

# FLOOD MENACE IN KADUNA METROPOLIS: IMPACTS, REMEDIAL AND MANAGEMENT STRATEGIES.

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## ABSTRACT

This study assesses how Kaduna Metropolis have been affected by flood menace incidences as it takes a look at the devastating impacts, remedial and management strategies at curbing flooding in Kaduna Metropolis which has almost become a yearly occurrence. Data for this study were obtained from questionnaires, interviews, personal observation, archival records of ministries and newspaper reports. A total of 196 respondents, drawn from residents in flood prone areas, were sampled for this study. Descriptive statistics and Likert Rating System were used in the analyses of the data. The results of analyses show that floods in Kaduna Metropolis occur mostly at the event of rainfall intensity, especially at the peak of rainy season (September, 2015). And it takes 3 - 5days for the flood water to recede depending on the magnitude of event and receding factors in different areas. Factors other than rainfall identified to substantially influenced flooding in the study area are: Lack of and poor drainage networks, dumping of wastes/refuse in drainage and water channels, topographic characteristics, overflowing of river banks, low infiltration due to high water table and degree of built or up areas leading to increased runoffs, and climate change. Despite the flood hazards, occupants in flood prone have remained on the basis of having no alternative, cultural ethnic affinity, family home place where parent were buried, used to flooding as the whole area suffers from flooding, nature of occupation, and cheaper houses to rent. Personal properties and public infrastructures suffer all forms of flood damages. Flood remedial and management strategies include river re-channelization, raising house foundations, land use planning and management and public enlightenment are recommended measure to checkmate activities aiding flooding in Kaduna metropolis.

**Keywords:** Flood, Menace, Infrastructure, Impacts, Remedial and Management Strategies.

## INTRODUCTION

Flooding, according to Geo-science Australia (2013) can simply be described as "water where it is not wanted". It can also be conceptualized as a situation that results when a part of the earth surface that is usually dry is inundated and covered with water due to high amount of rainfall or the over flowing of a water body. Furthermore, flooding was expounded by pagasa.dost (2013) as a "natural hydrological phenomenon and its occurrence is usually the aftermath of metrological events such as seismic activities, astronomically influenced phenomena (high tides coinciding with occurrence of high rainfall), construction of temporary dams, as

well as the failure of hydraulic and other control structures." The effects of floods are always debilitating, though their intensity and scope vary depending on terrain, intensity of human activities, quantum of water and the level of preparedness by the stakeholders.

Flooding, especially River flooding are among the most devastating natural disasters in the world, claiming more lives and causing more property damage than any other natural phenomenon (Adeaga, 2008). Though not the leading cause of death in Nigeria, but it affects and displaces more people than any other natural disaster (Akani and Bilesanmi, 2011). Therefore, there is the need to understand, prevent, prepare for, and mitigate its effects by authorities concerned, especially in developing countries. This has now particularly become rife due to the rapid urbanization and population growth experienced in developing countries, which often results in increased population concentration in unplanned environment. Consequently, Ishaya *et al.*, (2009) opined that identifying areas that are vulnerable to flooding as well as collecting and analyzing information on the "elevation, slope orientation, proximity of built-up areas to drainages, network of drains, presence of buffers, extent of inundation, cultural practices as well as attitudes and perceptions" are the most effective means of ensuring flood preparedness and risk reduction.

Floods are the most common and widespread of all the natural hazards. The consequences of floods are vast on the physical environment, economic and social well-being of the inhabitants of an area (Adeaga, 2008; Akani and Bilesanmi, 2011). Ishaya *et al.*, (2009) posited that in many parts of the world, flood seems to be occurring more often and they seems to be increasing in size. Human activities, however, sometimes exacerbate them (Akani and Bilesanmi, 2011). Human often court disaster when they make environmentally unsound decision such as building in an area that is prone to flooding (urbanization) and by deforestation (Bryant, 1991).

Flood occurs when there is an inundation of an any area which is not normally covered with water, through a temporary rise in the level of a river, lake or sea, and when excess precipitation exceed natural infiltration, evaporation, and possible transmission (Ward, 1978; Ayoade, 1988; Akosile 2008;

Akani and Bilesanmi, 2011; Ololade, 2011). Floods are generally regarded as extreme hydrological events, where there is excess

of water which may have devastating effects. According to Ayoade (1988), floods in tropics are partly or wholly climatological in nature, that is, they result from torrential rainfall. Beside, human interference in the hydrological relationship within the watershed can cause flooding.

In Nigeria, the incidents of flood is becoming a reoccurring decimal in most urban area leading to colossal loss of properties and lives. For example in 1973, 1974 and 1976, cases of floods were recorded in Ilorin (Jimoh, 1999; Mordi, 2011 and Amaize, 2011) in 1973, 1980 and 2011 Ogunpa flood in Ibadan occurred. Floods in low-lying coastal areas, such as Lagos, Port Harcourt, Warri, Sapele and Yenegoa, as well as the hinterland and arid semi arid places like Ondo, Ilorin, Makurdi, Kaduna, Minna, Borno and Gombe have formed Nigeria newspaper headlines..Concern over the incidents of floods, especially in urban areas, have attracted several studies focusing on different aspects (Akintola, 1978; Akintola, 1982; Omiunu, 1981; Odemerho, 1983; Ayoade and Akintola, 1980; Babatolu, 1997; Oriola, 2000; Ologunorisa, 2004; Ali, 2005; Ologunorisa and Tersoo, 2006; Thisday, 2008; Aderogba, 2012 and Aderogba *et al.*, 2012).

The objective of this work is to study the peculiarity of the incidences of flooding in Kaduna Metropolis, its impacts and proffer a remedial and management for flood menace in Kaduna Metropolis.

**THE STUDY AREA**

Kaduna Metropolis is located between latitude 10° 28' and 10° 37' North and longitude 07° 19' and 07° 31' East occupies an area of about 260km<sup>2</sup>; the distance between the eastern and western limits of the city is approximately 13.7km (Fingesi, 2001). It is made up of two main local government areas, the Kaduna North and the Kaduna South, other adjoining local government areas that makes up the entire metropolis are Igabi and Chikun.

Table 1: Local Government Areas that Form Kaduna Metropolis and their Population Densities

Local Government Area	Locations affected with flood	Population (2007 Census projected to 2014)
1. Kaduna North	Kigo road new Extension, Ungwan Rimi	677,714
2. Kaduna South	Barnawa, Down-quarters and Bashama road (Tudun-wada).	584,105
3. Igabi	Nariya, Rigasa	268,250
4. Chikun	Ungwan Rido	334,890

Source: NPC, 2007

The metropolis is the economic and financial capital hub of Kaduna state, the metropolis is made up of 4 Local Government Areas - all in Kaduna State. Chikun has the largest land area of 192.3km<sup>2</sup> followed by Igabi and Kaduna North with 185.2 km<sup>2</sup> and 158.2 km<sup>2</sup> respectively in table 1 and Figure 1. The total population that made up the metropolis has the largest concentration at Kaduna North, (677,714) followed by Kaduna South (584,105) and Chikun (268,250). The average population density for the entire metropolis is 7,941 persons per Km<sup>2</sup>.

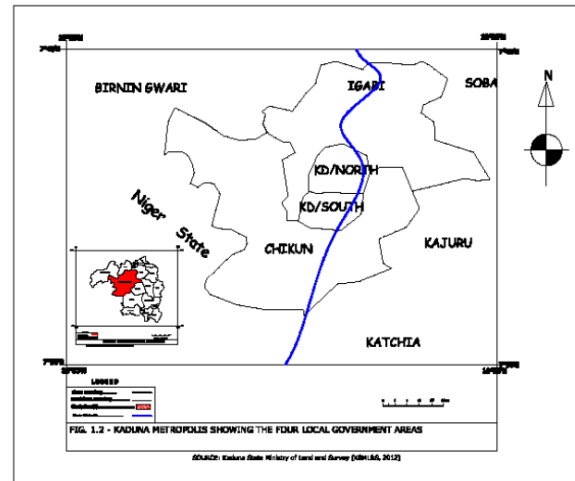


Figure 1: Map of Kaduna Metropolis  
 Source: KSML&S, 2015

**MATERIALS AND METHODS**

Data for this study were obtained from both primary and secondary sources. Primary sources included the use of questionnaires, interviews and personal observations, supplemented by newspaper reports and official document of relevant Government Ministries and Agencies. Data were collected on sex, educational status, residence, duration in the place and damages incurred as result of flooding from respondents. Other information were gathered on areas vulnerable to flooding (figure 2 – Appendix I), period of occurrence, frequency of flooding, flood receding time, flood damage, causes of flooding, human response to flooding and severity of flooding. The sampling technique adopted for this study purposive sampling and the respondent were conveniently selected. A total of 196 respondents in floodable areas were sampled for this study through questionnaire administration. The analyses was done using simple descriptive statistics and Likert Rating Scale of Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D) and Strongly Disagree (SD).

**RESULTS AND DISCUSSION**

The respondents comprised 169 (86.23%) males and 27 (13.77%) females. This population was drawn from residential areas that experienced recent flooding. These include Barnawa, Down-Quarters, Tudunwada (Bashama road), Kigo Road (New Extension), Nariya, Kabala Costain, Ungwan Rimi and Ungwan Dosa up to 69% of the respondents have lived in these areas for 5-10years, as such, they have sufficient knowledge of the flood events in the areas. All respondents (100%) indicated that they have experienced flooding in their area, this cut across indigenous ethnic groups such as Hausa, Ibo, Yoruba, Southern

Zaria, Idoma, Igala and others.

### Perception of Flooding in the Study Area

On period of flood occurrence, 48.4% and 42.5% of the respondents observed that flooding occur in their areas when there is heavy rainstorm and at the peak of rainy season August/September respectively. It takes 3-5 days for flood water to recede depending on the intensity and amount of rainfall, as noted by 37.9% and 58.5% of the respondents respectively. Flooding experienced in Kaduna Metropolis may be categorized into flash and river flood. Because of the low-lying and waterlogged nature of the environment, 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 Tudunwada, Kabala Costain, Nariya, Ungwan Rimi and Ungwan Dosa areas of the town. River flooding is experienced in places such as Barnawa, Kigo Road, Ungwan Rimi and Down-quarters where River Kaduna and other streams drain the area as observed by 59.8% of the respondents. At the instance of every prolonged rainfall and intensity, river Kaduna swell in size thus overflowing their banks thereby flooding the adjacent land. Flooding in Kaduna Metropolis was rated to be very high this year (September, 2015) by over 50% of the respondents.



Plate 1: Flooded area in Kigo road (New Ext.).



Plate 2: Flooded area along Ramat road (Ungwan Rimi).  
Source: Researcher Compilation, 2015.

### Impact of Flooding in Kaduna Metropolis

According to 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 Kaduna metropolis, 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 (*Daily Trust Newspaper*, 2007). Ayado (2011) reported that over 500 houses in Kaduna Metropolis were flooded as result of heavy downpour which destroyed properties and rendered many homeless. According to him, rain that started at about 11pm lasted till 10am the following day. Table 2 shows the summary of how flooding has affected the respondents in the study areas.

From Table 2, 64.79% of the respondents have their houses flooded, 41.32% prevented from moving out, 25.51% houses collapsed, 25% suffer health problems and 22.44% have their sources of water, especially hand dug wells, polluted. Beside the personal effects of flooding, all the respondents noted that flooding has affected public infrastructures such as roads been submerged, electric and telephones pulled down, markets, schools and churches flooded and drainage channels blocked with wastes.

Table 2: Effect of Flooding in Kaduna Metropolis

Effect	Respondents (n=196)	Respondents (%)
House flooded with water	127	64.79
House collapse due to flooding	50	25.51
Prevented people from moving out	81	41.32
Source of water polluted	44	22.44
Heath problems arises due to flooding	49	25

Source: Fieldwork, 2015.

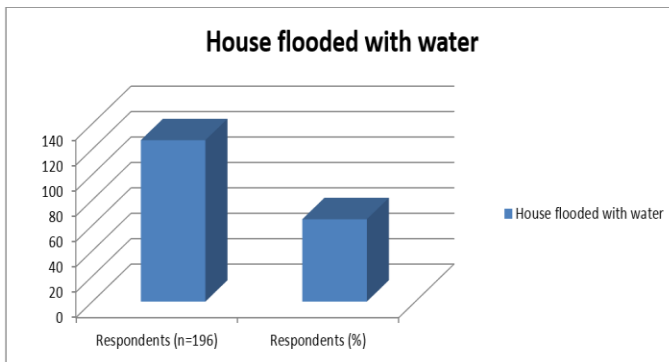


Figure 2: Percentage of Houses Flood with Water  
 Source: Researchers Computation, 2015

**Major Causes of Flooding in Kaduna Metropolis**

The major 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 (Ayoade, 1988; Akintola, 1978; Babatolu, 1997; Ologe, 2002; Oriola,2000; Ali, 2005; Ologunorisa and Tersoo, 2006). Table 3 summaries the results obtained of the causes of flooding in Kaduna Metropolis.

From Table 3, 64.79% strongly agree and 22.44% agree that heavy torrential rainfall is one of the causes of flooding in the study area. Rainfall intensity, duration and amount are generally believed to be the principal factors in most flood events in the tropics which are partly or wholly climatological in nature (Ayoade, 1988).Other factors only aided the incidence of flooding in urban areas of Nigeria. This has been confirmed by several studies (Oriola, 2000; 2004; Ologunorisa, 2004; Daily Trust, 2007; This Day, 2008, Adedeji and Kuyoro, 2011; Ayado, 2011).

Kaduna Metropolis is located within the floodplain of River Kaduna, a low lying terrain spanning 73-167m above sea level. It is therefore susceptible to flooding at the event of every torrential rainstorm. This was believed to be true by 81.2 of the

respondents living in parts of Kigo road, Barnawa, Nariya, Ungwan Rimi and Down-quarters. Respondents representing 62.4% believed that low infiltration resulting from rise in groundwater table aid flooding, especially in waterlogged areas of Ungwan Rimi and Kigo road new extension. Ocheri *et al.*, (2010) observed shallow well in Kaduna Metropolis are full to the brim during rainy season and water could easily be fetched without the use of ropes and buckets. Beside, the degree of built up area limits infiltration and increase run off as noted in parts of Nariya . This is consistent with findings from studies carried by Anderson (1970), Akintola (1978) and Oriola (2000) in Virginia, Ibadan, Ilorin and Ondo towns respectively.

Lack of drainage network in the disposal of flood waters is believed to be a major factor substantially aiding flooding in the study areas. The respondents representing 87.3% of those sampled agreed that lack of drainage network is a chief factor that facilitated events of flooding in Kaduna Metropolis. Closely related is the factor of poor drainage network, which is believed by 75% of the respondents to be inhibiting disposal of flood waters. Based on the respondent opinion, factors identified to have influenced flood event in Kaduna Metropolis in order of magnitude are as follows: rainfall intensity, duration and amount, lack of and poor drainage networks, dumping of wastes/refuse on drainage and water channels, topographic characteristics, overflowing of river banks, low infiltration and climate change.

Table 3: Causes of Flooding in Kaduna Metropolis (n=196)

Major Causes of Flooding	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Heavy rainfall	127(64.79%)	44(22.44%)	19(9.69%)	6(3.06%)	0(0%)
Overflowing of river Kaduna banks	105(53.57%)	60(30.61%)	6(3.06%)	22(11.22%)	3(1.58%)
Topography	114(58.16%)	61(31.12%)	0%	10(5.10%)	11(5.61%)
Infiltration	84(42.85%)	73(37.24%)	12(6.12%)	11(5.61%)	16(8.16%)
Lack of drainage network	160(81.63%)	31(15.82%)	0%	3(1.53%)	1(0.51%)
Poor drainage network	147(75%)	39(19.90%)	0%	4(2.04%)	6(3.06%)
Building on water channels	96(48.90%)	52(26.53%)	2(1.02%)	22(11.22%)	24(12.24%)
Dumping of wastes on channels	122(62.24%)	34(17.34%)	2(1.02%)	10(5.10%)	28(14.28%)
Climate change	27(13.77%)	73(37.24%)	1(0.51%)	34(17.34%)	61(31.12%)

Source: Fieldwork, 2015.

**Human Response to Flooding in Kaduna Metropolis**

Man responds to flood hazards through adjustment, flood abatement and flood protection measures. Adjustment covers any action to minimize or ameliorate flood hazards; flood abatement relates to landuse 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). In this study, respondent were asked to

suggest appropriate measures to reduce the risks of flooding in Kaduna Metropolis. This result is presented in Table 4. For relocation from floodable areas to avoid flood hazards, a total of 52.2% of the respondents disagreed while 35.9% accepted. River re-channelization as way of checkmating the risks of flood was upheld by 68.4% of the respondents. However, 15.9% of the respondents, who do not experience river flooding, objected the option.

Table 4: Flood Mitigating Control Measures in Kaduna Metropolis (n=196)

Major Causes of Flooding	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Relocation	37(18.88%)	34(17.34%)	0%	73(37.24%)	52(26.53%)
River Rechannelisation	96(48.90%)	61(31.12%)	2(1.02%)	27(13.77%)	10(5.10%)
House foundation raised	122(62.24%)	52(26.53%)	1(0.51%)	11(5.61%)	10(5.10%)
Use of sand bags	32(10.0%)	61(31.12%)	10(5.10%)	50(25.51%)	43(21.94%)
Bridge	51(26.02%)	46(23.47%)	5(2.55%)	60(30.61%)	34(17.34%)
Neighbours	73(37.24%)	96(48.98%)	0%	22(11.22%)	5(2.55%)

Source: Fieldwork, 2015

The suggestion that house foundation should be raised high enough to keep above flood water was strongly agreed to by 62.24% of the respondents while 31.12% agreed that flood prone residential areas should adopt use of sand bags as levees to keep away flood water. Building temporal bridges to connect houses to dry points was accepted as a good measure by 26.02% of the respondents especially where people may be trapped in their houses during 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 48.98% agreed that instead of waiting for government to intervene, neighbours should come together to see what they can do to help the victims.

#### Human Adjustment to Flooding in Kaduna Metropolis

It is expected that where life is threatened as result of natural hazards, such as flooding, people should relocate to safe places. This study has proved the contrary, as those who have suffered from flood hazards remained in the same area. The reasons are presented in Table 5.

Table 5: Continuous Occupation Floodable Areas of Kaduna Metropolis

Reason	Respondents (n=196)	Respondents (%)
Family place where parent was buried	70	35.71
Ethno-cultural affiliation	72	36.73
Nature of occupation	50	25.51
Houses are cheaper to rent	44	22.44
Whole place do get flooded	61	31.12
We are used to flooding	55	28.06
Have alternative	92	46.94

Source: Fieldwork, 2015

The respondents, representing 35.71 % of those sampled, indicated that they had no alternative to living in the place because they own the property and that the occupation of their houses would be cheaper than staying in rented quarters. Another reason is ethno-cultural affiliation 36.73%) as people migrating to cities prefer living where most of ethnic group is concentrated. This is common with Hausas, Gbagyi and Southern Zaria's in the study area. Up to 31.12% of the respondents believe that when flooding occurs in their area it will subside after some days as such do not see the need of relocating from such a place. Nature of the occupation such as fishing and farming in floodplain areas was accepted by 28.06% of the respondent for their continuous stay in the floodable area of the Kaduna Metropolis.

#### Remedial and Management Strategies of Flood Control

Flood menaces in Kaduna Metropolis have been on the increase in recent times but the flood event of September, 2015 seems to be the worst experienced in recent times. Proactive and preventive options involving structural and non-structural measures need to be adopted and implemented at curbing the menace of floods. The structural measures such as check dams, levees, flood walls and adequate drainage systems will help control periodic inundation in the areas that are liable to flooding in the following ways:

- The construction of structures for irrigation and the use of excess run-off water for inter-basin transfer as an alternative to absorb excess water from the Cameroons.
- Check dams will reduce peak flows
- Levees and flood walls confines flow within predetermined channels
- Adequate drainage systems will reduce peak flow stages of flood and divert excessive flow.
- In communities were the rate of flow of storm water is high, embankments should be constructed to breakdown storm water so as not to result into floods. These embankments could be permanent or temporary, such as sandbags placed when a flood is imminent.

Consequently, the following non structural measures could be adopted to curb the menace of flood in Kaduna Metropolis are:

- Floodplain management is seen to be the best approach. In finding solution to flooding using this approach, the first step is to

construct a flood-frequency curve based on historical records and an examination of vegetation to determine how often on average a flood of a certain size occurs in a particular area. Although this approach does not tell exactly when floods will occur, but it gives an insight of how often they might occur based on past history. From the data obtained, a plan can be developed and applied to:

- (a). prohibit certain types of buildings or activities in flood high risk zone
- (b). elevate or flood proof buildings that are allowed on the legally defined floodplains.
- (c). construct a floodway that allows floods to flow through the community with most minimal or no damage.

(ii). As is obtained in developed countries of the world particularly in America and Europe, there is always a standing taskforce that is set up to deal with the problem of snow once winter is approaching. In the same way, the Nigerian government needs to be proactive by setting up standing taskforce that will tackle the issue of flood once the rainy season is approaching.

(iii). Town planning laws should be properly enforced and strictly adhered to as this will go a long way to curbing the menace of floods. The Kaduna State government should always plan ahead of the population so as to avert the occurrences of unplanned houses and cities. This is necessary because deviation from the original master plan by prospective town developers do facilitate the occurrence of floods as investigations has shown that a lot of houses built today in Kaduna Metropolis are constructed without planning approval, especially land acquired from the informal land market.

(iv). Drainage systems should be regularly inspected and monitored to take note of any failure with a view of effecting repairs. Also sedimentation and littering of the drainage systems should be guided against while vegetations like trees whose rooting system tends to or are likely to distort, break or undermine the drainage system should be removed.

(v). Residence of Kaduna metropolis should be enlightened that "Action and reaction are equal and opposite". To this end, they should properly dispose off their refuse/waste and not into drainage channels as improperly disposed refuse/waste which comprises discarded plastic, foot-wears, clothes etc. equally block the drains especially at their narrow ends or points.

(vi). Streams, rivers, etc should be channeled by deepening, widening or straightening to allow more rapid runoff.

(vii). Collaborations between local communities, NGOs, voluntary groups, local and international donor organizations towards managing floods should be established.

(viii). Within the realm of professional practice (land use planning and management) professionals should undergo training and re-training programmes in related fields (human capacity development) and uphold the ethics of their profession, particularly avoiding corrupt planning practices that can jeopardize lives and properties of the people.

## Conclusion

Flood menace have ravaged several areas in Kaduna Metropolis for several decades leaving in its wake loss of lives and tens of millions of naira worth of properties damaged (*Daily Trust Newspaper*, 2007), which calls for holistic urgent action on our part as individuals and that of the government. The importance of sensitizing government at all levels on the reality of climate change and on possible risk reduction strategies is crucial in preventing flood menace in Kaduna Metropolis. The need for an effective community based early warning system for flood prevention and control for Kaduna Metropolis and Kaduna State in general cannot be over emphasized. Government at all levels need to shift from being reactive to being proactive in responding to flood menace. There is also the need for government at all levels and its agencies to fund and map out contingency plans and emergency preparedness plans to prevent persistent and continuous flood outbreak in Kaduna Metropolis.

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## Appendix I

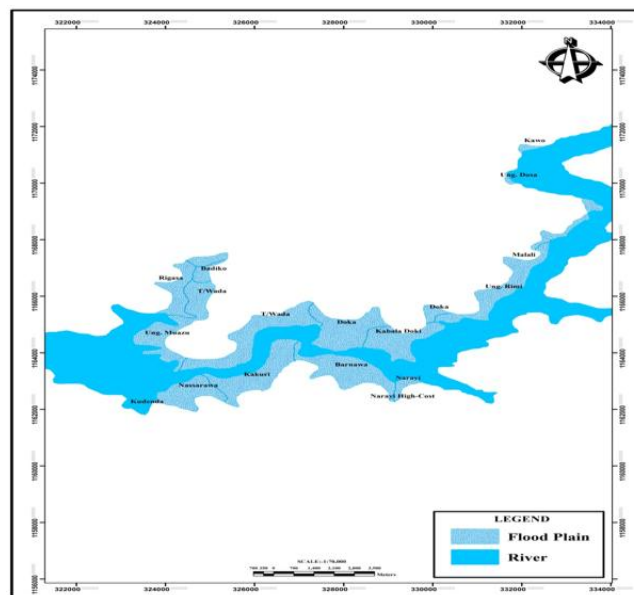


Figure 2: Areas Vulnerable to flooding in Kaduna metropolis  
 Source: GIS Lab, Department of Surveying and Geo-informatics, Kaduna Polytechnic, 201