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FLOOD RISK ASSESSMENT IN URBAN MAKURDI, BENUE STATE, NIGERIA

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ABSTRACT

This study assesses the level of risks and damages associated with flood disaster in the area for five years (2014-2018). Makurdi has been ravaged with episodes of floods over the years. The aim of the study is to assess flood risk in Makurdi. A combination of both field and archival data were used, and survey method involving the use of questionnaire was adopted in obtaining the required information, Digital Elevation Model (DEM) was also employed in identifying flood-prone areas. Findings from the study revealed that flood is the most common environmental disaster in the study area 97.75%, mismanagement of water reservoirs (mainly dams), heavy rainfall, and inadequate drainage facilities are the major causes of the flood disaster. The frequency of flood occurrence in the study area was found to be often, occurring at uneven intervals. About 447.02km^2 of land area (55.6%) is exposed to a high risk of flood. It was discovered also that disaster management/response organizations are making efforts in responding to the menace, however, their efforts are skewed primarily towards relief and rehabilitation support for the victims. This is highly inadequate in addressing the situation. There is strong need for the community, institutions, and all stakeholders to strengthen efforts towards providing feasible precautionary measures to the risks and menace of flood disaster in the area.

Key words: *Flood, water, Risk Assessment, Makurdi, Digital Elevation Model.*

INTRODUCTION

Human settlements where possible are established close to water bodies like; streams, rivers and lakes, due to availability of water supply, rich soils and a good medium of transportation. These areas often experience floods, which may have positive effects such as replenishing wetlands, recharging groundwater and supporting agricultural systems. Unfortunately, floods also severely compromise the economy, health, and safety of people living in these areas. The negative impacts caused by floods can be amplified in regions with inadequate understanding of flood risks management.

The increasing variation in climate, accompanied by excessive rainfall and its devastating consequences remain indelible in the lives of many people and the environment. Over the years and in almost every part of the world, excessive rainfalls due to climate change have resulted to flood, which has claimed lives and properties [3]. These unpleasant experiences have placed many communities, on hold in their struggle for development. As the world's population increase at an alarming rate with the increase in infrastructural development on the rise, lives and properties are becoming more vulnerable to the risk of flood hazards whenever extreme events occur [9].

In Nigeria, flood usually occurs in the form of coastal, river, flash, or urban floods, with its causes ranging from natural to anthropogenic. It accounts for the highest occurring natural hazards, with great consequences on the lives and properties [3&5]. The worst but recent of

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all the flood events that caused huge devastation across the country was the July, 2012 event. The flood (worst since 40years), occurred in at least 33 states including Benue (Makurdi) area of the country as a result of very heavy rainfalls that caused a lot of damages to lives and properties. In 2012 alone, about 7,000,867 lives were affected by the widely spread flood while 363 and ₦77,960,000 deaths and economic damages were recorded respectively, [5].

There is however a wide range of activities and agencies involved in the successful implementation of flood management strategies for mitigation and control. They include individuals, families and communities along with a cross-section of civil societies such as research institutions, governments and voluntary organizations. Their success or failure in ameliorating the menace can only be seen after a systematic assessment of their management procedures.

Issues relating to hydrological disasters such as floods and droughts have increasingly been major disturbing concerns world over. Flood effect and rate of occurrence has particularly drawn the attention of many scholars and organizations. It has caused a great setback to mankind, majorly in areas or places of low terrain, like the coastal and riverine regions of the world. A recent report by the United Nations Environmental Programme (UNEP) revealed that, in the last 2 decades, flood disaster accounts for 56% of all weather-related disasters. According to the report, about 2.3 billion people are exposed to flood risks and over 157 million died as a result of floods in these years.

Flood affects numerous aspects of man's environment, while affected persons suffer some psychological effects. It causes land pollution which leads to widespread of water-borne and infectious diseases.

The Benue River, whose origin and flow cover some part of Adamawa plateau in northern Cameroon down to Nigeria, is considered the second largest floodplain in the country after the river Niger, Crossing many towns and cities. The wetlands of this river suffer serious devastations from floods almost every year.

The Makurdi area of the valley particularly has been ravaged with episodes of flash floods (a form of riverine flood) which occur as a result of heavy rainfalls of long durations and dam failures upstream. The flood causes lots of damages to lives and properties with notable destruction of farmlands, crops, livestock, houses, schools, roads, markets and displacement of people among other things (Figure 1 and 2). Although the flood disasters in these areas are associated with heavy amounts of rainfall, and rainfall cannot be stopped, the hazard and risks of floods, depending on its nature can be curtailed.

Figure 1: Flooded Road situation in Makurdi (Source: independent.ng)

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Figure 2: The situation of a flooded community in Makurdi (Source: guardian.ng)

Civil society groups, Government, private organizations, development partners as well as United Nations agencies have pursued a wide range of strategies, programs and commitments in responding to flood disaster situations in the study area. However, their efforts remain ineffective.

Flood has caused much havoc and difficulties to the inhabitants of urban Makurdi. The school system is often disrupted as communication and mobility prove difficult. Many public school buildings in the area are often used as refugee camps for flood victims. Over the years, government and non-governmental organizations have been engaged in providing drainage systems, funds, and policies with a view to reducing flood damages. Regrettably, in 2012, flood victims in Nigeria and Makurdi, in particular, were forced out of camps, which exposed the government's inadequacy in handling flood situations [2].

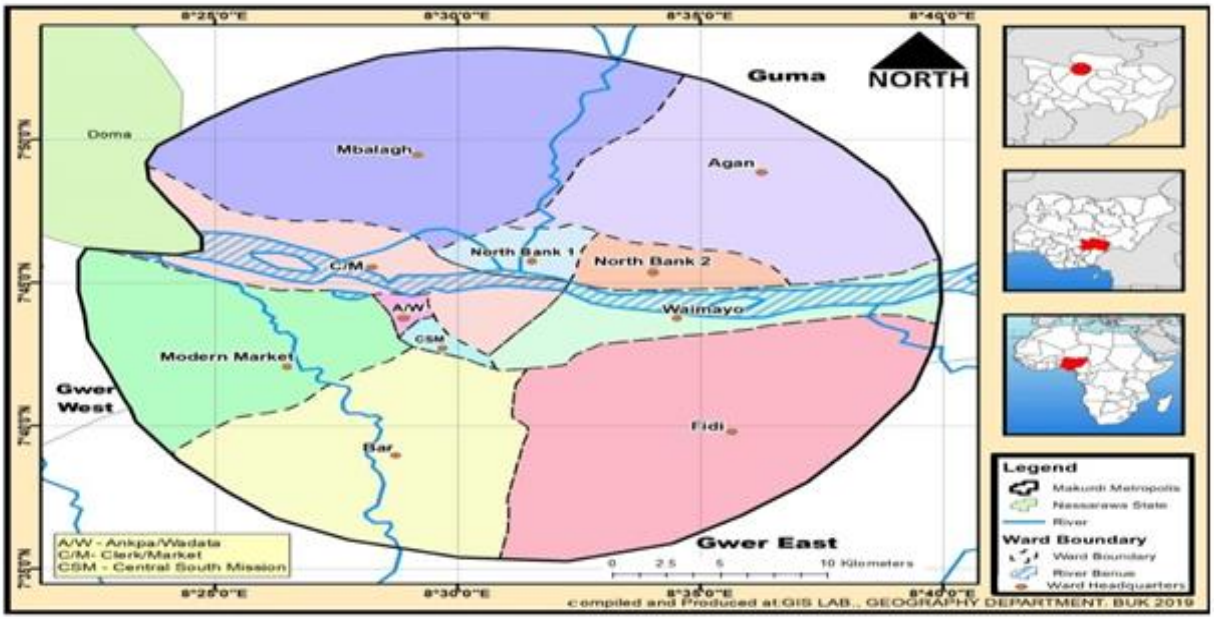

Figure 3: Map of Makurdi showing the local Wards (Source: GIS Lab. Bayero University Kano)

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MATERIALS AND METHODS

This study uses both hydro-metrological data (rainfall records) and geomorphologic parameters (elevation) to ascertain the conditions that lead to flood occurrence and also identify the risks associated with the recurrent events. Additionally, the questionnaire technique was also used in obtaining information about the nature, frequency, consequences and coping measures put in place for flood disaster management in the study area. The study utilized a mixed approach of data analysis, i.e. the use of statistical techniques and Geographic Information System (GIS) in analyzing the geological and hydro-metrological data respectively. The Sample size for this study was determined using a formula adopted from [10] and a total of 400 respondents were sampled proportionately across the local wards. The data collected were analysed using simple percentages and presented in tables and maps for easy understanding.

Study Area

Makurdi the Benue state capital lies between latitude 7° 33' 00" N to 7° 47'00" N and longitude 8° 27'00"E to 8° 4'00" E. It is located in the North central zone of the country. The local government is bordered by Guma to the North, Gwer-east to the south, Gwer-west to the west and Doma local government Area of Nassarawa State to the North West (Figure 3). It has a 16km radius circle covering 804km^2 land-mass [6].

Makurdi climate falls within the tropical sub-humid wet and dry. The wet season starts from April and lasts till October, while the dry season starts in November and lasts up till March. The annual rainfall received ranges from 775mm to 1792mm. The mean monthly relative humidity in the area varies between 43% in January to 81% in July-August period [13].

Makurdi town is basically composed of sedimentary rocks, which sandstones are the dominant rock type. Low-lying areas like Wadata are overlain by shale. The sandstone is divided into micaceous and feldsphatic sand-stones. Some of these are exposed in parts of the town. While the relief is generally low laying (averaging 100m-250m) and gently undulating with inselbergs, laterite, and knoll. Soils in the area reflect the geology. There are two major soil types in Makurdi town, first is the Hydromorphic soils developed on alluvium sediments found along the River Benue and then the Red ferrasols which developed on sedimentary rocks away from the immediate river channel [1].

Makurdi Local government falls within the Guinea Savannah belt of Nigeria. The Guinea Savannah belt is a transitional vegetation zone, separating forested belt of southern Nigeria from the true savannah in the north. It is characterized by a mixture of tall grasses and trees of average height. Examples of tree species found in the area are, Haa (Khayasenegalensia), Malina (Gmelinaarborea), Gbaaye (Prosopis Africana) Hulugh(Vitexdonniana). Most of the trees are deciduous and shed their leaves during dry season[6].

Makurdi is drained by the River Benue which bisects the town into two parts-north and south banks. Other minor rivers that drain the town, and in turn empty their waters in the River Benue includes Rivers Idye, Genebe, Kpege and Kereke. These rivers are highly seasonal and dry up in the dry season leaving behind some stagnant pools. Due to the generally low relief of Makurdi, sizeable portions of the area is waterlogged and flooded during a heavy rainstorm [4].

Makurdi town is inhabited by many tribes with a population of 297,398 to 157,295 males and 140,103 females. These tribes include the Tiv which is the dominant tribe, others are; Idoma, Etilo, Jukun, Egede, Hausa, Yoruba and Igbo etc. The town is made up largely of people who engage in civil service duties, commercial activities and agrarian peasantry. [1].

Makurdi is the most developed urban town in Benue state haven doubled as the capital of Benue state and the headquarters of Makurdi local government. Few areas have a structural linear arrangement, however, unplanned urban surge dominates. The town also, carries a fair share of urban crime, unemployment, congestion, slums and refuses disposal problems. [11].

RESULTS AND DISCUSSIONS

4.1 Demographic Characteristics

4.1.1 Residential Status of the Research Respondents

From the result, 87% of the respondents are indigenes of the study area, hence they are in the right position to give a good account of the risks and damages associated with the flood disaster that has been affecting the area over the years. Only 13% are non-indigene or settlers (Table 1)

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Table 1: Residence Status of the respondents

Residence Status	No. of Response	Percentage (%)
Indigene	349	87
Non-indigene	51	13
Total	**400**	**100**

Source: Field Survey, 2018

Research findings indicated that 86% of the victims reside in the affected areas for over 10 years, and 2.25% for less than 2 years. (Table 2). Since a majority of the victims are residents of the affected areas for over 10 years.

This period however, falls within the temporal scope of the study (2014-2018). Thus, it supports the assertion that the research respondents are in a good position to give information on the risks of flood disaster in the affected areas.

Table 2: Duration Victims Reside in the Areas

Duration	No. of Response	Percentage (%)
0-2 years	9	2.25
3-5 years	15	3.75
6-10 years	32	8
Over 10 years	344	86
Total	**400**	**100**

Source Field Survey, 2018

Analysis of questions regarding the organizational affiliation of disaster management or response organizations revealed that there are collective efforts from both sectors (Governmental & Non-governmental organizations) in providing responses during flood disaster occurrences in the study area. From the analysis, 60% of the management/response organizations are government-affiliated while 40% are Non-governmental organizations (Table 3).

However, looking at the number of the available organizations (both Governmental and Non-governmental) it is obvious that there is very little effort from the general public who are in the receiving end and government alone is inadequate in providing appropriate response and management actions in the affected areas.

Table 3: Organizational Affiliation of Disaster Management/Response Organizations

Affiliation	No. of Response	Percentage (%)
Non-Governmental	2	40
Governmental	3	60
Total	**5**	**100**

Source Field Survey, 2018

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4.2 NATURE AND MAGNITUDE OF FLOOD DISASTER IN THE AREA

4.2.1 Environmental Disasters in the Study Area

On the distribution of the most common environmental disasters occurring in the study area, 97.75% identified flood as the most common environmental disaster in the study area only 1.75% selected drought (Table 4). This is in line with the findings of Abah (2012) [1], who also find flood to be the most common disaster in urban Makurdi.

Table 4: Most Common Environmental Disaster in the Study Area

Environmental Disasters	No. of Response	Percentage (%)
Flood	391	97.75
Desertification	3	0.75
Droughts	7	1.75
Erosion	113	28.25

Source: Field Survey, 2018

A total of 100% might not be obtained. Some respondents indicated more than one item. It can be seen from the analysis that, 96.75% of the research respondents indicated that the flood disaster occurring in the affected areas over the years is devastating, while 3.25% indicated that the flood is not devastating (Table 5).

Flood disasters are often accompanied by tragedies and serious risks and damages to socio-economic and environmental features in the affected areas. This usually forces thousands of people away from their homes, destroying farmlands, properties, and polluting water bodies.

Table 5: Nature and Magnitude of Flood Disaster in the Affected Areas

Nature of Flood	No. of Response	Percentage (%)
Devastating	387	96.75
Non-devastating	13	3.25
Total	400	100

Source: Field Survey, 2018

4.3 FREQUENCY OF OCCURRENCE AND LEVEL OF FLOOD RISK

4.3.1 Frequency of Flood in the Area

Result shows that 67% of the respondents indicated that flood occurs regularly while 33% indicated that the flood occurrence is irregular (Table 6).

Table 6: Frequency of Flood Occurrence

Frequency	No. of Response	Percentage (%)
Annually/Regularly	268	67
Irregularly	132	33
Total	400	100

Source: Field Survey, 2018

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From the analysis, a majority of the respondents identified flood as an environmental disaster that occurs regularly. This revealed that flood disaster occurs almost every year in the study area. This goes in line with the findings of Okonkwo (2013) [9], who find flood in urban Makurdi to be occurring regularly.

4.3.2 Severity of Flood Risk in the Study Area

The result from the statistical calculation of risk showed that the area under study is highly susceptible to flood risk of 64%. This result agrees with the findings of (Abah, 2013) [2], who found north central cities of Nigeria to be of high risk to flood.

Similarly, the result from GIS simulation was categorized into three risk areas namely; areas with a high risk of flood, areas with moderate risk and areas with low risk (figure 4).

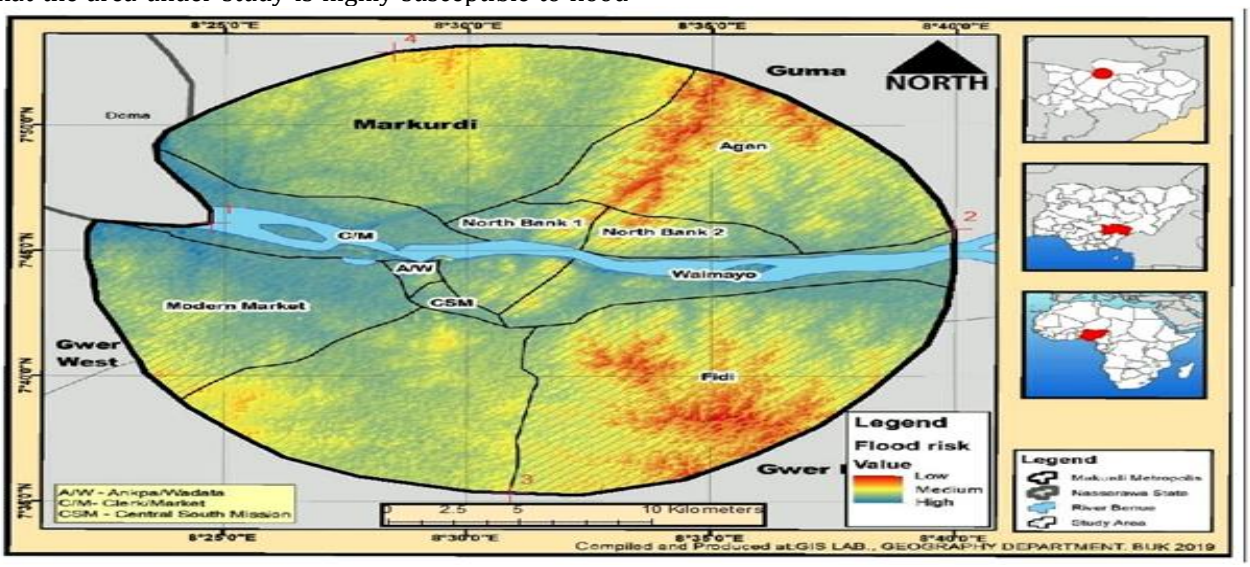

Figure 4: Flood Risk Map of the study Area
Source: USGS DEM (Processed at GIS Lab. Bayero University, Kano, 2018).

4.3.1.1. Low Risk Areas

It was also discovered that only 171.25km2 of the total land area of Urban Makurdi 21.3% is at low risk of flood disaster. The local Wards or areas that fall within this category are Fiidi and Agan wards (Figure 4).

4.3.1.2 Moderate Risk Areas

From the GIS simulation, it was observed that 185.72km2 of the land area of urban Makurdi 23.1% is exposed to moderate risk of flood disaster. The local Wards or areas within this category are Northbank ward 1 and Northbank Ward 2. (Table 7).

4.3.1.3 High Risk Areas

It was also observed that 447.02km2 of land in the study area 55.6% is exposed to high risk of flood disasters (Figure 4). The local wards that fall within this category are: Wailomayo ward, Modern Market ward, Wadata ward, Clerk Market ward, and Central South Mission ward. This however did not conform to the findings of (Abah, 2012) [1], whose work showed larger area coverage.

4.3.1.4 Area Extent of the flood risk Classes

The result from GIS simulation also indicates that a greater proportion of the land in urban Makurdi 55.6% is under high risk of the flood while 21.3% and 23.1% are under low and moderate risks respectively (table 7).

Table 7: Area extent of flood risk classes

S/N	Risk Classes	Area in km²	Percentage (%)
1	Low	171.25	21.30
2	Medium	185.72	23.10
3	High	447.02	55.60
Total		804km²	100%

Source: Field Survey, 2018

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4.4 CAUSES AND CONSEQUENCES OF FLOOD DISASTER

4.4.1 Causes of Flood Disaster in the Study Area

From the analysis, a greater number of 79.5% of the respondents believed that flood occurs as a result of poor management of water reservoirs or dams upstream. While 75.75% indicated that heavy rainfall of long duration contributes to flooding occurrences in the study area (Table 8). From the analysis, it is obvious that poor management of water reservoirs or dams upstream is the major cause of floods in the study area. This finding to a very large extent contradicts that of (Shabu and Tyobee 2013) [10], where intensive rainfall was found to be the leading cause of flood in Makurdi.

Table 8: Causes of Flood Disaster

Causes	No. of Response	Percentage (%)
Heavy Rainfalls	303	75.75
Normal Rainfalls	133	33.25
Inadequate Drainage Facilities	295	73.75
Mismanagement of water reservoirs (Dams)	318	79.5
Siltation/Infestation of water channels	171	42.75

Source: Field Survey, 2018

A total of 100% might not be obtained because some respondents responded to more than 1 item.

4.4.1.1 Relationship between Rainfall and Flood Occurrence

The correlation between the victims' response on the frequency of flood occurrence and the rainfall amounts in the study area is shown in the (Figure 5). The trend line reveals that, the higher the rainfall amount the more the tendency of the flood to occur. This finding, therefore, supports the assertion of (UNEP, 2006) [12], that rainfall is one of the leading causes of flood disaster in the world.

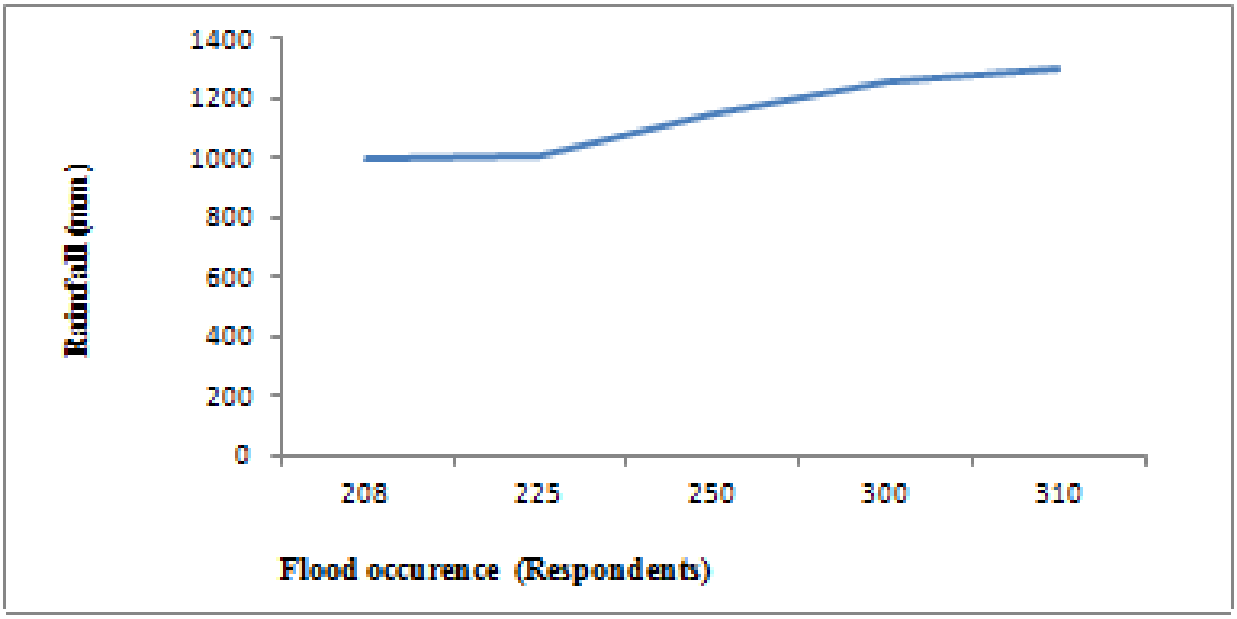

Figure 5: Flow chart showing the relationship between rainfall and flood (Source: Field Survey, 2018).

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4.5 ASSESSMENT OF THE LEVEL OF FLOOD DAMAGE

4.5.1 Assessment of the Level of socioeconomic, infrastructural and agricultural Damages caused

According to the findings, there are more damages on houses followed by roads (figure 6)

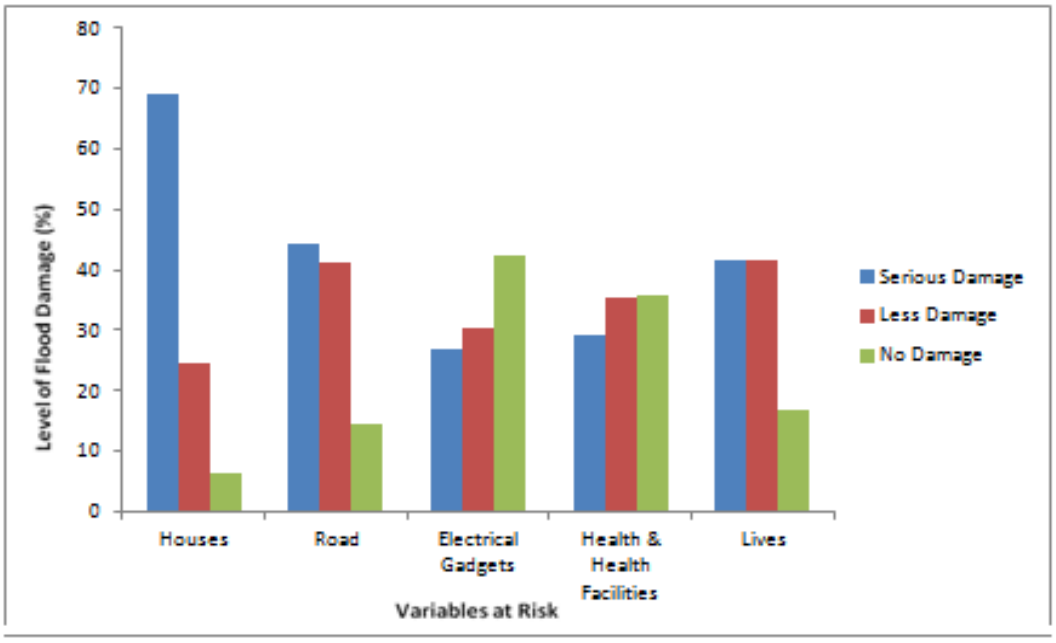

Figure 6: Level of flood damage to Infrastructure (Source: Field Survey, 2018)

The result also revealed that the level of damage flood disaster causes to crops is serious as indicated by the majority of the respondents 79% (fig. 7). That is to say, whenever the disaster occurs, it destroys a lot of crops and several hectares of farmlands in the areas as equally reported by the National Emergency Management Agency (NEMA, 2013) [7].

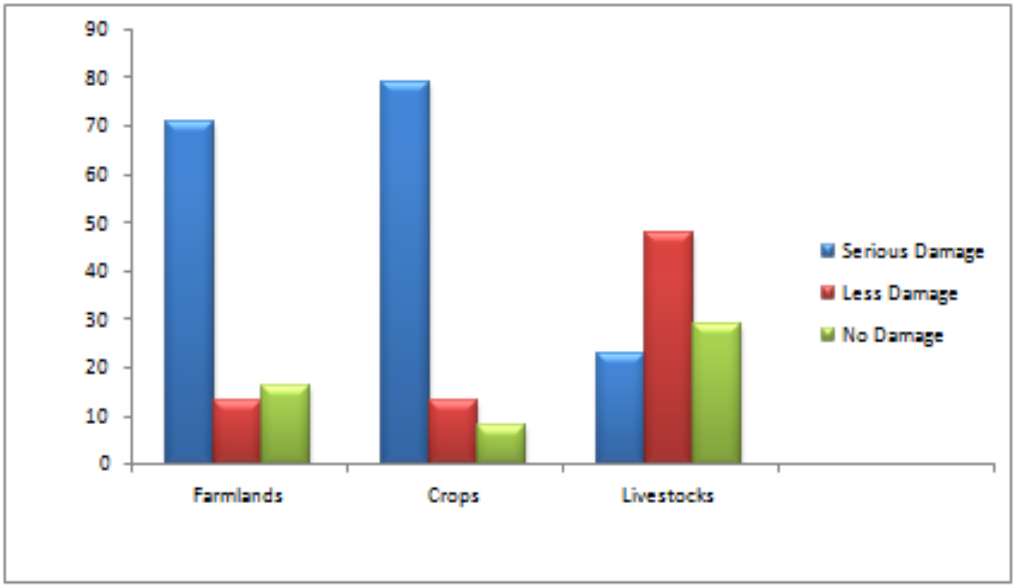

Figure 7: Level of flood damage on Agriculture (Source: Field Survey, 2018)

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4.6.1 Assessment of Mitigation Efforts by Flood Disaster Management or responds Organizations

Based on the analysis of the responses from disaster management organizations on whether or not the organizations have existing flood disaster management plans, it was discovered that the present disaster management organizations in the study area have an existing conventional management plan. The disaster management plans available include disaster preparedness, emergency response and recovery/action plans. This revealed that the existing disaster management/response organizations have good management plans for flood disaster management.

An analysis of the victims' and disaster management organizations' reactions on the type of response the disaster management organizations are providing during the times of flood disaster in the study area. Majority 73.25% of the flood victims indicated that they receive some form of relief materials from the response organizations only 18% receive public enlightenment programs on the risk of flood disasters in the study area (table 9).

Table 9: Type of Response Victims are Receiving

	Number of Respondents	
	f	**%**
Flood relief materials	293	73.25
Flood warning services	88	22
Public enlightenment on the risk of flood	72	18
Provision of relocation shelters	141	35.25
Disaster Management/Response Organizations		
Disaster Preparedness	5	100
Flood relief materials	4	80
Flood warning services	5	100
Public enlightenment on the risk of flood	4	80
Provision of relocation shelters	2	40

Source: Field Survey, 2018

Disaster management organizations are making efforts in responding to the menace of flood disaster. However, findings revealed that their efforts are skewed towards the distribution of relief materials as indicated by the majority of the respondents 73% this is ineffective in addressing the risks and menace of flood disaster in the study area.

5.2 CONCLUSION

Urban Makurdi, which is strategically divided into the north and south banks of river Benue has been seriously affected by episodes of the fluvial and urban flood, usually, flash in nature and stay for few days but causes serious damages to socioeconomic and environmental variables.

Exposed to high flood risk, poor management of reservoirs, high rainfall, high frequency of flood occurrence and the management efforts skewed primarily towards relief and rehabilitation support for the victims, flood disaster condition in the area can only get worse each passing year if nothing new is done in addressing the situation. The study recommends a good synergy amongst the people involved (government, management organizations, development partners, civil society groups, victims etc.) so as to gain a proper and effective flood disaster management system in the area.

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