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PROBLEMS AND CHALLENGES OF FLOODING IN YENAGOA CITY, NIGERIA

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ABSTRACT

The aim of the study is to identify and assess the problems and challenges of flooding in Yenagoa City, Nigeria. The study adopted a multi-stage and simple random technique to administer and collect data for study. The study found that the city experiences flooding regularly due to unchecked development on wetlands fuelled by unplanned rapid urbanisation, weak development control practice, inadequate storm water drainage infrastructure, development along and within natural drainage paths and unsustainable waste management practices which all have given rise to environmental, health, social and health challenges. The study recommended that Yenagoa Masterplan, 2004 should be implemented, sustainable flood management framework should be prepared, non-structural and structural techniques should be employed where appropriate in the city.

KEYWORDS: Flooding, Wetland, Storm water, Infrastructure, Urbanisation, Development, Planning.

1. INTRODUCTION

Over the years, disasters have claimed many lives and destroyed properties in the world. These threats have occurred more in urban centres in which more than half of humans and assets are concentrated (UN-HABITAT, 2007). Flooding is among these disasters and has

featured prominently in the destruction of human achievements. Rapid human development and growth especially in urban areas have accentuated and aggravated this prevalence. However, with increase in spatial area and intensive densification in terms of human population and development level, coupled with environmental changes that are fuelled by climate changing activities have further exasperated the matter (UN-HABITAT, 2007).

This human-induced disaster is a major problem and concern to the global communities, especially in urban areas, whose surface has grossly been paved and concretized through urban development. This has considerably caused environmental, social, health and economic problems in the built environment whether in the developed or developing societies (Enger, et al, 2006) but more commonly in the developing societies. The geomorphic effects from heavy rainfall have further increase the occurrence of flooding in urban areas (Terranova, et al., 2016). The sloppiness of the environment further aggravates the flooding intensity in the environment leading to landslide risks (Terranova, et al., 2016). Rainfall movement follow the slope and contour lines to wash away buildings and other man-made and natural assets in the environment (Capparelli, et al., 2012). In the past, many developed cities had single system to handle both sewage and storm water runoff. During heavy precipitation, the runoff from streets could be so large for waste water treatment plants to handle the volume and these waters will be directed to any natural water bodies close by without treatment. Currently, developed cities have separated sewage and storm water runoff for easy treatment and handling (Enger et al, 2006).

Flood management is a significant problem and challenge in several urban areas in Nigeria. Many urban areas are faced with these flood problems across the country causing devastating effects on the environment. Though, this is common in coastal areas in the country. According to Bryan (2002), oftentimes urban areas experience local flooding as storm water is channelled along streets whereby runoff may not be able to escape from the environment. Heavy and long-period rainfall is common in the coastal regions of Nigeria which has caused flooding incidences and damages in cities and Yenagoa is no exception in this case. The focus of this study is to identify and assess the problems and challenges of flooding in Yenagoa City which experiences this menace annually. The study shall come up with the appropriate strategy to mitigate the problems and challenges of flooding in the city to achieve a sustainable urban environment.

1.1 Statement of the Problem

Flooding as a disaster has impacted on many cities in the world especially those in the coastal regions and Yenagoa City is no exception in this case. Yenagoa City which is located in a floodplain and wetland is faced with problems and challenges associated with flooding. The study has identified that the lack of storm water management in the city has given rise to flooding in the city which, in turn, has led to environmental degradation, pollution and contamination of surface and underground water and distortion of livelihoods and properties and displacement of people. Hence, there is a need to address this threat to the city. This study identifies these flooding problems and challenges in the city and suggests a sustainable and appropriate approach for effective flood management in the city.

1.2 Aim of the Research

The aim of the study is to identify and assess the problems and challenges of flooding in Yenagoa City and to suggest sustainable approach for effective flood management in the study area.

1.2.1 Objectives of the Research

To achieve the aim of the study, the objectives of the study are to:

1. Identify the problems and challenges of flooding in the city;
2. Assess the extent of the problems and challenges of flooding in the city;
3. Identify factors that cause the incidence of flooding in the city; and
4. Suggest an effective flood management policy and framework for the City.

1.3 Scope of the Study

The geographical scope of this study covers six (6) selected communities in Yenagoa City Local Government Area namely Yenagoa, Amarata, Ekeki, Okaka, Yenezue-Gene and Azikoro. Other parameters to be measured in the study include problems and challenges of flooding in the city, the main causes inducing flooding and the effects of the flooding on inhabitants of the city (see Fig. 1).

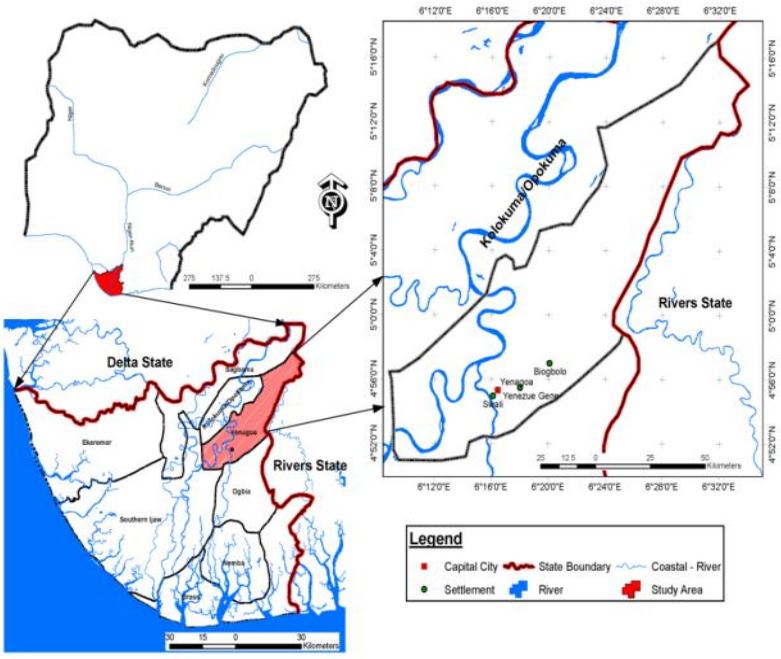

Fig. 1: Map of Yenagoa City LGA Showing the Study Area.

Source: Surveyor General Office, Bayelsa State, 2016

2. LITERATURE REVIEW

2.1 Flooding: An Overview

Generally, urban development will change, alter, affect or make a significant impact on the environment. The construction of buildings and roads has extensively changed the hydraulic properties of many habitable human settlements. Naturally, some areas have been observed to be less permeable or even impermeable to storm water and these areas are elevated to trap runoff in the environment. The construction of surface and conduit drainage meant for efficient and sustainable runoff drainage in the urban areas tends to remove natural vegetation causing reduction, interception, and transpiration of plants in the environment (CSIR, 2000). The limited vegetation cover in the environment exposes the soil to the impact of rain during precipitation, leading to increased erosion and flooding in the environment. Logically the direction of water systems may be canalized for more effective flow of runoff through the construction of drainages. Storm water management is the science or skill for limiting negative impacts of storm water on the environment and enhancing the positive impacts or catering for the hydraulic needs of a development in any environment while minimizing the associated negative impacts (CSIR, 2000).

Hence, the impermeable surfaces in urban areas as a result of extensive development will usually encourage flooding very often. Runoff from such concretized surfaces has a high

velocity, during and after rainfall, which increases storm water in drainage systems in the built-up areas. This increases peak flow and overland flow volume and decreases natural groundwater flow as infiltration is near impossible. Urban runoff has increased pollution and contamination of water bodies in the environment, which leads to serious environmental consequences (Parkinson, et al, 2010). The traditional model of storm water management is based on a misconception by people which the main aim is to drain urban runoff as quick as possible from the environment through channels and pipes and this increases peak flows and costs of storm water management in urban system. This type of solution has been observed to promote or transfer flood problems from one section of the basin of an urban area to another section. Urban runoff most time contains large amount of solids and higher concentration of metals and other toxic components during the flowing process as a result of not treating them before discharge (Parkinson, et al, 2010).

2.1.1 Techniques for Flood Management

There are two main techniques generally used for flood management whether in urban or rural area. These techniques are hard and soft engineering techniques. The hard engineering techniques include construction of dams, dykes, artificial levees, channel straightening and diversion spillways. The soft engineering techniques include flood zoning, wetland restoration, afforestation and river restoration (Jackson, 2013; Beat, 2012). The hard engineering techniques apply scientific knowhow and technology in the execution of the project. They are useful but have their own consequences to the environment when they fail or are overwhelmed by flooding. Their consequences include biodiversity and livelihood loss, flooding, displacement of humans and destruction of properties. The soft engineering techniques are regulations and standards to promote sustainable growth and development. They enhance the environment through conservation and preservation of the natural systems (Jackson, 2013).

2.2 Problems and Challenges of Urban Flooding

Urban flooding is a serious and growing phenomenon affecting both developed and developing countries. However, with the growing and rapid urbanisation, climate change leading to changes in urban hydrologic; events such as urban flood are increasing rapidly (Amoako, 2012). Urban flooding have caused massive distressing effects on many aspects of urban life especially on the residents, their economy and environment (Eschooltoday, 2010a).

Economic: In the event of flooding, residential developments, access roads, electricity, schools, hospitals and other infrastructures and facilities in the urban area are affected and or destroyed. This impact makes inhabitants of the urban area to be homeless and displaced for some time. In such events, the government spent a large amount of economic resources by deploying emergency services personnel such as firemen, police, even the military and other types of emergency apparatus to help evacuate affected persons. In this case, huge financial resources are required by the government to carry out this responsibility while people's valuable economic resources are destroyed or lost during the flooding events. It always takes time and huge financial resources to re-build these affected infrastructures and facilities destroyed and for the economic and social activities to come back to normalcy (Eschooltoday, 2010b).

Environment: The environment is the primary source of life to human and other living things. Therefore, when flooding occurs is the environment, it suffers the most devastating effects. Flooding increases the amount and concentration of pollutants in the environment which, if they stay for a long time, destroy the soil and increase contaminants in the natural water bodies within the flood area. These substances cause imbalance to the biological lives and ecological systems in the environment. In 2011, a huge tsunami hit Japan, whereby sea water flooded a large part of the coastline causing massive leakages in nuclear plants and high radiation in that area. Authorities in Japan analyzed that Fukushima radiation levels may be 18 times higher than expected (Eschooltaday, 2010b).

People, Animals and Plants: Humans, animals and plants are the most affected creatures in the environment when urban flooding occurs as most of the world's human population are concentrated in urban areas. Flooding causes a huge number of loss of human lives and injuries, and even causes several diseases and sicknesses related to pollution. As water supply and electricity distribution are disrupted, people will have to struggle and may suffer infections such as military fever, pneumonic plague, dermatopathic diseases and dysentery. Even animals and plants are affected as their natural habitat are polluted and destroyed causing a lot of havoc in the environment and general survival challenges (Eschooltoday, 2010b).

3. METHODOLOGY

In order to obtain relevant information/data on problems and challenges of flooding, the study employed a sample survey and personal observation techniques for collection of data. In the

first stage the study identified and listed twenty two (22) communities in the study area. In the second stage, the study purposely selected a total of six (6) communities namely Yenagoa, Amarata-Epie, Okaka-Epie, Yenezue-Gene, Ekeki and Azikoro. This selection was purposely based on the degree of vulnerability to flooding in the communities. In the third stage, the simple random sampling technique was used to select 377 respondents (household heads) from the six selected communities (see Table 1). Both types of primary and secondary data were collected. The primary data were collected through pre-coded questionnaire, key informant interview, photographs and direct physical observation of flood related activities. The secondary data were gathered in the form of maps and records from the government agencies such as Bayelsa State Physical Planning Board, Nigerian Metrological Agency (NIMET) and other online sources relating to flooding and urbanisation in the study area.

Table 1: Questionnaire Distribution in the Study Area.

S./N.	Sampled Communities	No. of Questionnaires
1	Yenagoa	153
2	Amarata-Epie	59
3	Okaka-Epie	63
4	Yenizue-Gene	37
5	Ekeki	28
6	Azikoro	37
	Total	**377**

Source: National Population Commission, 1991; Researcher's Fieldwork, 2016

4. DISCUSSION OF FINDINGS

1.1 Environmental Degradation and Socio-Economic Problems

The study revealed that Yenagoa City is prone to regular flooding every year as 37.9% of the respondents experience flooding quarterly, followed by 35% annually, 13.5% said monthly while 4% said every six month and 9.5% said not at all. This means that majority of the residents experience flooding every year (see Fig. 2). The flooding experienced by the residents in the study area is mostly caused by the absence of drainage system in most of the streets and communities. Most of the communities in the study area are not planned before development begins which has led to haphazard development. The flooding experienced in the study area has caused environmental, health and social problems. From Fig. 3, it shows that in respect of environmental challenge, 78.8% of the respondents said that it affects them very strongly, 42.8% said strong, 1.6% said fair while 3.4% said not strong and not strong at all, respectively. Fig. 4, reveals that in respect of health challenge, 54.1% of the respondents said it affects them very strongly, 27.8% said strong, 7.5% said fair, 8.8% said not strong and

1.9% said not strong at all. For social challenge, Fig. 5 shows that 43.7% of the respondents said it affects them very strongly, 25.2% said strong, 17.5% said fair while 8.3% and 5.8% said not strong and not strong at all, respectively. From Fig. 6 and Table 2, it is recorded that, as most of them are civil servants, economic challenges are not that much affecting on the residence. All these challenges mentioned are caused by the failure of the poor drainages available in streets and communities. This has caused contamination of water bodies in the city such as the Ekole, Epie, Yenagoa, Amarata, Azikoro, Biogbolo Creeks, the Ox-Bow Lake and other natural water bodies in the study making the fresh water undrinkable and use for other domestic uses.

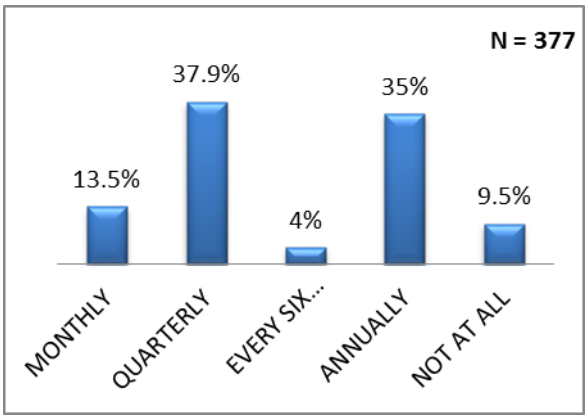

Fig. 2: How Often Flooding Incidence is Experienced in the Communities

Source: Researcher's Fieldwork, 2016.

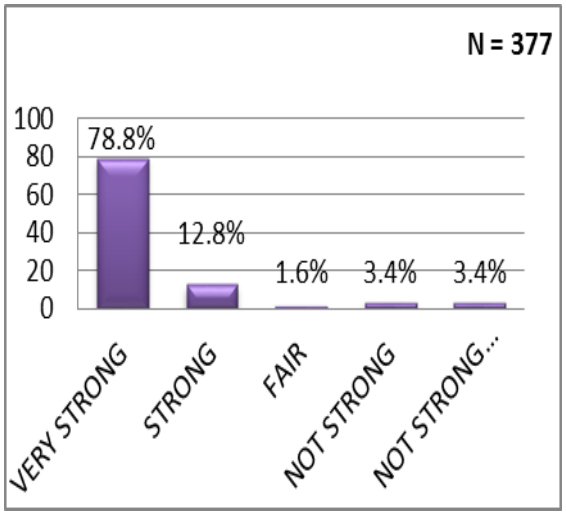

Fig. 3: Environmental Challenge.

Source: Researcher's Fieldwork, 2016.

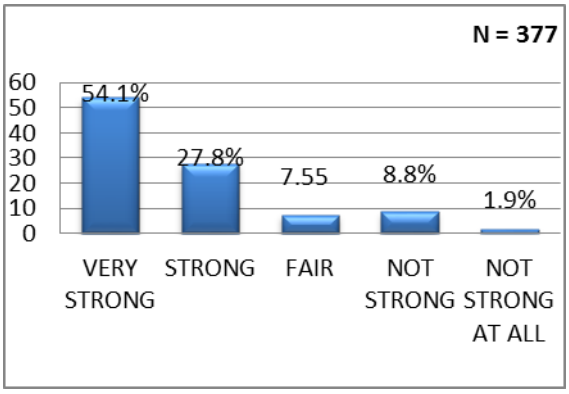

Fig. 4: Health Challenge.

Source: Researcher's Fieldwork, 2016.

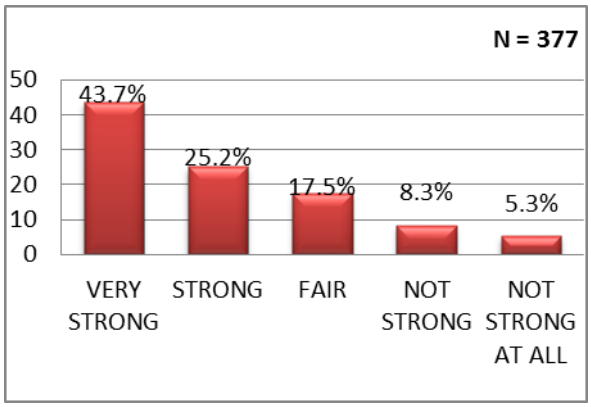

Fig. 5: Social Challenge.

Source: Researcher's Fieldwork, 2016.

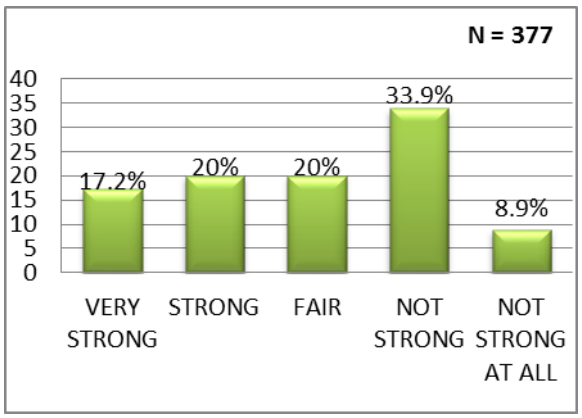

Fig. 6: Economic Challenge.

Source: Researcher's Fieldwork, 2016.

Table 2: Occupation of Respondents

Occupation	No.	%
Civil Servant	189	50
Company Worker	41	10.9
Technician/Artisan	27	7.3
Farming	16	4.2
Fishing	24	6.3
Contractor	21	5.7
Trading	59	15.6
Total	**377**	**100.0**

Source: Researcher's Fieldwork, 2016

1.2 Urban Planning Issues

One fundamental problem identified in Yenagoa is that there is lack of physical planning and urban management in the study area. Virtually, most of the communities in the study area are not planned with well laid-out streets including the required street infrastructure and amenities. This can be attributed to weak development control mechanism in the city because the government has failed to implement the Yenagoa Master Plan of 2004 and the Yenagoa City Development Strategy of 2007. A few areas are planned in the city within which some of the communities in the study area are located. These planned areas are gated neighbourhoods developed by the government for her staffs and officials. They are Azikoro Housing Estate, Civil Servant Estate at Ovom, and Opolo Housing Estate I and II. However, these estates are still experiencing flooding because the drainage provided is not well channelled to the natural drainage paths around the settlement areas.

Most of access roads in the study area are not well laid out and designed to be provided with drainage beside them to collect and drain water from the streets during and after rainfall. Even the drainage of some streets is not well channelled to the natural drainage paths. It is also observed that people are developing close to the natural drainage paths without proper setbacks narrowing these paths. The intensive development in wetlands is increasing the level of densification in the communities and reducing the wetlands that are supposed to be conserved to serve its natural function of water retention. From the satellite imageries, it is found that the level of urbanisation is increasing yearly. Table 3 shows the level of change in urban growth between 2010 – 2016. It indicates that about 946.32 hectares have been developed upon between this period and some of these areas are within the identified wetlands. There is no concrete plan to manage and control the level of urbanisation in the city to achieve sustainable urban growth and development (see Figs. 7, 8, 9 & 10).

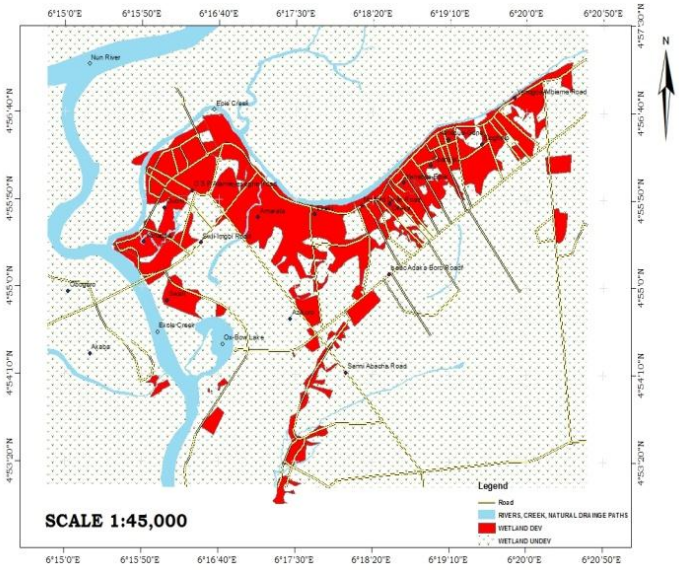

Fig. 7: Extent of Urban Growth and Development of the Study Area at 2010.

Source: Google Earth& Dept. of Urban & Regional Planning GIS Lab, RSUST, 2016.

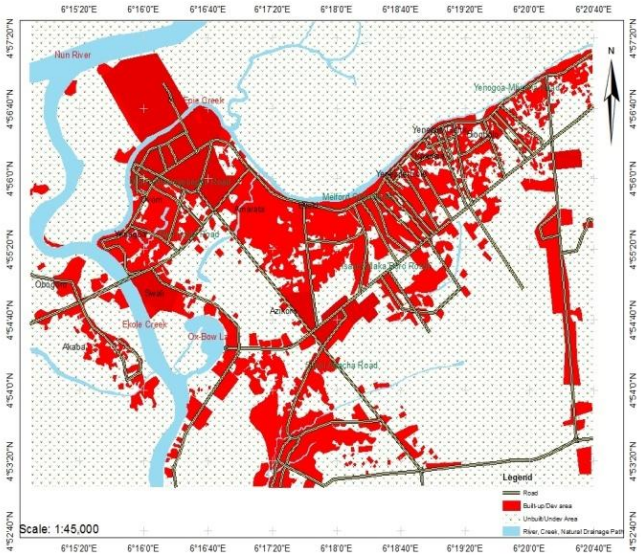

Fig. 8: Extent of Urban Growth and Development of the Study Area at 2016.

Source: Google Earth & Dept. of Urban & Regional Planning GIS Lab, RSUST, 2016.

Table 3: Extent of Urban Growth between 2010 – 2016 in the Study Area.

Landuse Description	Area in (Ha) 2010	Area in (Ha) 2016	Level of Change in (Ha)
Undeveloped Area	9809.51	8863.19	-946.32
Developed Area	1206.09	2152.41	944.32
Rivers/Creeks/Natural Drainage Paths	590.49	590.49	0
Total	**11606.10**	**11606.10**	

Source: Researcher's Fieldwork, 2016

Fig. 9: An Environmentally Sensitive Area (Wetland) not Planned Earmarked as Central Business District at Swali.

Source: Researcher's Fieldwork, 2016.

Fig. 10: Wetland Occupied by Residential Buildings at Swali

Source: Researcher's Fieldwork, 2016.

4.3 Other Factors Exacerbating Flooding in the Yenagoa City

One important factor contributing to flooding in the city is the habit of residence dumping refused wastes in the natural and man-made drainage systems. Table 3 shows that 41.6% of the respondents believed that poor functional drainage in the study area is caused by refuse dumped in the drainage system. The wastes are not dumped in the approved dumping sites but indiscriminately dumped on illegal sites, compound lands and open spaces and sometimes natural forces such as wind and rain carry them to drainage and water bodies in the city. The existing natural drainage systems are not maintained often times. Wastes and water hyacinths are seen on them, obstructing free flow of water to the creeks especially along Yenagoa, Amarata, Azikoro, Biogbolo and Epie Creeks that receives runoff.

Moreover, people have developed close to and along natural drainage systems without proper setbacks, thereby narrowing their paths of flow of storm water during rainfall. Some of the wetlands, identified in the study area, that are serving as natural retention ponds and river basins are being invaded by residents for urban development without considering their conservation and preservation. This is common in Azikoro, Swali, Biogbolo, Amarata, Ovom and Ekeki Communities.

There are also poor drainage design and construction of storm water infrastructure. Table 3 shows that 39.6% of the respondents believed that the drainage system is poorly designed and constructed. It was observed that the existing drainage network is not uniform in size (depth and width) across the study area. However, there are no specified standards for the construction of drainage in the study area but from measurement in the study area, a typical drainage is 0.5 m wide and 0.7 m deep. This is not considered to be adequate for the volume of rainfall in the study area during raining season especially during peak months of rainfall as rainfall last at least for 9 months of the year. Most of communities are observed to be having poor drainage network to discharge storm water to the natural drainage systems.

Another factor causing flooding problems and challenges in the study is that all the major roads in the city do not have drainage systems for collection of storm water during rainfall. These roads include Melford Okilo, Yenagoa-Mbiama, D.S.P. Alamieyeisegha, Isaac Adaka Boro, Sani Abacha and Swali-Imgbi Roads. They are elevated and paved higher than the abutting properties along them. This impedes collection and free flow of storm water during and after rainfall. Also, some local streets in the study area have a similar problem of no drainage as 15.7% of the respondents attest to this reason (see Table 4 & Fig. 9).

Though, some of these roads were constructed to serve as dykes in the city but this has practically made discharge of runoff impossible to the natural drainage paths and wetlands in the study area. Although some streets and communities in the study area have drainage system, it is not functional. It was discovered that most of the communities are not planned and laid out by the government and the community themselves, so drainage is not provided to divert water to any water body within the communities. These can be attributed to human factor as residence having attitudinal problem of not adhering to public health standards and regulations to create hygienic environment that will promote healthy living environment.

It was also discovered that the government is not properly financing the storm water management infrastructure development in the city to solve the reoccurring incidence of

flooding (see Table 4 & Fig. 11). Most of the drainage canals are not de-silted by the government agencies and are clogged by refused dumps and sediments. Most of the road-side gutters and storm water drainage canals are not effective in evacuating runoffs from the built-up areas.

Table 4: Factors for Poor Drainage System in the Communities

Reasons for Poor Drainage System	No.	%
Dumping of Refuse	157	41.6
Poor Design and Construction of Drains	149	39.6
Absence of Drainage Network	59	15.7
Development on Wetlands	12	3.1
Total	**377**	**100**

Source: Researcher's Fieldwork, 2016.

Fig. 11: Isaac Adaka Boro Road without Drainage in the Study Area.

Source: Researcher's Fieldwork, 2016.

5. CONCLUSION

The natural and conventional flood management systems have failed in Yenagoa City that has further intensified flooding problems and challenges. There is need to recognize and adopt modern and current flood management strategies for flood management in the city to balance the demands for land for urban development and to reduce flood risks that are triggered by the inadequate flood management system in the city.

The inadequate flood management system coupled with intensive and uncontrolled urban development had caused persistent flooding incidents in the city. This has led to environmental, health, social and economic challenges to the residents of the city. There is

need for a collective collaboration by the government, residents and corporate organisations to combat this threat.

6. RECOMMENDATIONS

The recommendations are as follows

a. Implement the Yenagoa City Master Plan of 2004 to guide, monitor, control and manage the areas designated as urban lands to achieve sustainable urban growth and development.
b. As a state policy and urgency, Flood Management Framework should be prepared for the city to control, manage and monitor flooding incidence.
c. Structural (engineering methods) and Non-structural (regulations and standards) Flood Management techniques should be employed to control and manage flooding in the city.
d. Proper planning and layout of residential neighbourhoods before construction of drainages and channelling of storm waters to natural drainage systems in the city.
e. HEC-1 and HEC-RAS software should be used to analyse and estimate natural drainage systems hydrology, hydraulic and flow systems of channels.
f. There should be a collective participation of the government, residents and other organisations in monitoring flooding activities in the city.
g. There should be regular research by government agencies, educational institutions and professional bodies on flooding management for the city by providing financial and technical supports for storm water management through promulgation of legal framework by the state legislative and judicial systems.
h. There should be proper education of the residents of the city for not dumping their wastes on the natural and artificial drainage systems in the city while invoking punishment of offenders.
i. There should be regular de-silting of the artificial drainages and natural drainage canals of water hyacinths and refuse in the city especially before and during raining season and all buildings within wetlands and natural drainage paths should be demolished; and.
j. All emergency government agencies and voluntary organisations in the state such as fire service, police, Red Cross Society, medical services, NEMA, should be well equipped technically and financially to tackle flood related disasters in the city by providing special endowment fund.

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