Available online www.unicrossjournals.com

UNICROSS JOURNAL OF SCIENCE AND TECHNOLOGY, UJOST

RESEARCH ARTICLE VOL. 3(1) MARCH 31, 2024 ISSN:2814-2233

Date Approved March 31, 2024 Pages 167 - 174

IMPACT OF FLOODING ON RESIDENTIAL LAND USE ZONES OF CALABAR METROPOLIS, NIGERIA

[1]Obongha, Ukpali E. and [2]Ojo, Patience A.

[1]Department of Urban and Regional Planning, University of Cross River State, Calabar, Nigeria.

[2]Department of Urban and Regional Planning, University of Calabar, Calabar, Nigeria

Corresponding email: obpaddy7777@gmail.com

Abstract

Measuring the impact of flooding on residential land use zones of Calabar Metropolis is imperative, following its widespread destruction of lives and property within the zones. The aim of this study is to examine the impact of flooding on residential land use planning in Calabar Metropolis. In order to achieve this aim, a null hypothesis was speculated as: there is no significant relationship between the spatial extents of flood and the number of residential buildings consistently flooded. The study adopted a longitudinal survey approach spanning from 2020 to 2022. Primary and Secondary data sources were used. Data on spatial extents of flood were obtained through metric measurement and numerical value of flooded residential buildings for the three years under study was obtained from State Emergency Management Agency (SEMA). The analyses of spatial extents of flood and the number of flooded residential buildings were carried out using linear regression analysis in SPSS version 28. The result of the analyses shows a statistically significant relationship which was confirmed by the normal distribution curves of the histogram and regression plots residuals. However, the regression model satisfied it goodness of fit in the data and the overall model fit was R^2=0.787. Findings also show that non-compliance to the master plan, uncontrolled physical development, and ineffective town/land use planning have contributed to frequency of flooding in the residential zones of Calabar Metropolis. Others are rainfall amount, intensity and duration due to climate change, land configuration, poor waste disposal methods. The study, therefore, suggests urgent review of the Calabar urban master plan and proper channelization of drainage systems with adequate capacity to accommodate the runoff. Others are effective town planning and controlled development. Stringent legislation on waste management and adaptation options would again, help to reduce flood impact on residential zoned areas of Calabar Metropolis.

Key words: *Flooded residential buildings; Inundation; Linear regression analysis; Master plan; Residential zoned areas; SEMA; Spatial extents of flood.*

1.0 Introduction

Global interest in flooding, its impact on man his socio-economic activities, and environment have intensified recently, though information on recent flood trend is inconclusive. However, global trends in rising sea levels and temperatures now provide strong evidence of a climate signature (Few, Ahen, Matthias, & Kovats, 2004). Global climate change indicates a change in either the mean state of the climate or in its variability, persisting for several decades or longer. It is important to note that changes in individual weather events have potentially contributed substantially to changes in climate variability. Climate change could occur naturally as a result of a change in the sun's energy or earth's orbital cycle (natural climate forcing), or it could occur as a result of persistent anthropogenic forcing, such as the addition of greenhouse gases, sulphate aerosols, or black carbon into the atmosphere, or through land use change (Obongha & Yaro, 2020; Jimoh & Iroye, 2009).

Interest in flooding events brought about awareness of flood risk, the limited knowledge of flood disaster management in many areas and the significant number of human population that is vulnerable to flooding (Peduzzi, Dao, Herold, & Mouton, 2011; Action Aid; 2006; Gill, Pauleit, Ennos, Lindley, Handley, William, & Ueberjahn-Tritta, 2004;). The impact of flooding recorded in the past three decades in some cities of the world have been enormous. For example, in the autumn of 2000 in the United Kingdom, 16,000 residential properties were flooded and about 1,200 properties were flooded in Central and Southern England in 2003 (UNDP, 2005, Ojikpong, Ekeng, Obongha, & Emri, 2016). These flood impacts have amounted to tens of billion US dollars being spent on flood events (Guha-Sapir, Hoyois, & Below, 2013). Flood events have also affected many countries in Asia, notably China, Bangladesh and Thailand recording hundreds of thousands of deaths and rendering billions of people homeless, psychological depression, physical injuries, water borne diseases, anxiety and post-traumatic stress (Keith, 2013; Tapsell & Tunstall, 2008; Few, Ahen, Matthias, & Kovats, 2004; Hunter, 2003). The August 2016 flood disaster in Louisiana, USA recorded as one of the greatest destruction in the city in historic time. The flood occurred as a result of 72 hours down pour leading to inundations that claimed the lives of 13 people and 40,000 homes completely damaged (National Weather Service, 2016).

In Nigeria for example, the July 9, 2017 flood incidence in Lekki, Lagos was also the result of continuous three-day downpour, claiming many lives and causing a wide range of destructions. On August 6, 2017 in Calabar, a similar flood incidence occurred where property worth billions of Naira were lost, many buildings submerged, residential land uses destroyed and roads remained impassable (Obongha, Ojikpong & Ukam, 2020).

Residential land use planning in the ancient city of Calabar Metropolis is uncontrollably intermixed with other uses. This in most cases leads to conflicts or antagonism; that is one land use being detrimental to the other. For example, it is common to find mechanic workshops interspersed in areas of residential land use and open markets in high class residential areas. This land use antagonism result in non-conforming urban land uses.

Non-conforming land uses are those which by virtue of their juxtaposition are detrimental to each other (Kim, 2011). Such urban land uses exert negative influences on each other instead of promoting mutual relationships. Non-conforming land uses conflict with each other in that one is a nuisance to the other. Non-conformity of land uses are concomitants of composite urban land use location and allocation decisions made in successive traditional, political and administrative regimes in times past, before the art of urban planning became known. Such antagonistic land uses are a common feature of environmental degradation such as flooding.

The developing countries such as Nigeria and Ghana, for example, had experienced difficulties in achieving total compliance to the ordinances and laid down standards guiding urban land use planning due to administrative lacuna. Hence, chaotic and incongruous land uses become the order of the day (Boamah, Gyimah, & Nelson, 2012). In Calabar, for example, non-conforming land uses have existed overtime due to increase in human population. Population increase began in 1987 after the creation of AkwaIbom State out of the then Cross River State. However, migrants from Akwa Ibom State chose to remain in Cross River State, albeit, in Calabar. At that point, the population of Calabar began to grow in number and expand spatially (Oka, 2009). As a result, the marshlands and swamps in Anantigha and the green belt areas meant for farming along Ikot-Eneobong and Ikot-Effangha Mkpa became densely built up for all manner of uses without control. The area zoned for industrial land use was rezoned for residential land use in the year 2000. This resulted to competition between industrial activities and residential development giving rise to environmental degradation such as flooding and erosion. Similarly, development contradicts the Calabar urban master plan by developing flood plains and wetland areas for residential uses. This study is therefore, aimed at examining the impact of flooding on residential land use planning in Calabar Metropolis. In order to achieve this aim, a null hypothesis was speculated as: there is no significant relationship between the spatial extents of flood and the number of residential buildings consistently flooded.

2.0 Materials and Methods

This study adopted a longitudinal survey approach which involved repeated flood observations, measurements and interviews for three years (i.e. from 2020 to 2022). Primary and secondary sources of data were collected and used. Primary data were collected through metric measurement of the areas inundated by flood along streets. Interviews were also conducted on 50 occupants/owners of flooded residential buildings and officials of Town Planning Department in the Ministry of Urban Renewal and Development, Calabar. Questions were asked on areas such as methods of waste disposal, effectiveness of town planning practices, controlled development, effectiveness of the master plan, size of drainage channels, rainfall pattern (intensity, duration and frequency), frequency of flood events, and its effects on the residents.

Spatial extent of flood is defined as the area of coverage of flood, the scale/magnitude of flood in a street determined by its diameter. Diameter in this context is a straight line along a street inundated by floods and measured in metres using a metric tape as used in Obongha &Yaro, (2020); Obongha, (2018); Ojikpong et al, (2016); and Houghton et al, (2001). Streets that are consistently flooded within the period under study were identified, determined its diameter and then measured only portions that are flooded using a metric tape. Streets identified within the residential zones were put together during measurements and figures summed up for easy manipulation in SPSS.

Secondary data were collected from the State Emergency Management Agency (SEMA) Calabar on the number of residential buildings consistently affected by flood across the three years under study in the two LGAs of Calabar Metropolis. Data sets were collected according to the months that recorded flood cases. This means that there are some months that recorded flood cases in 2020 and not flooded in 2022 (e.g. August and October) and 2021. Other secondary data sources included; map of Calabar used to earmark flood prone areas as well as Journal articles, text books, and unpublished materials. The Calabar urban master plan document (action plan) was also sourced from the Town Planning Department and used to compare with the existing land uses of Calabar Metropolis in order infer if there are some deviations between them.

Residential buildings considered vulnerable to flood were determined by SEMA (under its statuary responsibility) and the total number were collected and used in the study. Floods do not occur evenly throughout Calabar Metropolis which comprises two Local Government Areas (Calabar Municipality and Calabar South LGA) but in areas liable and prone to flood. These areas have been earmarked in the map of Calabar Metropolis. Descriptive statistics with Tables, charts and percentages were employed for the analysis and the linear regression analysis in SPSS was conducted to determine the relationship between the spatial extents of flood and total number of residential buildings consistently flooded in 2020, 2021 and 2022 (i.e. within the residential zones).

2.1 Study Area

Calabar is the Capital City of Cross River State of Nigeria and has a population of over 500,000. It is located between latitudes 040 5611^0 N and 050 411^0 N and longitudes 080 1811^0 E and 080 2411^0 E. It is bounded at both sides by Great Kwa River and Calabar River (Figure 1). It can be accessed by sea, land and air. Its present settlement is on the Eastern flank of the Calabar River; its growth is limited by mangrove swamps in the South. There are two local government areas in Calabar Metropolis, these are Calabar Municipality and Calabar South L. G. A. There are 18 residential zones in Calabar Metropolis Figure 2 shows these 18 residential zones of Calabar Metroplis.

Calabar has a subequatorial type of climate. The annual temperature is moderately high about 31-35°C and does not fluctuate greatly. The rainfall distribution shows that it is characterized by double rainfall maxima, which starts from the months of May to November, reaching its climax in the months of July and September. The annual average rainfall is about 2000-3000mm with a short dry period in August. The heavy rainfall tends to accelerate runoff volume and rate thereby resulting in flooding and environmental degradation in the city. Figure 1 shows Calabar Metropolis in Nigeria and Cross River State.

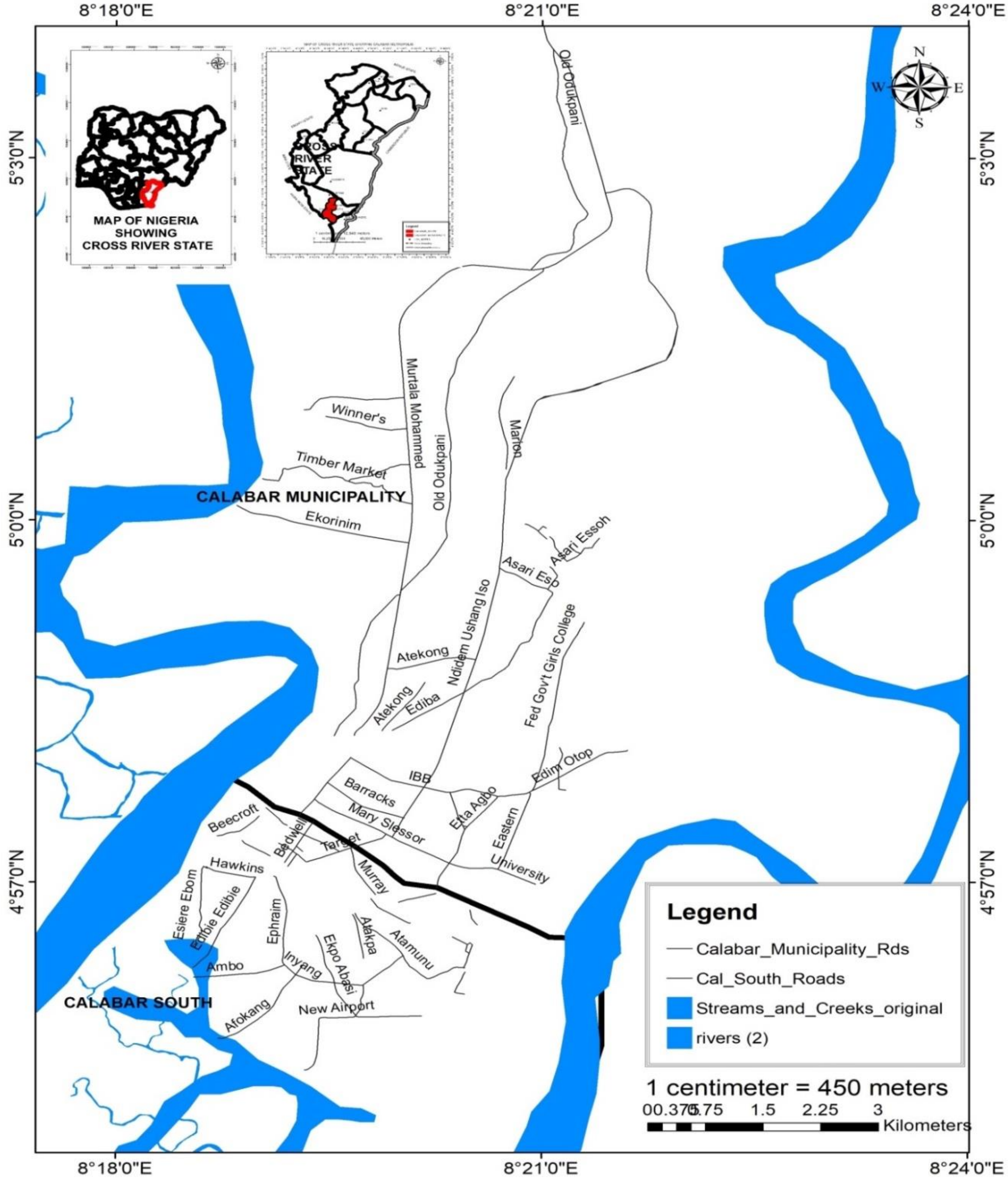

Figure 1: Maps ofCalabar showing Nigeria and Cross River State.

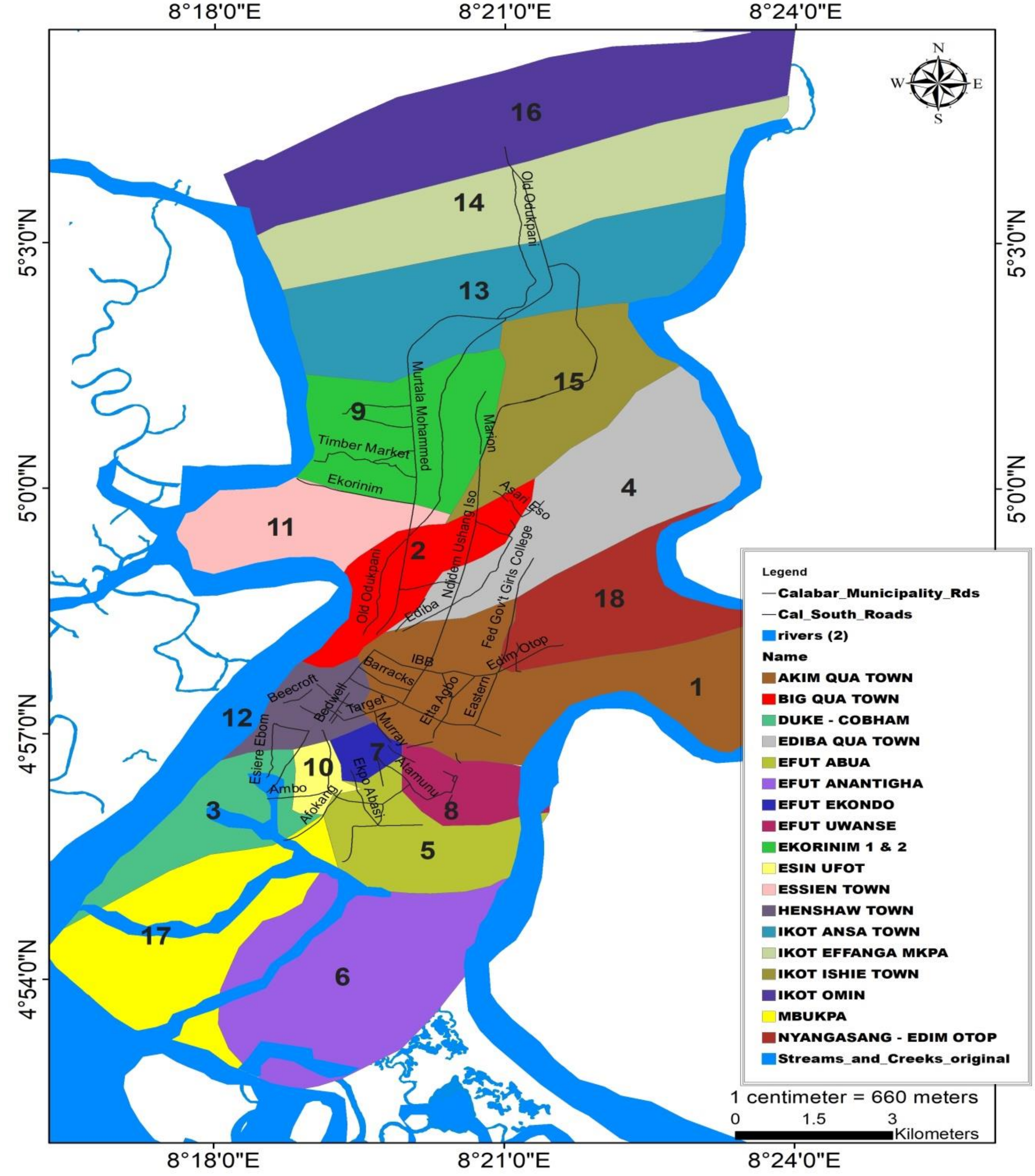

Figure 2*: *Map of Calabar Metropolis showing the 18 residential zones

Source: Obongha, 2023

3.0 Data analysis and results

Primary sources were obtained from metric measurement of the scale of flood and interviews while secondary sources were obtained from SEMA and the Town Planning Department.

Table 1: Causes of flooding in the residential zones

S/No.	Causes and impacts	No. of respondents	Percentage
1	Methods of waste disposals	25	50
2	Planning permission procedures in flood prone areas	5	10
3	Measures used in development control	5	10
4	Deviation from the master plan	5	10
5	Size and number of drainage channels	47	94
6	The pattern of rainfall	50	100
7	Frequency of floods	50	100
8	Effects of floods on the residents of affected areas	50	100

Source: Researcher's analysis, 2023.

Table 1 shows that 25 respondents out of 50 observed dumping of waste in drainage channels as a major cause of flooding. The residents lamented that when it rains these waste prevents runoff and the result is ponding of water on the streets. Town Planning officials were asked, whether planning permission were granted for developments within the flooded zones? They responded that many of the buildings are old and were built before the advent of town planning, as such, were not granted planning permission. They added that 90% of the buildings in the flood prone zones were not brought to the office for planning permission, while others were redeveloped from the existing old structures. The measures used for development control were also considered and the officials disclosed that town planning is an establishment of government and would only act on the directives of the government, however, controlled development according to them is currently practicable in the peripheral areas of the Metropolis. There are also deviations from the Calabar urban master plan in some residential zones as observed by the Town Planning Officials. According to them most of these deviations are carried out by Politicians and top Government Officials in the State.

Also, 47 victims out of 50 said the drainage channels are so narrow that they could not contain the volume of runoffs and that many streets are without drainages and becomes difficult for the rain water to flow. All interviewed victims believed that intensive rainfall patterns of over 5-6 hours duration is the major reason for flooding in the Metropolis. Flood frequency also depends on the intensity of the rains, duration, and the months of the year. They have observed that over the years the months of June to October have always been catastrophic to them. Some of the victims who live close to the Calabar and Great Qua Rivers also mentioned the frequency of increased volume of the rivers as contributing to floods. Speaking on the effects and impacts of flooding on the victims, they narrated that flooding has made them loose loved ones, children, properties worth millions of Naira, brought poverty to them, destroyed their livelihood systems and rendered them homeless. Many of the victims complained that they were compelled by floods to start their lives all over after the August, 2017 floods. The plates 1 and 2 show at a glance these narratives.

Plate 1: Flooded Residential zone

Source: Obongha &Yaro, 2020.

Plate 2: Flooded home

Source: Obongha &Yaro, 2020.

Table 2: Spatial Extents of Floods

S/no	Street name	Diameter of flooded zones (Metres) (X)	Location
1	IkotOmin, IkotAnsa Lane, Ebedem, EsamAbasi	578	Calabar Municipal
2	IkotOffiong, Bible way, IkotAbasiObori, Akai Efa	599	Calabar Municipal
3	Ediba and Old Ikang	345	Calabar Municipal
4	Big Qua, IsoOqua	174	Calabar Municipal
5	Nyahasang/Atimbo	397	Calabar Municipal
6	Akim Qua Town	403	Calabar Municipal
7	Mount Zion, Yellow Duke, Atamunu, Palm Street Extension	772	Calabar South
8	Goldie, Target, Anating, Murray, Nelson Mandela, Atu, Mayne Avenue	997	Calabar South
9	Idang, EwaEkeng, Egerton, Marina, Edibedibe	368	Calabar South

10	EkpoAbasi, Ekeya, Spat Avene, Bassey, Inyang, St Mary's, Howel	835	Calabar South
11	Abitu, New Airport, Jebs, Afokang	570	Calabar South
	Total	**6,038**	**Calabar Metropolis**

Source: Researcher's Analysis, 2023.

Table 2 shows the field measurement that were conducted to determine the spatial extents of flood by measuring the diameter of the streets considered to be flooded as the independent variable (X).

Table 3: Residential buildings consistently flooded from 2020-2022

S/no	Street name	Number of buildings flooded from 2020-2022 (Y)	Location
1	IkotOmin, IkotAnsa Lane, Ebedem, EsamAbasi	161	Calabar Municipal
2	IkotOffiong, Bible way, IkotAbasiObori, Akai Efa	99	Calabar Municipal
3	Ediba and Old Ikang	26	Calabar Municipal
4	Big Qua, IsoOqua	24	Calabar Municipal
5	Nyahasang/Atimbo	142	Calabar Municipal
6	Akim Qua Town	60	Calabar Municipal
7	Mount Zion, Yellow Duke, Atamunu, Palm Street Extension	188	Calabar South
8	Goldie, Target, Anating, Murray, Nelson Mandela, Atu, Mayne Avenue	250	Calabar South
9	Idang, EwaEkeng, Egerton, Marina, Edibedibe	98	Calabar South
10	EkpoAbasi, Ekeya, Spat Avene, Bassey, Inyang, St Mary's, Howel	118	Calabar South
11	Abitu, New Airport, Jebs, Afokang	173	Calabar South
	Total	**1,339**	**Calabar Metropolis**

Source: State Emergency Management Agency (SEMA), Calabar, 2023.

Table 3 shows the residential buildings that are consistently flooded within the three year period under study. The data were used as the dependent variable (Y) in order to quantitatively measure the linear regression analysis in SPSS.The results of the linear regression analyses showing the relationship between the spatial extents of flood and residential buildings consistently flooded for three years (i.e. 2020-2023) are presented in Tables 4 and 5.

Table 4: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.887[a]	.787	.766	775.460	.787	36.920	1	10	.000

a. Predictors: (Constant), Spatial Extents ofFlood
b. Dependent Variable: Flooded Buildings
Source: Researcher's analysis, 2023.

Table 4 shows an explanation of 76.6% of the variation in the flooded residential buildings with a linear explanatory variable of one predictor (spatial extents of flood). 78.7% is the coefficient of determination (this means that it is the proportion of variance in the flooded residential buildings that is explained by the predictor). However, the Adjusted R Square penalizes the addition of extraneous predictor into the model. This explains a strong relationship between spatial extents of flood and flooded residential buildings.

Table 5: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	196.405	260.536		.754	
	Spatial Extents of Flood	2.078	.342	.887	6.076	.000

a. ***Dependent Variable: Flooded Buildings***
b. ***Independent Variable: Spatial Extents of Flood***
Source: Researcher's analysis, 2023.

From Table 5, it was observed that:

- Spatial Extents of Flood was statistically significant.
- The slope of the coefficient of spatial extents of flood is positive. This means that as many streets are flooded the more residential buildings are affected and this demonstrates a statistically significant relationship.
- The overall model fit was R^2=0.787

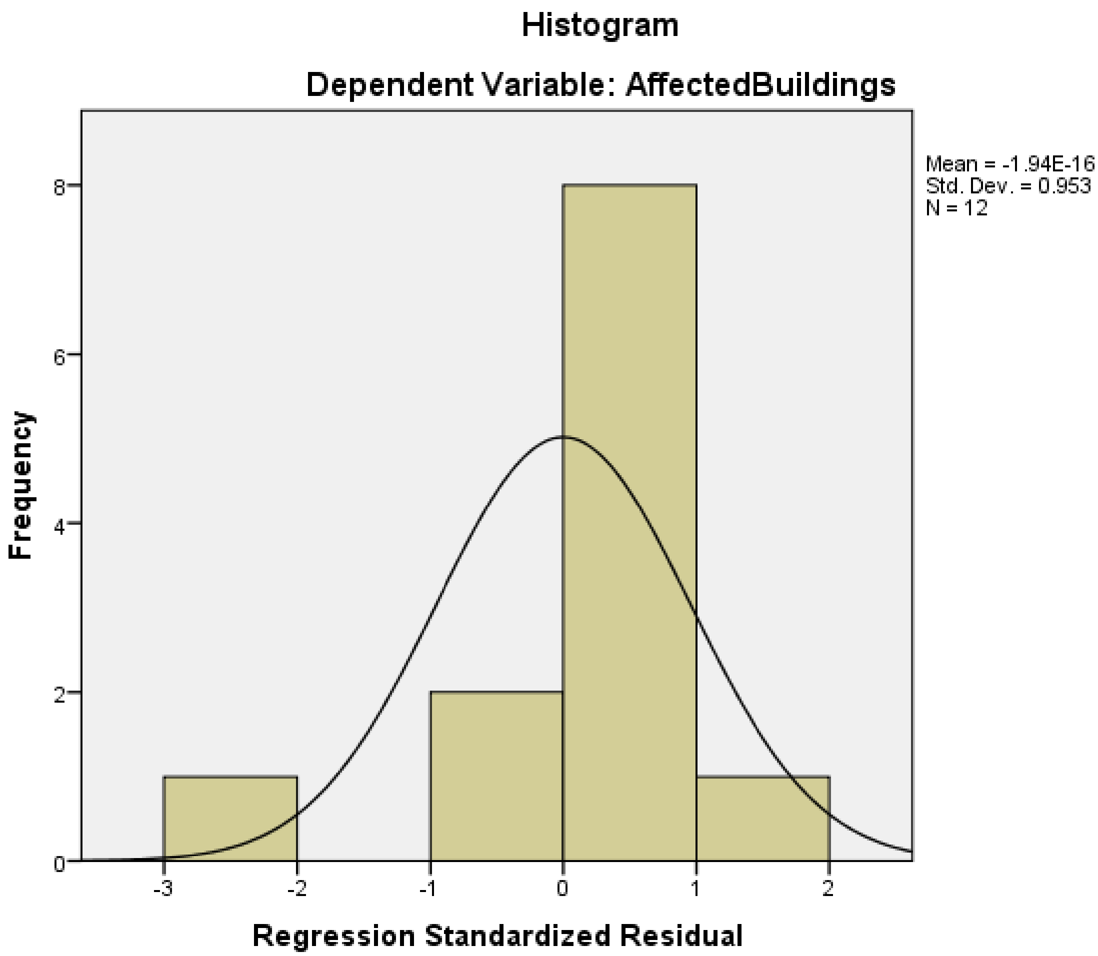

Figure 2: The Histogram showing the plots of Residuals versus Predicted Y

Source: Researcher's analysis, 2023.

Figure 2 is a histogram of frequency of plots showing the distribution of a regularly spaced variable. The above shown plot is a normal distribution which indicates a no problem with the assumption of the residual.

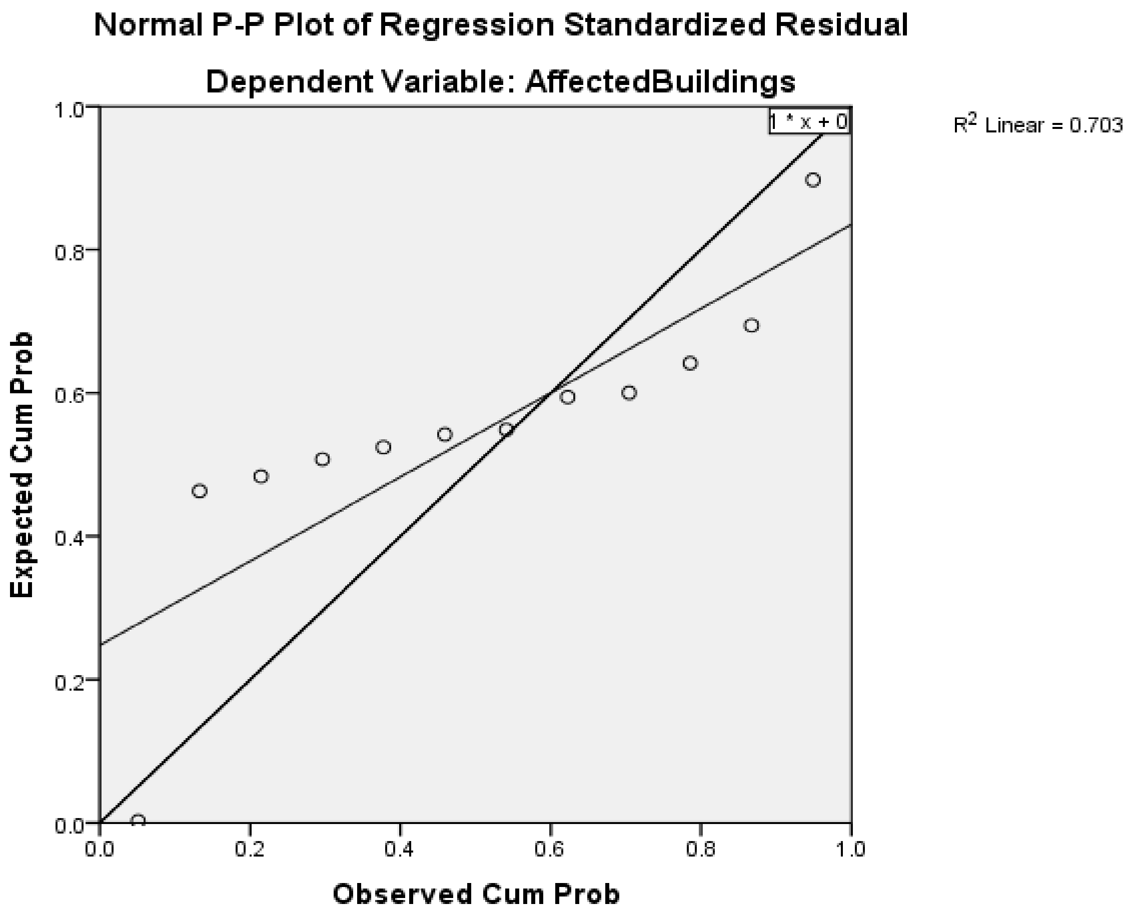

Figure 3: Normal Plot of Regression Standardized Residual Source: Researcher's analysis, 2023.

The assumption in the plot in Figure 3 shows that the residuals are not related to the explanatory variables and hence the slope of the regression equation demonstrated a gradual downward movement from right to left which is normal. It also shows a straight line relationship between the residual and the predicted responses.

3.1 Comparing the Calabar urban master plan (Action plan) with the Existing land uses

Figure 5 shows the existing land use patterns from the projections of the Calabar urban master plan. It indicates some additions of land uses that were not zoned in the master plan to include two cemeteries at Essien Town and Etta Agbor layout. Others are development of residential areas in the northern and southern industrial zones, development of flood plains for residential and other uses and encroachment into higher education land (University of Calabar and university of Cross River State, Calabar). Figure 5 is compared to Figure 4 (the action plan) of the master plan. From the two plans (Figures 4 and 5) there are indications that development of residential zones has not followed the prescription of the master plan and as such the result has been inundation of the residential zones of Calabar Metropolis.

Figure 4: Action plan of the Calabar urban master plan

Source: Town Planning Department, Calabar

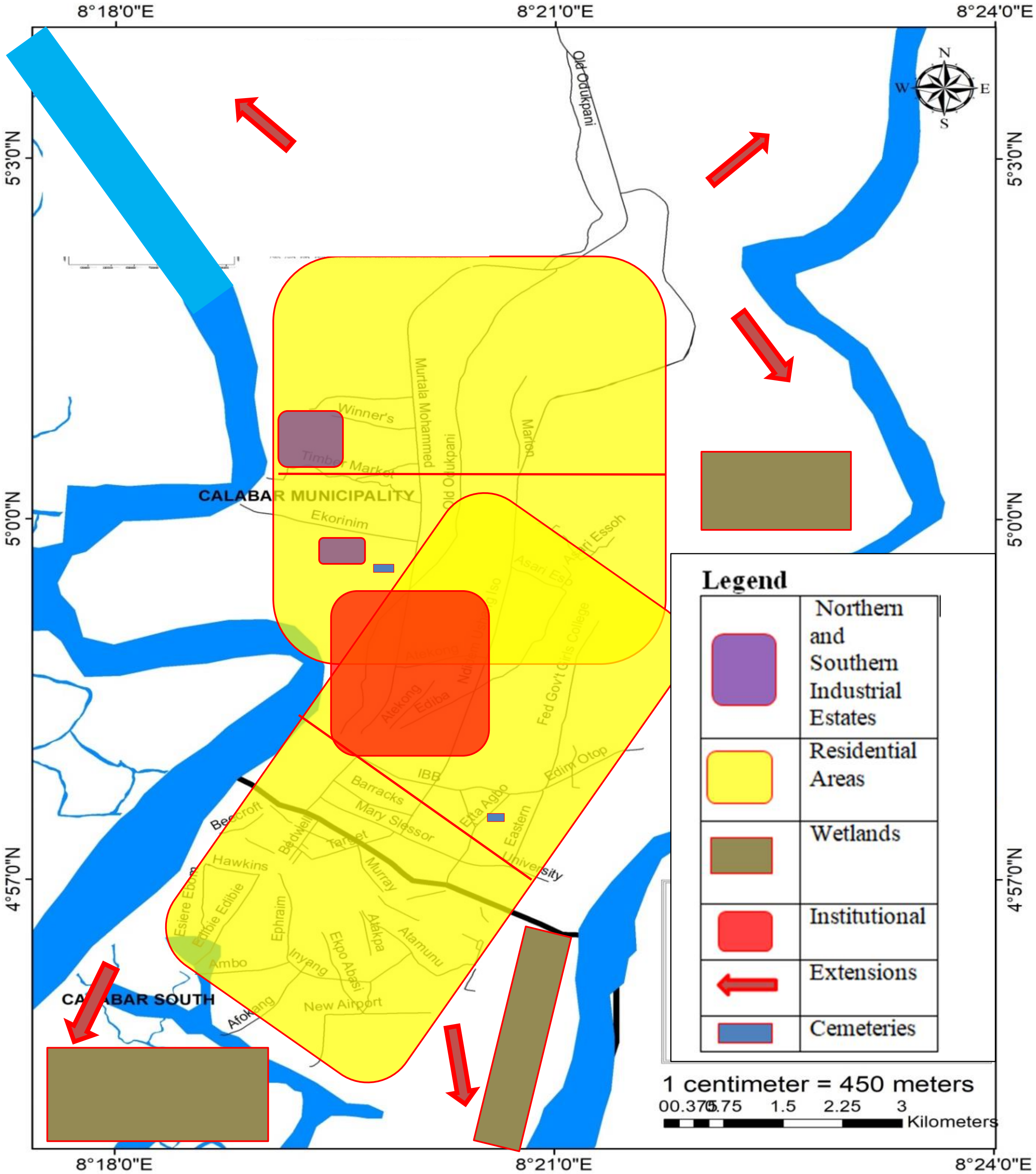

Figure 5: Existing land use patterns of Calabar Metropolis

Source: Obongha, 2023.

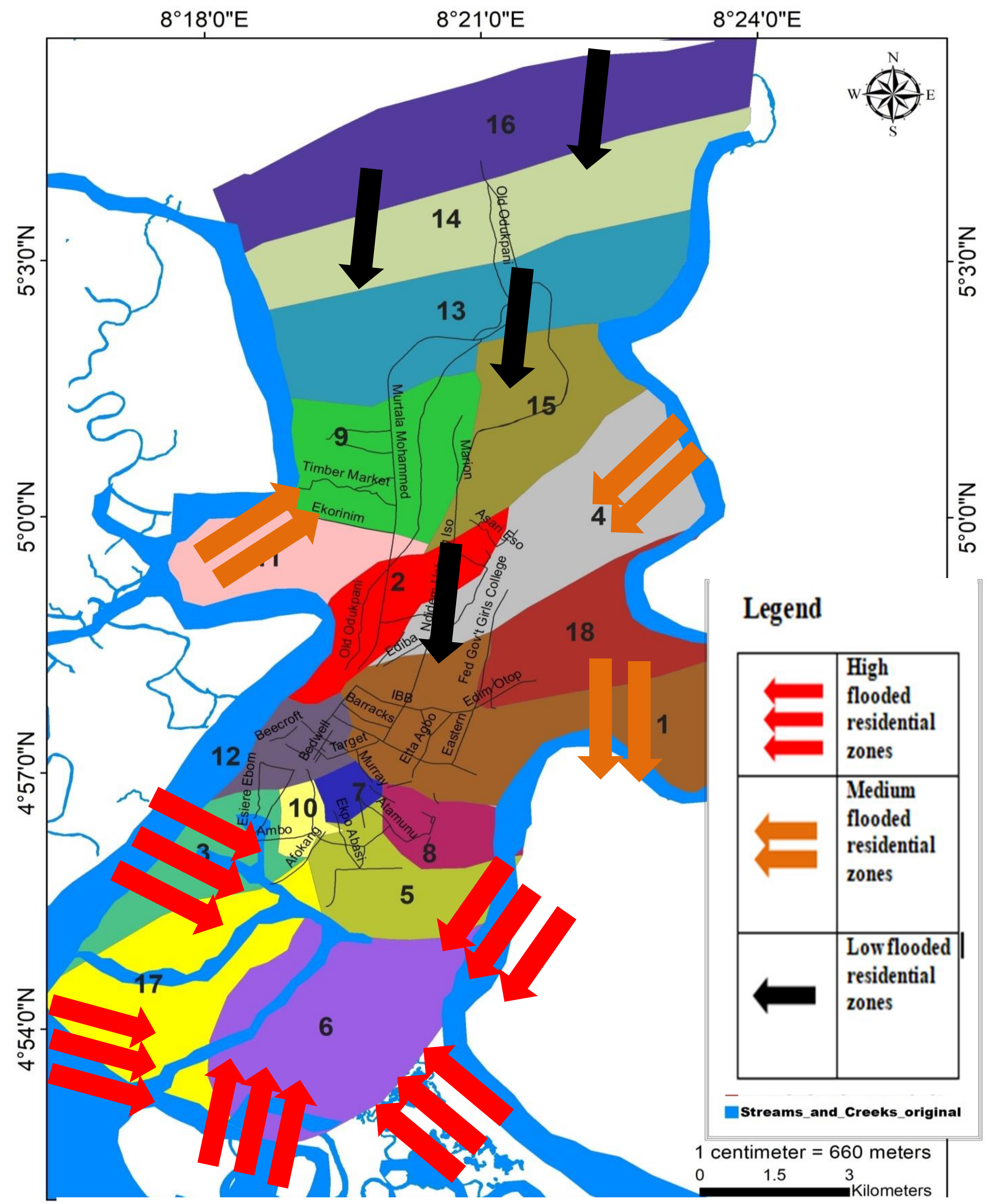

Figure 6: CalabarMetropolis showing flooded residential zones

Source: Obongha, 2023.

Figure 6 shows flooded residential zones of Calabar Metropolis. These zones were earmarked during the rainy seasons of the three years under investigation. The study shows three levels of flood zones namely: high, medium and low flooded residential zones. The high flooded zones are located along the major and minor drains that contain many silts and sediment of waste within the southern and south western areas of Calabar Metropolis. The medium flooded zones are those adjacent to the Eastern flank of the Calabar River and Western flank of the Great Qua River. While the low flooded zones are areas in the northern and central parts of Calabar Metropolisalong the two major Rivers. However, flooding is also attributed to the configuration of the land, high rainfall intensity and duration, poor waste disposal methods, uncontrolled physical development, and ineffective town/land use planning and non-compliance to the master plan. Residential zones found around the areas marked were seriously hit by floods throughout the years under study.

4.0 Conclusion

This study examined the impact of flooding on residential land use in Calabar Metropolis. Several data types were collected and result demonstrated a significant relationship between spatial extents of flood and the number of residential buildings that were consistently flooded in 2020, 2021, and 2022. The analyses proved that the more inundation of streets the more residential buildings were affected by the inundation. The regression model in the analysis has satisfied its goodness of fit in the data and as such the independent variable had reliably predicted the outcome of the dependent/explanatory variable. The normal distribution shown on the histogram and that of the normal plot of regression standardized residual also confirmed the strong relationship.

However, the study also compared the master plan (action plan) of Calabar Metropolis with the existing land uses in order to determine whether current residential development is in compliance with the master plan. Findings show that current development contravenes the prescription of the master plan and as such resulted to frequent flooding. It is also vital to note that, from the responses of flood victims and town planning officials, the spatial extents of flood and its impact occurs as a result of high rainfall intensity and duration. For example, due to climate change, increased in the volume of both the Calabar River and the Great Qua River, poor waste disposal methods especially along the drains, uncontrolled physical development, and ineffective town/land use planning and bastardization of the master plan.

This study, therefore, suggests as follows; review of the Calabar urban master plan with emphasis on residential land use planning/re-planning and channelization of more drains with adequate capacity to accommodate runoff volume would help reduce flooding in the study area. Relocation of victims whose buildings are considered vulnerable by SEMA due to the fact that they are consistently affected by flood hazard. Appropriate physical development control measures, accompanied with effective town planning to discourage developers from developing around the designated areas as flood prone zones. Waste management ought to be taken as a matter of priority by legislating on issues related to inappropriate disposal of waste particularly on drains.

Introduction of task force on waste disposal matters for effective monitoring and control would be necessary. Adaptation options could also be introduced especially as related to social and economic systems which would help reduce the impact of flooding on the residents of Calabar Metropolis and their property.

References

Action Aid International (AAI). (2006). *Climate Change, Urban Flooding and the Rights of Urban Poor in Africa*. Retrieved March 3, 2020 from http://www.actionaid.org/docs/urbanflooding/report.

Boamah, N. A., Gyimah, C., and Nelson, J. K. B. (2012). Challenges to the Enforcement of Development Controls in the Wa Municipality. *Habitat International*, 36 (4): 136-142.

Few, R. M., Ahen, F., Matthias, M., & Kovats S. (2004). *Floods, Health and Climate Change: A Strategic Review* . Tyndall: Tyndall Center for Climate Change Research.

Gill, S., Pauleit, S., Ennos, A. R., Lindley, S. J., Handley, J. F., William, G. J., and Ueberjahn- Tritta, A. (2004). Literature review: impact of climate change on urban environments. *Centre for Urban and Regional Ecology*, University of Manchester.

Guha-Sapir, D., Hoyois, P. H., and Below, R. (2013). *Annual disaster statistical review 2012: The numbers and trends*. Brussels: CRED.

Houghton, L., Nobilis, F., & Lorenz, P. (2001). Flood Trends in Australia. *IAHS Publications*, 8 (5): 77-81.

Jimoh, H. and Iroye, K. A. (2009). Flood Analysis of Yaba, Lagos. *Environmental Research Journal*, 3 (9): 17-21.

Keith, C. (2013). Flood disasters: lessons from the past, worries for the future. *Institute of civil Engineers publication*, 7 (9): 12-22.

Kim, J. H. (2011). Linking Land Use Planning and Regulation to Economic Development. *A Literature Review J. Plann. Lit.*, 26 (4): 35-47.

National Weather Service. (2016). *The August 2016 Floods in Louisiana, USA.* USA: National Service.

Obongha, U. E. (2023). Analysis of non-conforming land uses in Calabar Metropolis. A Ph.D. Thesis submitted to Department of Urban and Regional Planning, University of Cross River State, Calabar, Nigeria (unpublished).

Obongha, U. E., Ojikpong, B. E. and Ukam, L. E. (2020). Quantifying the spatial extent of the 2017 floods in Calabar, Nigeria. *Journal of Social and Environmental Sciences (JOSES)*, 2 (1): 33-41.

Obongha, U. E. and Yaro, M. A. (2020). The impact of flooding on residential buildings in Calabar Metropolis, Nigeria. *Journal of Contemporary Urbanology* 7 (1): 14-29.

Obongha, U. E. (2018).Application of Remote Sensing for Flood Management in Nigeria. An M.Sc. Dissertation submitted to the Faculty of Development and Society, Sheffield Hallam University, UK (unpublished).

Ojikpong, B. E., Ekeng, B. E., Obongha, U. E., and Emri, S. I. . (2016). Flood risk assessment of residential neighbourhoods in Calabar Metropolis, Cross River State - Nigeria. *Environment and Natural Resources Research*, 5 (8): 115-127.

Oka, P. O. (2009). Managing the Impact of Urbanization on Biodivsersity in Emerging Urban Fringe Settlement: The Case of Satellite Town Calabar, Nigeria . *Global Journal of Social Sciences*, 8(1): 13-20.

Pudezzi, P., Dao, H., Herold, C., and Mouton, F. (2011). Assessing global exposure and vulnerability towards natural hazards: the disaster risk index. *Natural Hazards and Earth System Science*, 8 (4):1149-1159.

Tapsell, S. M., and Tunstall, S. M. (2008). "I wish I would never heard of Banbury": The relationship between place and the health impact of flooding. *Health and Place*, 4 (3): 133-154.

UNDP. (2005). *Baseline Report on Flooding, Erosion, and Landslide in Anambra, Enugu, Lagos and Kogi states of Nigeria.* Washington DC: United Nations Development Projects.