AE (2010), Perception and Realities of Flood Hazards, Flood Mitigation and Control in Nigeria. Global Journal of Environmental Sciences Vol.9, No. 1 & 2 Pp 13-25
3. CNT (2013): Center for Neighborhood Technology, Chicago IL. "The Prevalence and Cost of Urban Flooding." May 2013
4. FEMA (2001a): Federal Emergency Management Agency, *Understanding Your Risks. Identifying Hazards and Estimating Losses. State and Local Mitigation Planning How-to Guide*. FEMA 386-2.
5. Gobo AE, Amangabara GT, Pepple WW (2013), Public Perception of Tidal Flooding Hazards on Bonny Island, Rivers State, Nigeria. Marine Science Journal, doi:10.5923/j.ms.20130303.04. Pp 91-99.
6. Ray KL (1986), Flood Estimates: How Good Are They?" Water Resources Research, Vol. 22, No.9, Pages 159S-164S, August 1986.
7. Smith K and Ward R (1998), Physical Processes and Human Impacts, John Wiley and Sons, Chichester, USA [Online]: <http://www.naturegrid.org.uk/rivers/gt%20tour%20casepages/fid-rivhtml>.

IJSER