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An assessment of the impact of flood events in Makurdi, Nigeria

Marcellinus A. Hula[1] Joseph C. Udoh[2*]
1. Department Of Geography, Benue State University , Benue State, Nigeria
2. Department of Geography and Natural Resources Management, University of Uyo, Nigeria

Abstract

Flood disaster is not a recent phenomenon in Makurdi people in the town have been experiencing its destructive tendencies which are sometimes enormous. Using information sourced from questionnaire, personal observation, and archival records of National Inland Waterways Authority (NIWA) and newspaper reports; this paper examines flood events and its impacts on the people of Makurdi Town. A sample size of 400 respondents was drawn from flood prone areas of the town and the data was analyzed using descriptive statistics and a modified 4-point Likert Scale Rating System. The results of the analyses show that floods in Makurdi occur at the event of high rainfall intensity and mostly between September and October. When flooded, it takes 2-3 days for the flood water to recede depending on the magnitude of event. Apart from rainfall, other factors that influence flooding in the study area included lack of and poor drainage networks, dumping of wastes/refuse in drainage and water channels, and degree of built up areas leading to and increased runoffs. Although, personal properties and public infrastructure suffer all forms of flood damages, residents in the flood prone areas have remained on the basis of having no alternative, cultural ethnic affinity, family home where parent were buried and cheaper houses to rent. Identified flood mitigation measures include river dredging, raising house foundations and building of levees and embankment. Public enlightenment and necessary legislation and enforcement are recommended to checkmate activities aiding flooding.
Keywords: Flooding, Hazards, Rainfall, Causes, Management measures and Infrastructure

1. Introduction

Globally, disasters are said to have devastating effect on economic development, livelihoods, agriculture, and health, social and human life (Wood, 2005). They are sudden, accidental events that may cause deaths or injuries. Abam (2006) defined flood as a large volume of water which arrives at and occupy the stream channel and its flood plain in a time too short to prevent damage to economic activities including homes. It is a natural hazard like drought and desertification which occurs as an extreme hydrological (run off) event (Nwafor, 2006). It could also be seen as the inundation of an area not normally covered with water, through a temporary rise in level of stream, river, lake or sea (Emodi, 2012).Prolonged rainfall events are the most common causes of flooding worldwide. Floods are generally regarded as extreme hydrological events, where there is excess of water which may have devastating effects. According to Ayoade (1988), flooding in the tropics is regarded as partly or wholly climatological in nature as they result from torrential rainfall.

Flood disaster is not a recent phenomenon in Nigeria and its destructive tendencies are sometimes enormous. According to the United Nations Environment Program (UNEP, 2006), flooding is one of the major environmental crises ravaging the universe within the century and the millennium. This is especially the case in most wetlands of the world. The reason is attributed to the general rise in sea level globally, due to the global warming as well as the saturated nature of the wetlands in Nigeria. Periodic floods occur on many rivers, forming a surrounding region known as flood plain. Within the cities, human activities such as rapid industrialization and urbanization, population growth, exploitation of natural resources and location of infrastructures (dams, piers and lands) exacerbates the occurrence of floods. Askew (1999) reiterated that floods cause about one third of all deaths, one third of all injuries and one third of all damages from natural disaster.

Floods occur in Nigeria in three main forms; coastal flooding, river flooding and urban flooding. Coastal flooding occurs in the low lying belt of mangrove and fresh water swamp along the coast (Folorunsho and Awosika 2001; Ologunorisa, 2004). It is typically a function of storm surge, waves (driven by wind) and heavy rainfall. River flood is a function of rainfall and run off volumes within the river valley. It occurs in the flood plain of larger rivers where sudden short-lived flash floods are associated with rivers in the land areas where sudden heavy rains can change them into destructive torments within a short period (Folorunsho and Awosika 2001; Ologunorisa, 2004). Urban flooding on the other hand occurs in towns, on flat or low lying terrains especially where little or no provision has been made for surface drainage or where existing drainage has been blocked with municipal waste, refuses and eroded soil sediments (Ali, 2005).

Oderrerho (2004) and Nwafor (2006) identified twelve (12) causes of urban flooding. They include; Surcharges

in water level due to natural or man-made construction of flood paths, sudden dam failures, inappropriate land use, deforestation of catchment basins, reclamation, construction sites and solid waste, inadequate drainage capacity to cope with urbanization and excess encroachment in flood ways. Urban flood problem is a global experience but the management practices differ according to prevailing technologies and aptness in planning concern.

Nott (2006), points out that flood events may not be considered a natural hazard unless there is a threat to human life and property. The most vulnerable landscape for floods are low lying coast and deltas, and small basins subject to flash floods. Empirical researches (Okereke, 2007; Kolawole et al., 2011) have highlighted the basic consequences of flooding as; loss of human lives, submerging of residence and streets, inflow of sewage, municipal pollution and health hazards, traffic obstruction, aesthetic discoloring, cleanup cost and disruption of services, infrastructural damage, and economic loss.

In flood events, socio-economic life and livelihood of the affected people may be distorted, in most cases farmlands and livestock are submerged which are the major source of people's livelihood. Flood losses are devastating as many never get recovered after the flood recedes. Vulnerable communities suffer great losses in events of flood, especially when the flood is unprecedented. Hunger, famine, disease and epidemic outbreak are usually resultant impacts of flood (Mmom and Aifesehi, 2003). Malaria and typhoid outbreaks after floods in tropical countries are common. It has been estimated that in India and Bangladesh 300 million people live in areas that are affected by floods (Nott, 2006).

2.0 Statement of Problem

Incidents of flood are not a recent phenomenon to people of Makurdi as they have been living in flood prone areas for centuries. Like most urban areas of the third world, Makurdi has experienced accelerated population growth which has led to changes in the land use activities. Land use changes in particular, have a direct impact on the magnitude and behavior of floods (Civco et al 2002). Flash floods are common features in Nigeria during the rainy season(May-October) but the country's flood event of the year 2012 have been described as the most devastating in over 40 years.

Two major events took place between the months of September and October 2012 in Nigeria, namely the Ladgo Dam flood in Adamawa State, and the River Benue and Niger adjoining States floods (Niger and Benue States). The event pushed most of the country's rivers over their banks and submerged hundreds of kilometers of urban and rural land. This resulted in widespread devastating flood disaster that hit the country cutting across major cities in about 14 states that borders the Niger-Benue River. The flood submerged houses and several transportation routes throughout the affected areas nationwide. Overall, an estimated 1.3 million people were displaced and about 431 people lost their lives with several hectares of farmland destroyed (MISNA, 2012). Though the unusually large flood was predicted by the Nigeria Metrological Agency NIMET, government at all tiers failed to act on time, resulting in the worst humanitarian crises in Nigeria since the civil war in 1967-1970.

Despite the expected increase in frequency and magnitude of flood in the Nigeria and invariably Makurdi, few impact assessment studies on the socio-economic livelihood of the people have been undertaken to establish the underlying causes of their vulnerability. In the absence of comprehensive data and information, the measures to cope with flood have remained ad hoc.

3.0 Materials and Methods

Spatially, this paper covers Makurdi town which also doubles as the administrative headquarter of Benue State. While temporary, the paper covers a period of 13 years (i.e. 2000-2012). Makurdi town lies between Lat.7^{o} 44N and Long.8^{o} 54E and is located within the floodplain of the lower River Benue valley (Fig. 1). Its physiography spans between 73 – 167 m above sea level. Due to the general low relief, sizeable portions of Makurdi is waterlogged and flooded during heavy rainstorms. Makurdi town is drained principally by river Benue which divides it into Makurdi North and South banks.

The climatic condition in Makurdi town is influenced by two air masses: the warm moist south-westerly air mass and the warm dry north-easterly air mass. The south-westerly air mass is a rain bearing wind that brings about rainfall from the months of April to October. The dry north-easterly air mass blows over the region from November to March, thereby bringing about seasonal drought (Ologunorisa and Tersoo, 2006). The mean annual rainfall total is 1190 mm and ranges from 775-1792 mm. The mean monthly relative humidity varies from 43% in January to 81% in July-August period. Temperatures are generally high throughout the year, with February

and March occurring as the hottest months. Temperature in Makurdi varies from a daily of 40o and a maximum of 22.5^{0}C (Ologunorisa and Tersoo, 2006). The geology of Makurdi town is of cretaceous and consists of fluvio-deltaic sediments with well-bedded sandstones which are of hydrogeological significance in terms of groundwater yield and exploitation (Kogbe et al., 1978).

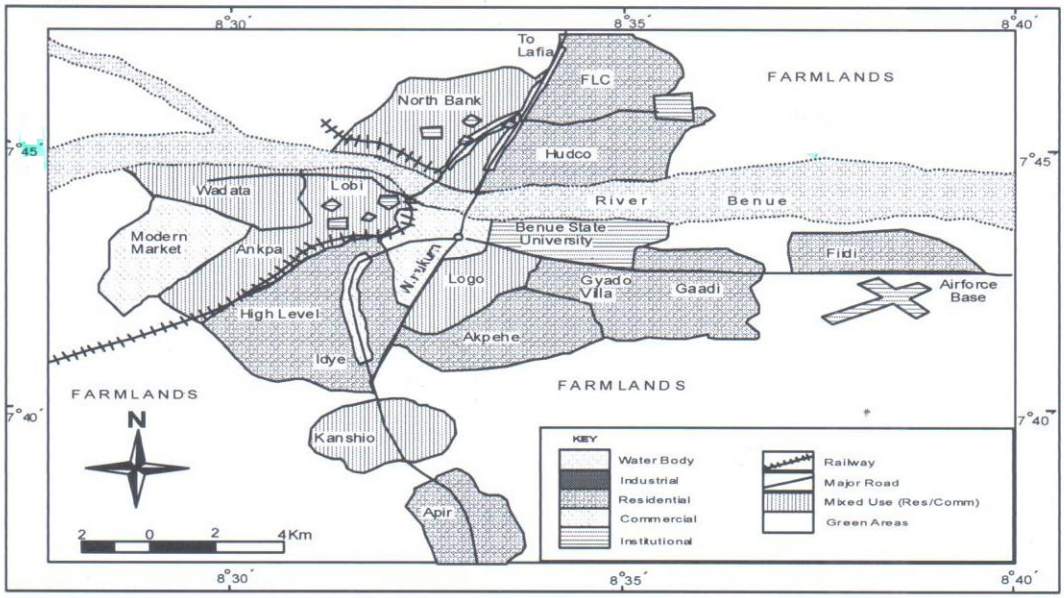

Fig 1 : Map of Makurdi Town showing Land uses
Source: Benue State Ministry for Lands and Survey, 2011

Information (relating damages incurred as result of flooding from respondents, period of occurrence, frequency of flooding, flood receding time, causes of flooding, human response to flooding and severity of flooding) were sourced through questionnaire administration, personal observations, supplemented by newspaper reports and official document of National Inland Waterways Authority (NIWA). Using Taro Yamene formula, a sample size of 400 respondents in floodable areas was drawn for the purpose of questionnaire administration. The analysis was done using simple descriptive statistics and a modified 4-point Likert Rating Scale of 1- as Strongly Agree (SA), 2- Agree (A), 3- Disagree (D) and 4- Strongly Disagree (SD). The scale as used specified the level of agreement or disagreement on a symmetric agreement-disagreement scale for the factors causing flooding and mitigation measures in Makurdi town. The mean score of each point was then used as the degree of response for a factor causing flooding in the town.

4.0 Results and Discussion

The sampled population was drawn from residential areas that have frequently experienced flooding in the town which include Wadata, Wurukum/Ungwan Jukun, Logo/Akpehe and Gyado Villa (Fig. 1). All the respondents (100%) indicated that they have experienced flooding in their area. This cut across indigenous ethnic groups such as Tiv, Idoma, Igede, Jukun, Etulo and other tribes like Hausa, Ibo, Yoruba and others.

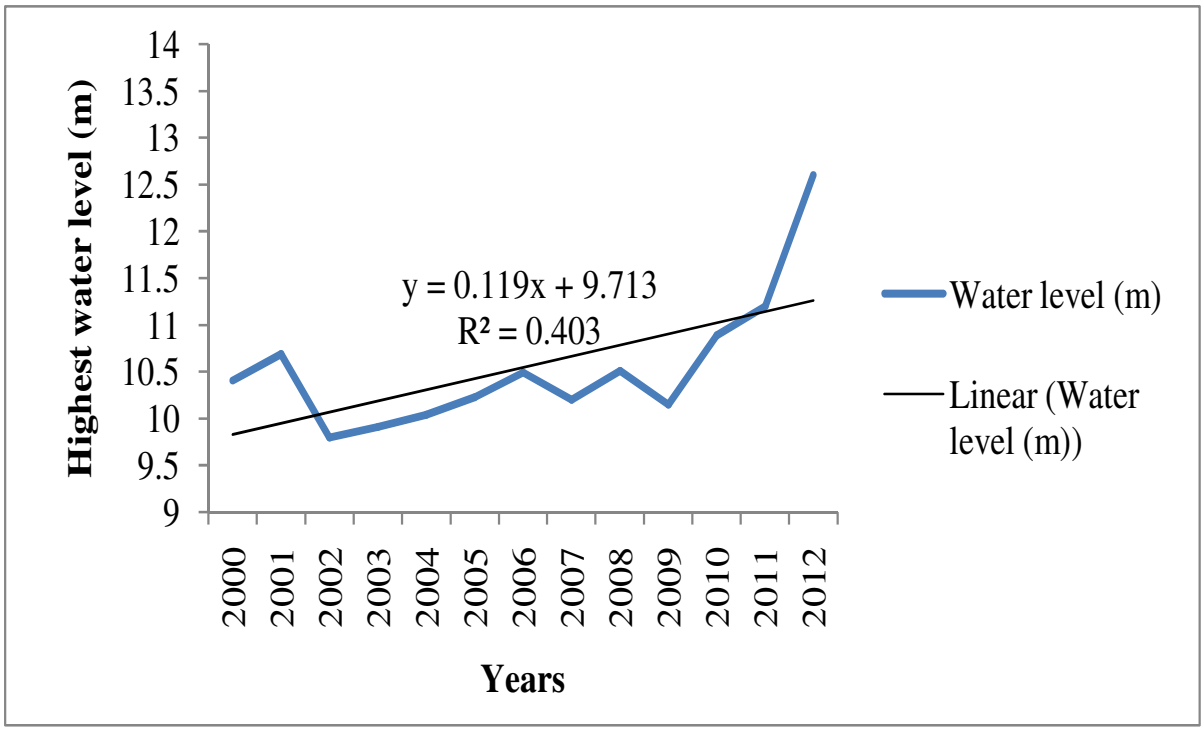

Fig. 2: Trend line of water level during flood events in Makurdi from 2000-2012 (Source: National Inland Waterways Authority *(NIWA)* Office Makurdi.)

Analysis of flood occurrence obtained from NIWA covering a period of 13 years consistently shows that floods occur in the town at the peak of rainy season between September and October respectively with 2012 having the highest water level of 12.60 m. Trend analysis of the water level during flood events in Makurdi shows a weak positive trend with a regression value of R^2 =0.403. This means that during the flood events within the period of study water level has risen slightly as shown in Fig. 2 . Similarly, 48.4% and 42.5% of the respondents confirmed that flooding occur in their areas when there is heavy rainstorm usually in September or October every other year (Table1). This result has confirmed the records kept by NIWA in Makurdi.

Table 1: Months flood occur in Makurdi town.

Month flood occurs	**Response**	**%**
April	-	-
May	-	-
June	10	2.5
July	6	1.5
August	20	5.0
September	194	48.5
October	170	42.5
Total	**400**	**100**

Source: Fieldwork 2013

In addition, the respondents further reiterated that it takes 2-3 days for flood water to recede in the town depending on the intensity and amount of rainfall, as noted by 96.4% of the respondents respectively. Because of the low-lying and waterlogged nature of Makurdi town environment, flood incidence may be categorized into flash and river flood which at the event of heavy rainstorm, most of these areas are inundated resulting into flash floods as observed by 62.5% of the respondents. This is common in Gyado Villa, Logo/Akpehe and Nyiman Layout areas of the town. River flooding is experienced in places such as Wadata, Wurukum/Ungwan Jukun and Agbough where River Benue and other streams drain the area as observed by 59.8% of the respondents. At the instance of every prolonged rainfall and intensity, these river/streams swell in size thus overflowing their banks

thereby flooding the adjacent land. Flooding in Makurdi town was rated to be very high by over 50% of the respondents.

4.1 Causes of Flooding in Makurdi town

According to Ayoade (1988), Babatolu (1997), Jimoh (2000), Oriola (2000), Ali (2005), Ologunorisa and Tersoo (2006), the causes of flooding in Nigeria urban areas include long hours of rainfall, type of land use pattern, dumping of refuse into water channels, lack of and poor drainage networks, topography, nature of urban land surface and building types, and stream basin parameters. Information presented in Table 3 summarises the results of the causes of flooding in Makurdi town.

Table 2: Causes of flooding in Makurdi

Causes	SA(1)	A(2)	D(3)	SD(4)	Mean
Heavy rainfall	254(63.5%)	85(21.3%)	61(15.2%)	0(0%)	1.48
Overflowing of river banks	68(17%)	185(46.2%)	39(9.8%)	108(27%)	2.21
Topography and poor infiltration	52(13%)	116(29%)	69(17.2%)	163(40.8%)	3.92
Poor drainage network/connectivity	247(61.7%)	93(23.3%)	44(11%)	16(4%)	1.09
Building on water channels	86(21.5%)	222(55.5%)	42(10.5%)	50(12.5%)	2.07
Dumping of wastes	302(75.5%)	60(15%)	9(2.2%)	29(7.3%)	1.41
Climatic variability	24(6%)	110(27.5%)	168(42%)	98(24.5%)	3.49

Source: Fieldwork 2013

Information presented on Table 2 shows that 63.5% of the respondents with a mean score of 1.48 strongly agreed that heavy torrential rainfall is one of the causes of flooding in Makurdi town. Consequently, this finding has supported the view held by Ayoade (1988) that rainfall intensity, duration and amount are generally the principal factors in most flood events in the tropics which are partly or wholly climatological in nature. However, other factors only aided the incidence of flooding in urban areas of Nigeria as has been confirmed by several studies (Oriola, 2004; Ologunorisa, 2004; Etuonovbe, 2011).

Another factor responsible for flooding in parts of Makurdi town was identified as overflowing of river banks most especially south bank. With a mean score of 2.21 it shows that the 46.2% of the respondents agreed that overflowing of river banks also contributed significantly to flooding in Wadata, Wurukum/Ungwan Jukun, Gyado Villa and Idye areas that are drained by River Benue and other streams. However, 27% of the respondents disagree because their places of abode are not close to the bank of the river. It was assumed initially that poor infiltration and the topographic configuration of Makurdi town substantially influence the incident of flooding in the area since the town is located within the floodplain of the River Benue and high rise in ground water table. This proves to be contrary as 40.8% of the respondents with a mean score of 3.92 disagreed strongly topography and poor infiltration as contributing to flooding in Makurdi town.

Lack or poor drainage network/connectivity in the disposal of flood waters is believed to be a major factor substantially aiding flooding in the study area. The respondents representing 61.7% with a mean score of 1.09 of those sampled strongly agreed that lack of drainage network is a chief factor that facilitated events of flooding in Makurdi town. This is a common scenerio in parts of Wadata, Wurukum/Ungwan Jukun, Gyado Villa and Modern Market areas of the town. This is further exacerbated by the rapid rate of urbanization in the study area. Respondents representing 55.5% of those sampled agreed that building structures on water channel is responsible for flooding in parts of Wadata, Wurukum, Logo/Akpehe and Idye areas of Makurdi town.

The unwise behaviour of urban dwellers has resulted into all kinds of environmental abuses as common in Nigeria cities. Heaps of wastes are indiscriminately dumped on streets, in drainage and water channels, thereby causing not only health hazards but also aiding incidence of flooding. Respondents, representing 75.5% recording a mean score of 1.41 strongly agreed that indiscriminate dumping of wastes/refuse in drainage and water channels was responsible flooding in Wadata, Demekpe and Wurukum of the study area. This finding agrees with Jimoh (2000), and Ali (2005). Elsewhere, climate change and variability have been indicated as contributing to flood disaster in some cities. According to Ololade (2011), increased storm frequency and intensity, related to climate change, are exacerbated by such local factors as occupation of flood plain, increased runoff from hard surfaces, inadequate waste management, inadequate and silted up drainage systems. However, 42% of the respondents with a mean score of 3.49 disagreed climate change and variability contributing to

incidence of flooding in Makurdi.

Summarily, factors identified to have influenced flood event in Makurdi town from 2000-2012 in order of magnitude based on the respondent's opinion are dumping of wastes/refuse on drainage and water channels; rainfall intensity, duration and amount; lack of and poor drainage networks/connectivity; building on water channels and overflowing of river banks. The least contributing factors are climatic variability and poor infiltration/topographic characteristics.

4.2 Effects of Flooding

As noted by Etuonovbe (2011), "floods are the most devastating natural disasters in the world, claiming more lives and causing damage to properties than any other natural phenomena. In Nigeria, though not leading in terms of claiming lives, flood affects and displaces more people than any other disaster. It also causes more damage to properties and at least 20% of the population is at risk of one form of flooding or the other". Table 4 shows how flood incidence has affected the respondents in Makurdi town.

Table 3: Effect of flooding on the respondents

Effect	**Respondent**	**%**
House flooded with water	210	52.5
House collapse due to flooding	60	15
Prevented from moving out	40	10
Source of water polluted	71	17.7
Heath problems due to flooding	19	4.8
Total	**400**	**100.0**

Source: Fieldwork 2013

The result of the information presented in Table 3, shows that 52.5% of the respondents have their houses submerged in water, 17.7% have their sources of water polluted most especially hand dug wells, 15% have their houses collapsed, 10% are prevented from moving out while 4.8% suffer some health problems ranging from dysentery and other water-borne diseases. Besides personal effects of flooding, observation shows that flooding public infrastructures such as roads have been submerged, electric and telephones pulled down, markets, schools and churches flooded and drainage channels blocked with wastes due to flood.

4.3 Human Response to Flooding in Makurdi Town

Human beings respond to flood hazards through adjustment, flood abatement and flood protection measures (Etuonovbe, 2011). Adjustment covers any action to minimize or ameliorate flood hazards; flood abatement relates to land use modification within a river basin to reduce the risk of flooding, and flood protection has to do with physical construction such as embankment, dykes, levees, river channelization, flood diversion channels and storage of flood waters (Ward, 1978). However, in the words of Desanker (2010) "people don't cope with floods, they survive floods then, they recover". Therefore, respondents were asked to suggest appropriate measures to reduce the risks of flooding in Makurdi town as presented in Table 4. For relocation from floodable areas to avoid flood hazards, a total of 61% of the respondents agreed only if a plot of land is given them elsewhere. On river rechannelization as a measure of checkmating the risks of flood 49% of the respondents with a mean score of 3.42 disagreed.

Table 4: Flood mitigating control/ measures in Makurdi town

Measures	**SA(1)**	**A(2)**	**D(3)**	**SD(4)**	**Mean**
Relocation	80(20%)	244(61%)	15(3.8%)	61(15.2%)	1.48
River Re-channeling	78(19.5%)	52(13%)	196(49%)	74(18.5%)	3.42
House foundation raised	84(21%)	168(42%)	98(24.5%)	50(12.5%)	1.69
Use of sand bags	93(23.3%)	247(61.7%)	16(4%)	44(11%)	2.14
Bridge	42(10.5%)	9(2.2%)	86(21.5%)	302(75.5%)	3.97
Neighbours	29(7.3%)	196(49%)	133(33.2%)	42(10.5%)	2.41

Source: Fieldwork 2013

The suggestion that house foundation should be raised high enough to keep above flood water was assented to by 42% of the respondents while 61.7% believed that flood prone residential areas should adopt use of sand bags as artificial levees to keep away flood water. Building temporal bridges to connect houses to dry points was strongly disagreed by 75.5% of the respondents as a good measure of coping with flood events. The usual call during disasters is for government to come to the aid of victims. However, what the public can do in case of flood events was explored. Respondents representing 49% agreed that instead of waiting for government to intervene, neighbours should come together to see what they can do to help the victims.

5.0 Conclusion / Recommendation

This paper reveals that flood severity is rated very highly in Makurdi town and that flooding in the town can be attributed to both physical and humanly activities. While factors, such as rainfall intensity and duration, cannot be controlled, early warning of flooding based on climatic variability will help people in flood prone areas to prepare ahead of time. Federal Ministry of Environment in collaboration with UNDP (2012) have launched a web-based Early Warning System (EWS) to alert people living in flood prone area to prepare ahead of time.

Construction and improvement of drainage networks to effectively dispose flood water will go a long way in reducing the risks of flooding. Indiscriminate dumping of wastes in drainage and water channels prevents the disposal of flood water thereby leading to flooding of houses, schools, churches and markets. Lastly, public enlightenment and education can result in change of behaviour toward environment abuses. There is an urgent need for a collaborative effort of both government and stakeholders to support town planning, engineering and other professional agencies to combat flooding in Nigeria to avoid its long-range consequences.

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