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FLOODING RISK ASSESSMENT OF UKANA AND ENVIRONMENT

Ubong Tobby and Jonathan Otobong
[1]Department of Civil Engineering Technology, Federal Polytechnic Ukana, Akwa Ibom State, Nigeria

Abstract: *Floods are natural events; however, due to various human-related activities coupled with climate change, flooding tends to be both human-induced and natural events. Geographical Information Systems (GIS) techniques can spatially process different physical-environmental parameters in flood risk assessment and the present study determine the extent of vulnerability of Ukana. From the analysis, spatial extent of 27.72 km² showed low flood vulnerability level while a spatial extent of 192.25`km² and 31.08 km² indicated moderate and high flood vulnerability level respectively. the entire communities have low vulnerability to flood hazard when compared to some community in the state, some communities at 76.58% have medium vulnerability level while other communities which represent 11.04 and 12.38% of the entire communities in the Ukana have low and high flood vulnerability level. The generated maps and identified LGA and communities at different flood vulnerability zones are useful in all steps of disaster management (prevention, mitigation, preparedness, operations, relief and recovery) and should be considered during initial planning.*

Keywords: *Flood, GIS, Vulnerability Assessment, Flood Vulnerability, Ukana*

INTRODUCTION

Every year, more than 200 million people worldwide are affected by disasters such as droughts, floods, cyclones, earthquakes, landslides and other natural phenomena. Global warming, environmental degradation, rapid urbanization, increased population densities and their concentration on hazard prone areas make the impact of natural disasters even worse. The consequences of these trends are especially important for Least Developing Countries (Nigeria inclusive), land locked countries and Small Island Developing States (SIDS), which are often affected disproportionately by such disasters (ISDR 2007). Flood has the greatest damage potential of all natural disasters worldwide and affects the greatest number of people. On a global basis, there is evidence that the number of people affected and economic damages resulting from flooding are on the rise at an alarming rate. It has claimed many lives, displaced millions and resulted to the destruction of properties and degradation of contiguous farmlands. It is the most frequent and devastating natural disaster in the world (DMSG 2001). Urban flooding is a global phenomenon and has caused devastation and economic losses. According to the Centre for Research on the Epidemiology of Disasters (CRED), flooding in 2010 affected 178 million people and amongst all natural disasters the occurrence of floods is the most frequent. In the last century based on International Strategy for Disaster Reduction (ISDR) statistical analysis, the total numbers of hydro-meteorological events was 7,486 (Abhas J., Lamond J., Bloch R Etal 2011). Flood hazards are natural phenomena, but damage and losses from floods are the consequence of human action like urbanization, which aggravates flooding by restricting where flood waters can go, covering large parts of the ground with roofs, roads and pavements, obstructing sections of natural channels and building drains that ensure that water moves to rivers faster than it did under natural conditions. Many of the devastating disasters, including flood, can however, be preempted and averted, if relevant government departments would form synergy with the Non-Governmental Organizations and other concerned stakeholders to address the risks of natural disasters through effective preparedness, forecasting, early warning, and prompt response. Flood disasters commonly lead to immediate responses by institution saddled with the responsibility, but as time passes, the memory and need for preparedness fades leaving communities unprepared the next time around. To develop safer, sustainable communities it is necessary for communities to become more knowledgeable about dealing with disasters, floods and storing their accumulated knowledge Beer, T. and Hamilton, R (2002). Society must therefore move from the current paradigm of post-disaster response. Plans and efforts must be undertaken to break the current event-disaster cycle. More than ever, there is the need for decision makers to adopt holistic approaches for flood disaster management (ISDR 2009). A major gap in disaster reduction in Africa is weak knowledge management. There is inadequate attention to information management and communications, training and research; consequently, there are gaps in knowledge about disaster risk. The ultimate aim of Disaster Risk Reduction (DRR) is to empower people to take timely and adequate actions to protect themselves, their livelihoods and ecosystem against disasters, disaster risk reduction is a shared responsibility and partnership between the state and the people AU/NEPAD (2004). Nigeria has got her own share of flood disasters, which is evident in the recent widespread devastating flood disaster that hit the country cutting across major cities in about 31 states in the country from June to September 2012. The worst affected states are those that are at the borders of the River Niger River Benue and those around the Niger Delta area, they are, Adamawa, Taraba, Benue, Niger, Kogi, Anambra, Bayelsa, Delta, Edo, Rivers, Cross River and Akwa Ibom. This flood incident has been characterised as the most devastating since the last 40 years and even now 2022. The flood submerged houses, severed transportation routes throughout the affected areas. Poor drainage systems, the untimely release of water from dams and the indiscriminate building of houses on river banks all contributed to exacerbating the effects of the flooding. Kolawole, O. M., Olayemi, A. B. and Ajayi, K. T. (2011). Since its inception in 1991 to 1995 when yobe state evolved a master plan designating UKANA as a resettlement town, the town had been growing rapidly and this was not without the attendant problem that goes with such development. Residents for some years now have been losing houses, businesses and personal belongings to flooding that accompany some down pours in the areas. The degrees of losses are always estimated in the millions of naira. The flood most often than not, submerge houses and vehicles and sweeping debris along the channel, the personal tragedies of those who were affected are deeply heart-wrenching. The importance of the application of geo-information technologies in flood studies cannot be over emphasized. Cinque et. al., contributed that the use of

Geographic Information System (GIS) technology has contributed with other technology in Flood intelligence and the result is the product of a process of gathering and assessing flood related data to enable emergency managers to determine the extent of actual or likely effects of flooding on a community. Remote sensing technology produces an authentic source of information for disasters mitigation, preparedness and management as a whole. The response or action taken during and immediately following a disaster can also be enhanced by Remote Sensing. During floods, timely and detailed situation reports are required by the authorities to locate and identify the affected areas and to implement corresponding damage mitigation. It is essential that this information be accurate and timely in order to address emergency situations. Flood hazard mapping is a vital component for appropriate land use planning in flood-prone areas. It creates easily-read, rapidly-accessible charts and maps which facilitates the administrators and planners to identify areas of risk and prioritize their mitigation/ response efforts. Sanyal J. and Lu, X. X. (2003) and Bapalu G.V, and Sinha R. (2005). Over the years, many writers have made some research on Flood Vulnerability Mapping and Risk Assessment in Nigeria, using Remote Sensing and GIS techniques; it is not just enough to create maps showing the flood prone areas and how low or highly susceptible an area is to flooding, there is the need to go a step further, to reduce the risks of such places. This research therefore will be assesses the vulnerability of UKANA to flooding as well as suggests ways of reducing the risk of the area to flooding by mapping out the areas as they influence the distribution of the floodwater; developing flood mitigation measures using geo-information technologies that will cater for the mapped area as well as determine an effective approach to effect disaster risk reduction (DRR) in UKANA.

The causes of flooding across the world differ. Correia et al., (1998) assessed flood hazard and management. Their study focused mainly on evaluating the understanding of people and their responses to natural hazards in Setubal, Portugal. They sought to device how the knowledge can be integrated in the planning and management of flooding. Their study relied on extensive interviews for data collection. They observed that the willingness of the public to participate in flood management plays an intricate role in the flood management process. For instance, when people are ready to be involved in flood management, approaches that will bring about management will be promoted. This may come in the form of community participation in the development of drainages and adherence to appropriate development control regulations and provisions. According to Tabiri (2015), the four main causes of floods in Accra metropolis, Ghana are negligence/ignorance or sheer megalomania, poor planning of the city, building on waterways and indiscriminate disposal of waste material. Tabiri observed that Accra is exposed to the challenges of flooding and that urgent measures need to be put in place in order to minimize the challenges of flooding in Accra. Among such include the development of good drainage channels to facilitate surface run-offs and the appropriate disposal of waste by relevant agencies. Komolafe et al., (2015) reviewed flood risk in Nigeria. They noted that there have been diverse flood events in Nigeria. Their study basically obtained data through past scholarly works and other secondary sources. They observed that flooding in Nigeria is caused by high level of vulnerability and lack of coping capacity of residents in Nigeria coupled with fast occurrence of extreme events resulting from climate change. Their study also revealed that flooding is increasing sporadically in the country due to poor urban planning and management. They warned that many lives and properties are at risk of experiencing flooding. They concluded that there is need to explore effective use of state-of-the-art flood models and integrate all hydrological processes for more accurate prediction and mapping of flood and its associated risks in Nigeria. They also suggested that further studies on environmental and health impact of flood be carried out. Nkwunonwo et al., (2015) assessed flooding and flood risk reduction in Nigeria with a view to determining the cardinal gaps. Their study observed that flooding has become a frequent hazard in Nigeria. They noted that factors such as rapid population growth, urbanization, poor urban planning and climate change especially increased frequency and intensity of rainfall had resulted in flooding in major parts of Nigeria. Specifically, they showed that between 1985 and 2014, flooding in Nigeria has affected 11 million lives resulting in 1100 deaths and properties being damaged to exceed US$17 billion. According to them, Lagos State has recorded the largest percentage of flooding in Nigeria while Niger, Adamawa, Oyo, Kano and Jigawa states are also experiencing flooding. They argued that in spite of the growing scenarios of flooding and its potentials to affect lives and properties, little is done to stem the tide of flood occurrence in Nigeria. They suggested that more robust and scientific approaches to flood risk reduction such as flood modeling and vulnerability assessment be employed in flood management in Nigeria. Magami et al., (2014) assessed the causes and consequences of flooding in Nigeria. They revealed that flooding in Nigeria is caused by dam failure, over flowing of major rivers, coastal storms, ignorance of warning from Nigeria meteorological agency, delay in evaluation of flood victims and settlement of people at flood prone areas such as riverine areas and sea coast. Other causes of flooding that they observed were climate change, extraordinary heavy rains and continued release of excess water from artificial reservoirs.

METHODOLOGY

The present study is an empirical study that depends solemnly on primary data from various sources. The data involved includes primary data from survey using questionnaire tool and geo-referenced data (explicitly, GIS and Remote Sensing) and critically examined flood risk vulnerabilities in UKANA. The data obtain from the survey and was analyzed using simple statistical analysis with aid of charts and percentages. The method utilized by this study stresses on the application GIS mappings and integration of descriptive statistics to display spatial trends of floods vulnerabilities in UKANA, in Akwa Ibom Stae, Nigeria.

RESULTS AND DISCUSSION

Slope Percent Rise (%)

The analysis of vulnerability level-based slope percent rise domain was presented in Tables 1 and 2 and Figure 1 and 2 Considering the Table and Figure, the analysis indicated three (3) categories of slope percent rise Ukana; 0-0.1527%, 1.528-3.173% and3.174-5.288. The vulnerability rating of the indicated 2-high vulnerability and 1 moderate vulnerability. Among the slope percent analysis of Ukana, the total spatial extent was 6022.31 km^2. The highest slope percent rise was at 0-1.527% with spatial extent of 2735.15 km2 (45.42 %) and interpreted as high vulnerability while the lowest slope percent rise was at 3.174-5.288% with spatial extent of 903.91 km^2 (15.01%) and interpreted as moderate vulnerability. From Table 2 and Figure 2 two (2) slope percent rise vulnerability levels were identified, the Moderate vulnerability level has spatial extent of 903.91 km2 (15.01 %) and high vulnerability has spatial extent of 5118.4 km2 (84.99 %)

Table 1 slope percentage rise (%)

Slope percentage rise (%)	Spatial extent (Sq km)	Percentage (%)	Vulnerability ratings	Vulnerability interpretations
0-1.527	2735.15	45.42	3	High
1.528-3.173	2383.25	39.57	3	High
3.174-5.288	903.91	15.01	2	moderate
Total	6022.31	100		

Table 2 Slope percentage rise Vulnerability level

Slope percentage rise Vulnerability level	Spatial extent (Sq km)	Percentage (%)
High	5118.4	84.99
Moderate	903.91	15.01
Total	6022.31	100

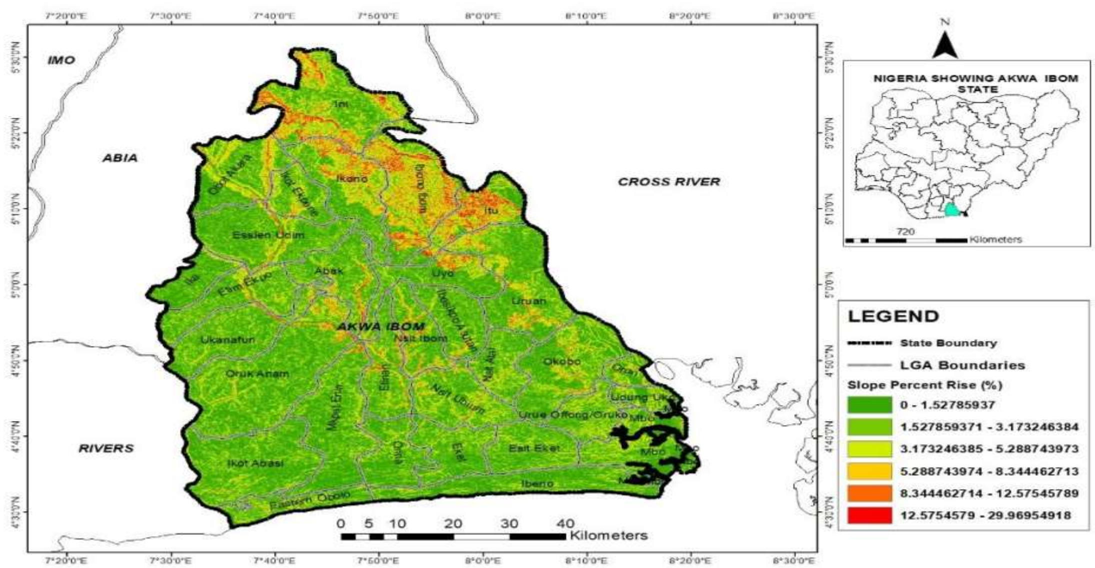

Figure 1 Slope Percent Rise of Akwa Ibom

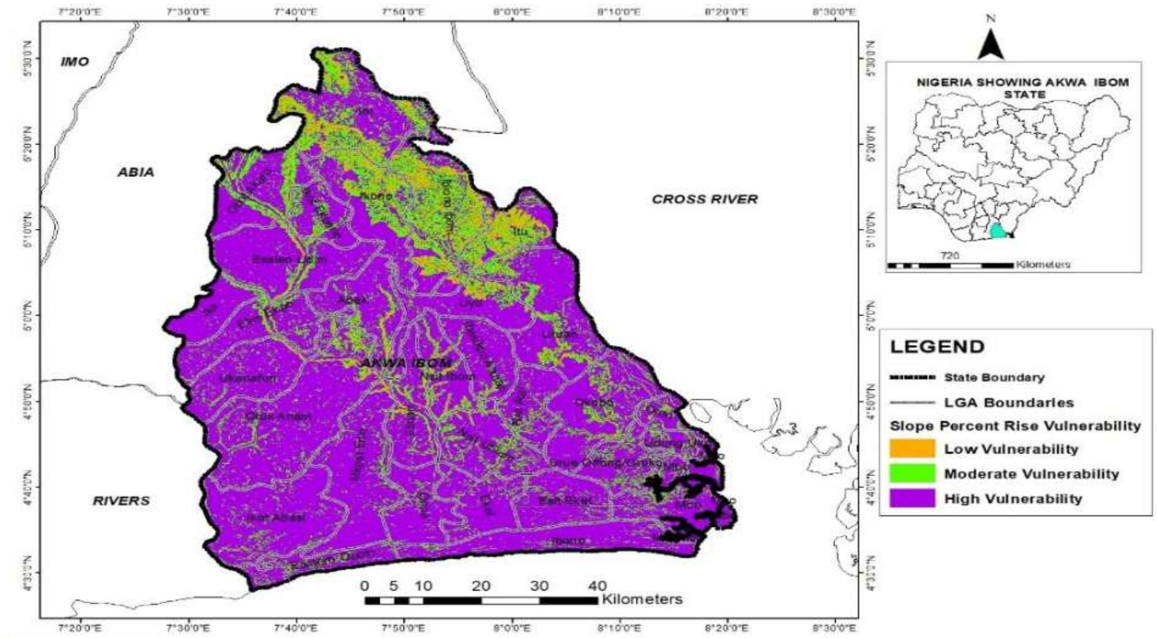

Figure 2 Slope Percent Rise Vulnerability of Akwa Ibom

Soil Texture

The soil texture analysis of Ukana and soil texture vulnerability was presented in Table 3 to 4 and Figure 3 and 4. From the analysis, two categories of soil texture were identified and spatially distributed across 5446.12 km2 spatial extent. Among the categories, spatial extent of 4939.85 km2 (90.70%) represented Coarse soil texture and it is interpreted as low vulnerability while the spatial extent of 506.27 km2 (9.30%) represented Fine soil texture and it is interpreted as high vulnerability

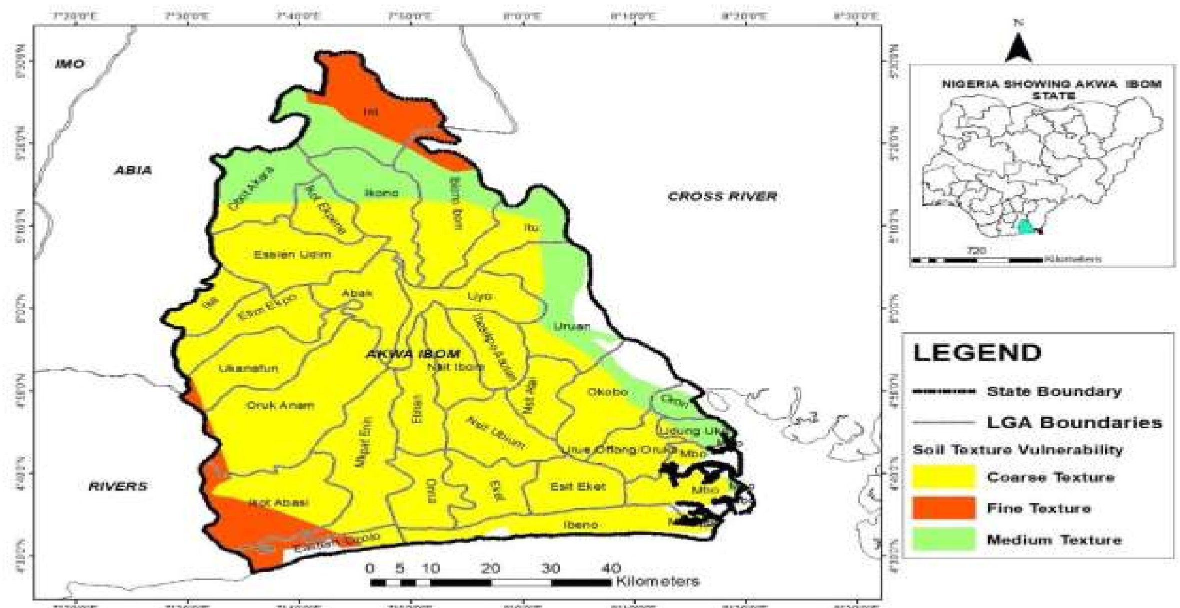

Figure 3 Soil Texture Analysis of Akwa Ibom State

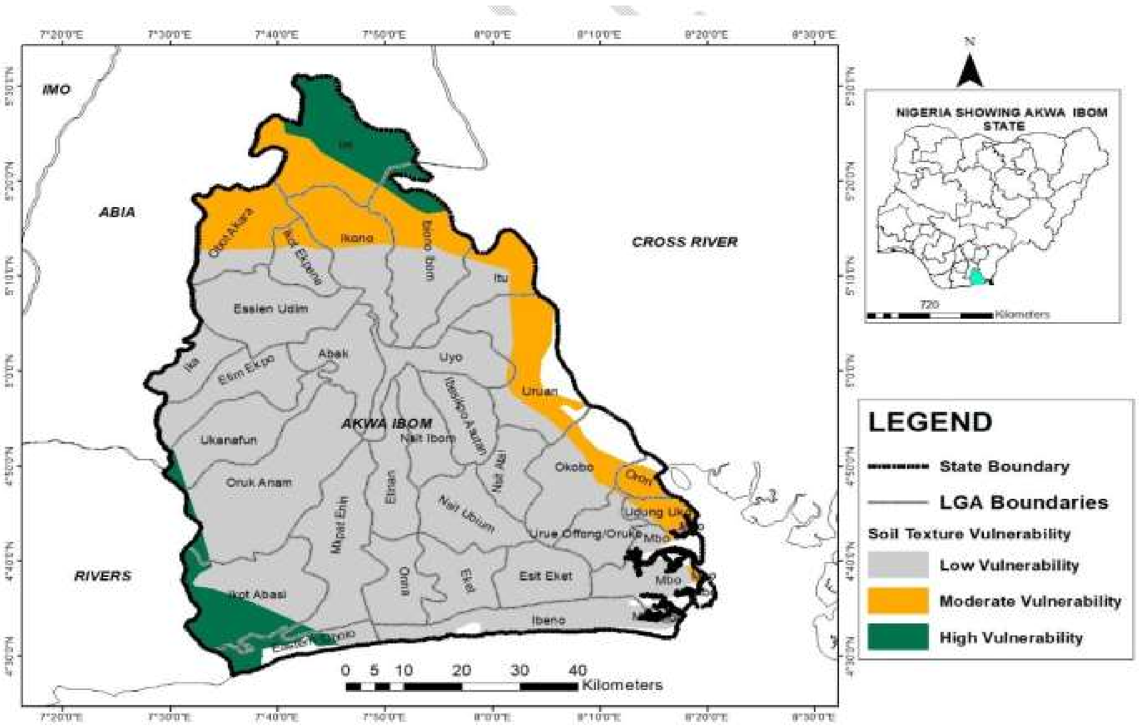

Figure 4 Texture Vulnerability Analysis of Akwa Ibom State showing Ukanafun LGA

Table 3 soil texture analysis

Soil texture	*Spatial extent (Sq km)*	*Percentage (%)*	*Vulnerability ratings*	*Vulnerability interpretations*
Coarse texture	***4939.85***	***90.70***	***1***	***low***
Fine texture	***506.27***	***9.30***	***3***	***High***
Total	***5446.12***	***100***		

Table 4 Soil Texture Vulnerability

Slope percentage rise (%)	Spatial extent (Sq km)	Percentage (%)
Low	4939.85	90.70
High	506.27	9.30
Total	5446.12	100

Rainfall Volume

The rainfall volume was analyzed as the domain for climate change influence on the flood vulnerability level of Ukana and the outcome of the analysis was presented in Tables 5 and 6 and Figures 5 and 6. From the analysis, rainfall volume of 1957.077-2032.545 covers a spatial extent of 1763.4km2 which represented 53.69 % while the rainfall volume of 2032.546-2104.420 covers a spatial extent of 1520.82 km2. In terms of vulnerability rating, the rainfall volume was rated 1 and 2, it is interpreted as low and moderate vulnerability for 1957.077-2032.545 and 2032.546-2104.420 respectively.

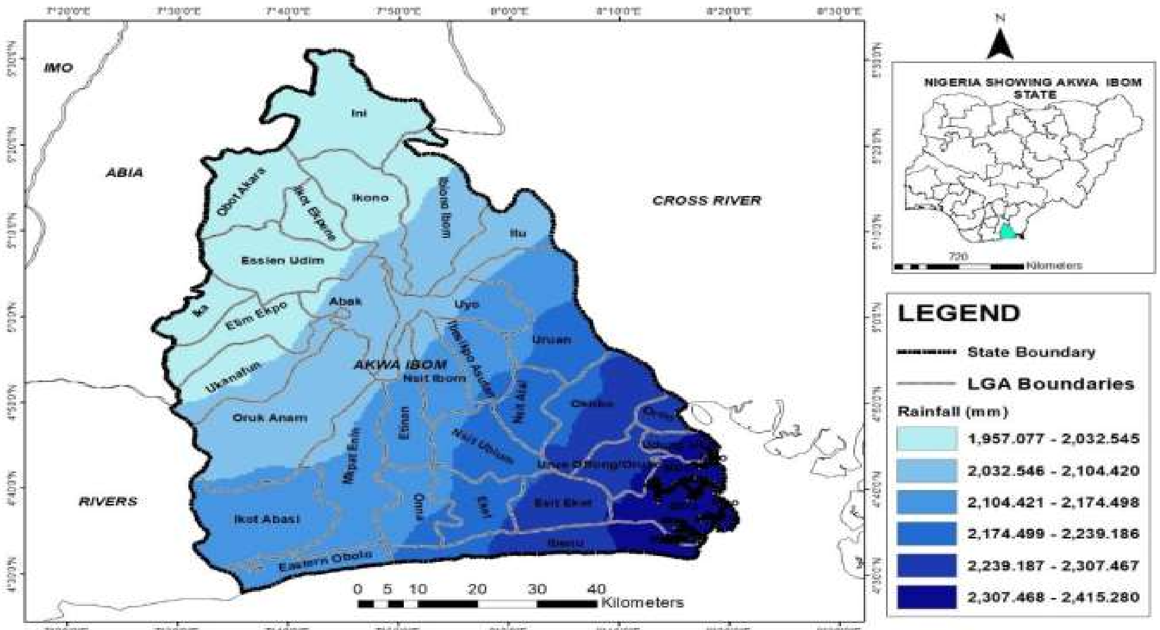

Figure 5 Rainfall Volume (mm) of Akwa Ibom State showing Ukanafun

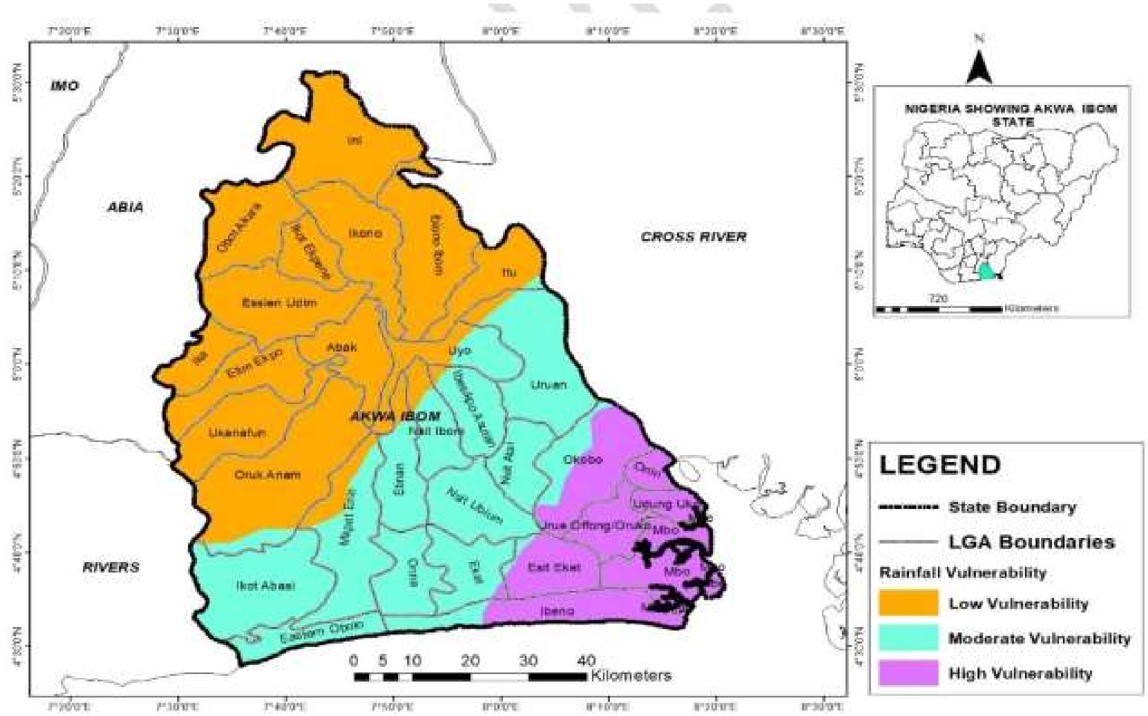

Figure 6 Rainfall Vulnerability of Akwa Ibom State showing Ukanafun

Table 5 rainfall volume analysis

Rainfall volume (mm)	Spatial extent (km^2)	Percentage (%)	Vulnerability Ratings	Vulnerability Interpretations
1957.077-2032.545	1763.4	53.69 %	1	Low
2032.546-2104.420	1520.82	46.31 %	2	Moderate
Total	3284.22	100 %		

Table 6 rainfall Vulnerability

Rainfall volume (mm)	Spatial extent (km^2)	Percentage (%)	Vulnerability Ratings	Vulnerability Interpretations
1957.077-2032.545	1763.4	53.69 %	1	Low
2032.546-2104.420	1520.82	46.31 %	2	Moderate
Total	3284.22	100 %		

Figure 7 Spatial Flood Vulnerability of ukana

	Low Vulnerability		*Moderate Vulnerability*		High *Vulnerability*		SE (km^2)	Percentage (%)
	SE (Km^2)	%C	SE (Km^2)	%C	SE (Km^2)	%C		
Ukana	27.72	2.98	192.25`	6.66	31.08	1.20	251.05	100

The study adopted various physical environmental domains such as slope, proximity to river channel and soil texture to establish the flood vulnerability levels of Ukana, Ukanafun LGA Akwa Ibom state. The established levels were categorized into low, medium and high vulnerability and their spatial extent cover was also established. The outcome of the study showed similarity with previous studies conducted using various physical environmental domains. Through domains such as land use, elevation and proximity to river channel, Afolabi et al. (2022) established the vulnerability categories of communities in Isoko North LGAs low, medium and high vulnerability. Chukwuma et al. (2021) through conditional factors such as slope, land use, elevation and soil texture, the vulnerability level of LGAs in Anambra state was determined. The approach adopted by this study; that is, the use of GIS is a common approach to flood modelling. This was corroborated by various studies including that of Bello and Ogedegbe (2015), Orimoogunje et al., 2016 and Umar and Gray (2022). On the Land use/Landcover, the activities with high vulnerability reported for these studies; that is, settlement, waterbodies, rocky land and sandy area are similar to those reported by Onuigbo et al. (2017). Wizor and Week (2020) opined that various anthropogenic activities affect the land use and landcover of an area and it is capable of increasing the exposure. Among various landuse/landcover categories reported for this study, settlement was rated the highest among the high vulnerability for landuse/landcover. Changes in land use due to urbanization increases flood susceptibility (Kaspersen et al., 2015) as urbanization is largely associated with the removal of soil and vegetation and these are important factors for limiting surface runoff (Adeoye, 2012; Pradhan-salike & Pokharel, 2017). The vulnerability rating scale adopted for this study which was based on high (3), medium (2) and low (1) vulnerability was similar to those adopted by Afolabi et al. (2022) and Berezie et al. (2019).

Conclusion and Recommendations

The Geospatial approach of the study further encourages the possibility of establishing the flood vulnerability level of an area through domains such as land use, elevation, and proximity to river bodies (drainage). The study concluded that domains of interest jointly contributed to the vulnerability level of Ukana and majority of the communities of the Ukanafun LGA are categorized to be medium/moderate flood vulnerability level. The map showing different flood vulnerability zones are useful in all steps of disaster management (prevention, mitigation, preparedness, operations, relief and recovery) and should be considered during initial planning. Various human activities that can contribute to increase vulnerability such as building on river channel should be adequately monitored and prevented. It is also recommended that the government and relevant agencies should provide adequate drainage system, weather forecast, insurance facilities, and timely and precise flood early warning systems to reduce farmers' vulnerabilities to flood disasters and enhance their livelihoods.

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