IX International Conference on Multidisciplinary Research
(IEI, Chandigarh) Institution of Engineers, India , Chandigarh
21st December 2019 www.conferenceworld.in ISBN : 978-81-943584-6-6

FLOOD MANAGEMENT AND BEYOND: LESSONS FROM RIVERSIDE OF CHAD BASIN IN NIGERIA

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ABSTRACT

Introduction: *Gashua is a riverine town that it rapid growth and development is threatened by continues flood. Thus, the growth has being facing serious risk of flood vulnerability, as a result of location of the town along river Yobe and on relatively flat terrain of only 11m interval (between the highest and lowest points).*
Materials and methods*: Based four distinct relief classification of Gashua; 334m-336m, 337m-338m, 339m-340m, and 341m-342m above sea level, GIS technique was used for terrain analysis, also a survey was conducted to captured as primary data using structured questionnaires.*
Results and discussions*: The study revealed that terrains of this area and soil type led to poor drainage after rain, as well as river's overflow. Moreover, most of the residential areas use clayed mud as their construction materials and poor street layout or urban planning made the flood disaster more effective whenever it occurred. It was also discovered that flood disaster was an annual tradition in Gashua, especially in areas located in between altitudes 334-336m.*
Conclusion and recommendations*: Both individual as well as community at various levels are mostly engaged in various roles in mitigating the effects of the flood; for instance, drainage dredging, construction of temporary embankments and channels, draining the overflowed water among other efforts. Lastly, this study suggested the need for future urban expansion suitability in addition annual precaution techniques of mitigating flood before the start of rainy season such as road and drainage construction in highly flood prone area.*

Keywords: Development, Disaster, Hazard, Integrated Water Resource Management, Natural Resource Management

1. INTRODUCTION

Flooding is a disaster which occurs when the contents of a river valley over flow its banks to surrounding areas or when there is heavy rainfall beyond the saturation of the soil of an area which leads to overland flow (Erich, 2002; Kingsley & Christopher, 2013; Amiewalan & Bamigboye, 2019). Flooding and its socioeconomic implications is a serious environmental problem affecting riverine areas in Chad basin (Bila, 2011; Adebola et al., 2018; Hassan & Zamani, 2019). The zone is very susceptible to flooding due to its gently slope terrain, occasional occurrences of

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torrential rainfall and failures of dams in upstreams especially during the peak of rainy season coupled with the activities of man such as overgrazing, excessive deforestation for irrigation and agricultural activities. Other anthropogenic activities includes the quarrying of sand and mud for construction purposes especially along the channel of the water that courses make the area to be susceptible to flooding.

Flooding is a natural phenomenon, and it severity depend on the response of hill slope and runoff production processes to heavy or prolonged rainfall or snow melt and to the nature of the area being flooded. (Holden, 2012; Hassan et al., 2019). The magnitude of floods has been affected by human action in different locations. Additionally, humans have decided to live in low – laying areas that are subjected to flooding event. These areas tend to be where there are fertile soils (often made more fertile by regular flooding) suitable for crops and where navigations of rivers by boats allow transport of goods and people (NEAZDP, 1990; 1992). So flood should be expected if people live on flood plains, and recently it is possible to produce maps areas prone to flooding.

The magnitude and extent of a river flood depends upon the size of the catchment area of the river (contributing watershed), the topography, soil conditions and vegetation, and the weather conditions involved (Holden, 2012). Within most riverside of Chad basin of Nigeria, communities and families activities were significantly hampered as well as their daily livelihood activities due to flooding (Oyebande, 1997). Other issues such as hunger, high cost of living, infestation of snakes, flies and other disease vectors and general deplorable living conditions were identified as some of the negative impacts of flooding in these areas (Amiewalan & Bamigboye, 2019).

Flooding has adverse effects on man and his physical environment which include loss of lives and properties, displacement of people, effects on health, environmental pollutions; etc (Erich, 2002; Hassan & Zamani, 2019). Flood disaster is among the consequences of recent global climate change especially at coastal and riverine areas. Climate change coupled with dams constructions at the upper course of river Yobe significantly reduced the discharge of the river which enable urban land use activities to be claiming the flood plains. The thrust of this study is to assess the vulnerability of flood disaster in Gashua town and also recommend suitable areas for future urban expansion.

2. MATERIALS AND METHODS

The present study adopted Hassan et al. (2019) relief classification of Gashua that categorized the area into four distinct zones; 334m-336m, 337m-338m, 339m-340m, and 341m-342m above sea level. A survey was conducted using stratified sampling technique to select 300 respondents. The sampling frame consists of 150 samples drawn from the subgroups of the population using stratified sampling technique. A sample from each sub population (zone) is then determined. The interview questions focused on the causes and effects of flooding, coping strategies, housing

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and sanitation and flood management issues. The structure questionnaires were administered to the four relief zones in the area in proportion to the size of their respective urban land use. A total of 120 questionnaires were administered in 339-340m, 70 in 337-338m, 60 in 341-342m and 50 in 334-336 m above sea level. The data generated through questionnaires in the different relief zones were sorted, arranged, analyzed and presented in charts. These data were further discussed with the aid of descriptive analysis according to their relief zones.

2.1. STUDY AREA

Gashua is the headquarters of Bade Local Government, Yobe State. It is located approximately within latitudes 12°51'30"N to 12°54'0"N and longitudes 11°E to 11°4'30"E. Gashua is lined by river Komadugu-Yobe to the south, bounded by Yusufari LGA to the North, Bursari LGA to the East and Karasuwa LGA to the West. Gashua is situated within the Sahelian zone of Nigeria which is largely influenced by Tropical Continental Air mass for most part of the year. Annual rainfall is generally low with a mean annual of about 500mm. The rainy season mostly last for four months (June-September), with August being the wettest month. The area is dryer for most part of the year (NEAZDP, 1990). The long dry season is characterized by dusty wind, which blows from adjacent Sahara Desert. Annual rainfall variability is very high which resulted in occasional occurrence of drought and flood conditions respectively.

The geology of Gashua largely belongs to the great Lake Chad formation which is underlain by pre-Cambrian basement complex Rocks covered by the new sedimentary rock deposits (Gana et al., 2019). However, both the relief as well as the drainage shared distinctly similar character through concurrent interrelationship. The study area is situated within the Chad Basin, it has a plain land with an elevation of less than 342m above sea level. The plain land has a gentle slope which is made up of recent deposits of sand and clay. Rain water sink directly into the Chad Basin sediments in most parts of Gashua, excesses were further are mostly drained by River Komadugu-Yobe, while some places are drained by Filin Tanda pond.

Figure 1: Map of Yobe State showing Bade Local Government and study area

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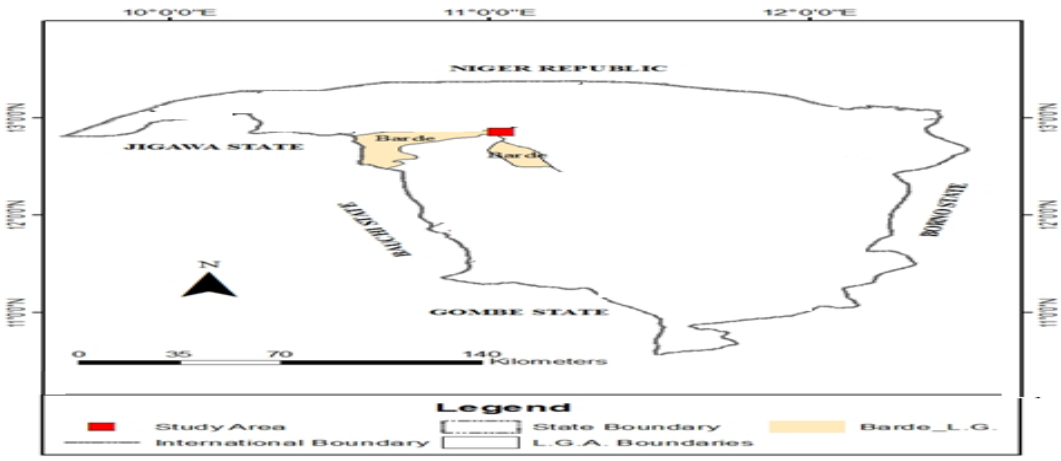


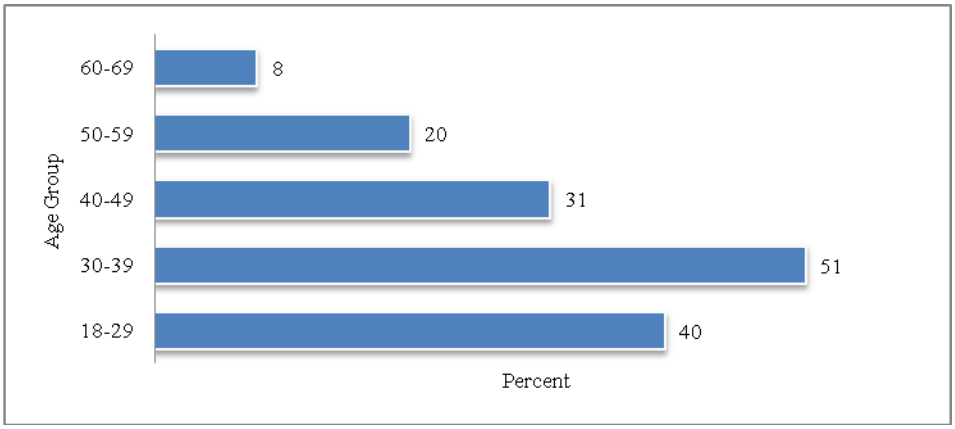
3. Results

The existing section presents various data collected for the purpose of this study and presented in various charts with aid of simple percentages and frequencies.

3.1 Background information

A total of 300 samples were successfully collected selected using stratified sampling technique. Several demographic data such as the age of the respondents, gender, marital status, educational attainment as well as occupation were all collected and analyzed. The results of these analyses are as follows:

Figure 1: Distribution of respondent' age group



Source: *Primary survey, 2019*

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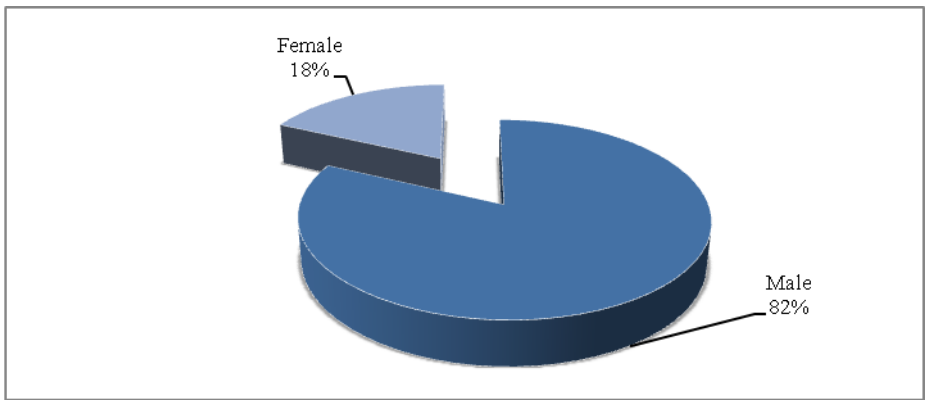
The figure 1 showed the age range distribution of the respondents in percent. The result showed that more than 51 percent of the respondents are found to be aged within the range of 30 to 39 years and followed with about 40 percent which were also aged from 18-29 years. Another important demographic information assesses is the gender distribution of the respondents which is presented in the figure 2 below.

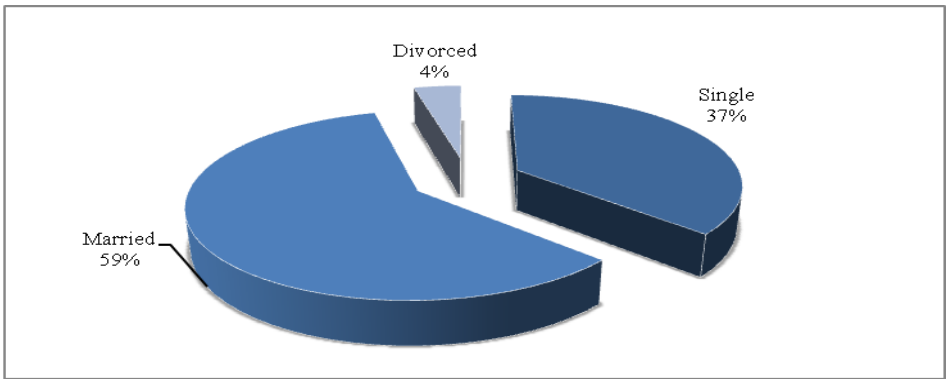
Figure 2: Distribution of respondent' gender



Source: *Primary survey, 2019*

The figure 2 showed the respondents gender composition in percent. The result showed that male comprises of about 82 percent of the respondents. This is largely due the masculine domination of the society where in more localize conventional society setting, only male where considered to be leaders of their respective families'. Another important demographic aspects examined by the study is the marital status of the respondents.

Figure 3: Distribution of respondent' marital status



Source: *Primary Survey, 2019*

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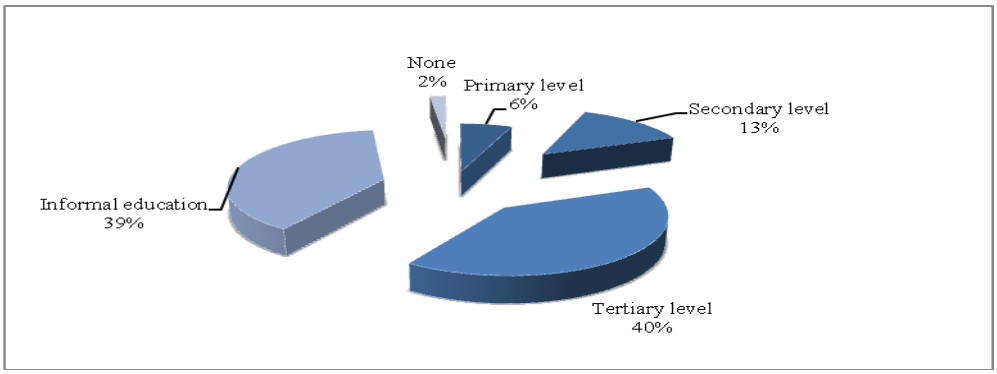
The figure 3 showed the respondents marital status in percent. The results showed that about 59 percent of the respondents are married and only 37 percent were found to be singles. The results of the marital status confirmed that most of the respondents are the head of their respective families'. Moreover, the study also inquired the respondent highest academic qualification acquired.

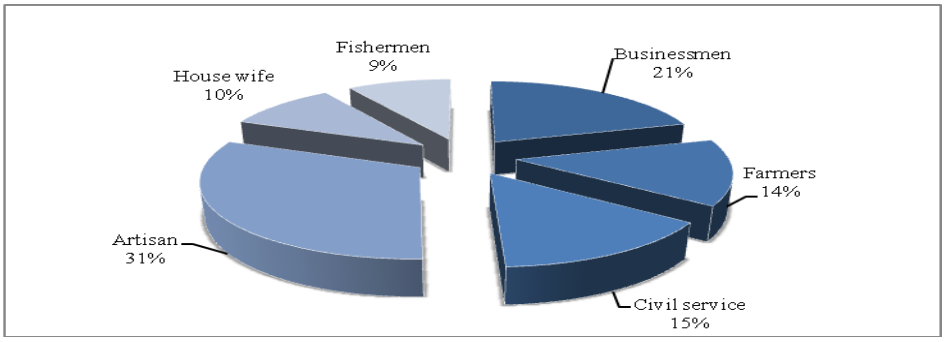
Figure 4: Distribution of respondent' level of education



Source: *Primary survey, 2019*

The figure 4 showed the respondents highest academic qualification obtained in percent. The most surprising result come from the highest academic qualification obtained which showed that only 2 percent of the respondents have no form of any education and cannot read or write whereas the about 39 percent have informal education (i.e. Islamic form of education). Moreover, about 40 percent of the respondents are also found to have attended tertiary institution (University, Colleges, Polytechnics or Monotechnics). Other forms of educational attainment acquired by the respondents are Secondary and Primary Education with about 13 and 6 percent respectively. The study further assesses the respondents' forms of occupations in figure 5 below.

Figure 5: Distribution of respondent occupations



Source: *Primary survey, 2019*

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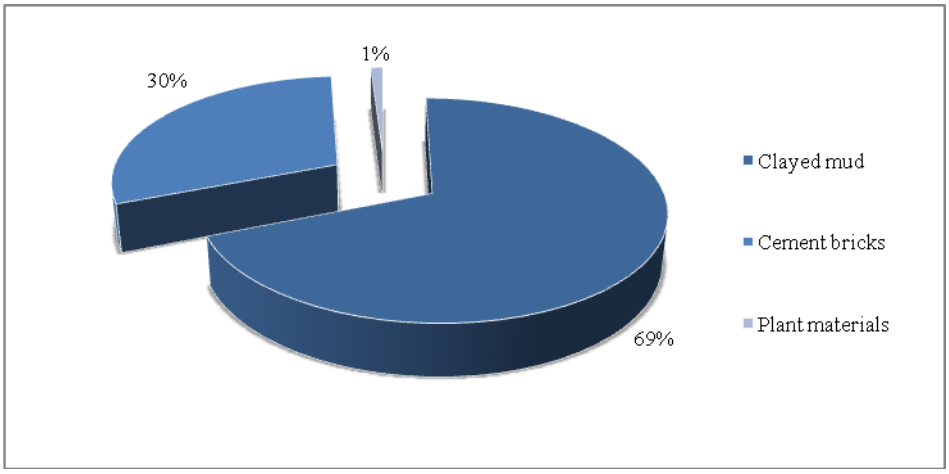
The result of figure 5 showed that most of the respondents of this study are artisan by occupation with about 31 percent. Other prominent occupations within the region are the businessmen/businesswomen, civil service, farmers and fishermen; explicitly constitutes about 21, 15 and 9 percent respectively.

Within the floodplains of Chad Basin, especially areas at the edge of river are mainly product of meanders that mostly erodes the edges as the water travel to the downstream. When a river breaks its banks in the region, it mainly leaves behind layers of alluvium that accumulated to form floor of the plain and eventual become a threat to building in that region, though this depend on the materials used for the building construction.

3.2 Housing and construction materials

Scarcity of land in Gashua town is pushing people to areas vulnerable to flood with the exception of the flood free area around Abujan Amare along Yusufari road, whose flood is due to poor street layouts or urban planning as people mistakenly built their structures across the streets. Gashua town is at edge of Bade local government area, as most of the surrounding villages to north, west, and east are in Yusufari , Karsuwa and Bursali local governments respectively.

Figure 6: Distribution of overall type of building materials



Source: *Primary survey, 2019*

In Gashua, about 69 percent of houses are made from clay mud, while only 30 percent and 1 percent are made from cement bricks and plant materials respectively. A worrisome housing congestion is reported with only 11 percent of respondents report 1-5 person per bedroom, while 32 percent report room density of over 16 people.

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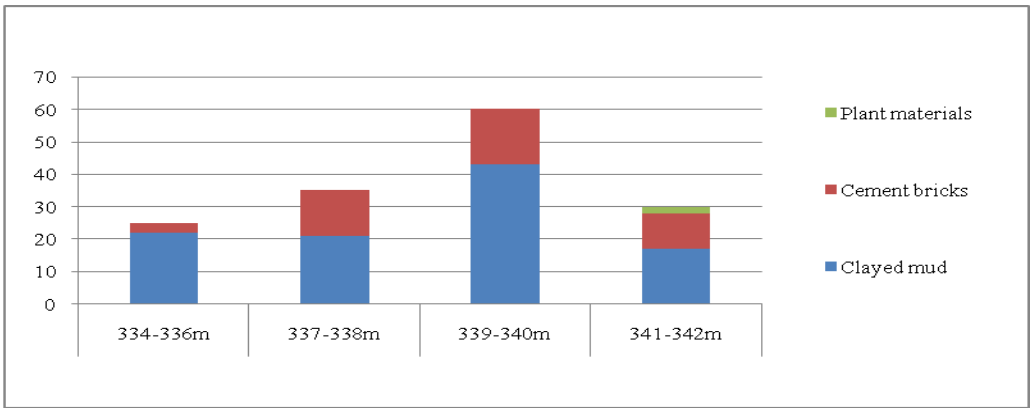
Figure 7: Distribution of types of building materials used per relief zone



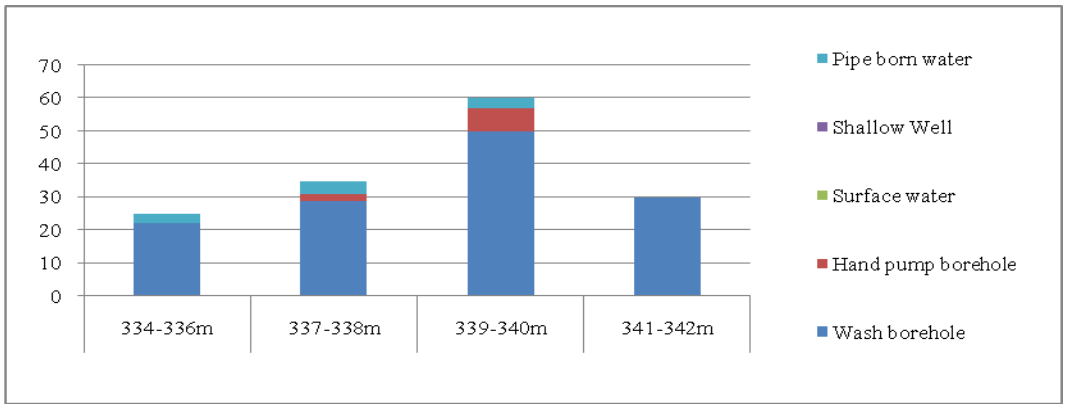
Source: *Primary survey, 2019*

As reported in figure 7 above, the data showed that most common material used for construction within the Gashua town. The result of the analysis showed that clayed mud was the most used across almost all the zones. Interestingly, even areas on lower altitudes that are highly vulnerable to flooding used the clayed materials.

3.3 Domestic water sources and sanitation

However, throughout the Chad Basin region, the whole domestic water resource sources are either from groundwater or surface-water sources. These domestic water sources usually come from various sources such as the spring, shallow or hand-dug wells, hand pump boreholes, piped water supply or water vendors.

Figure 8: Distribution of the region' domestic water source

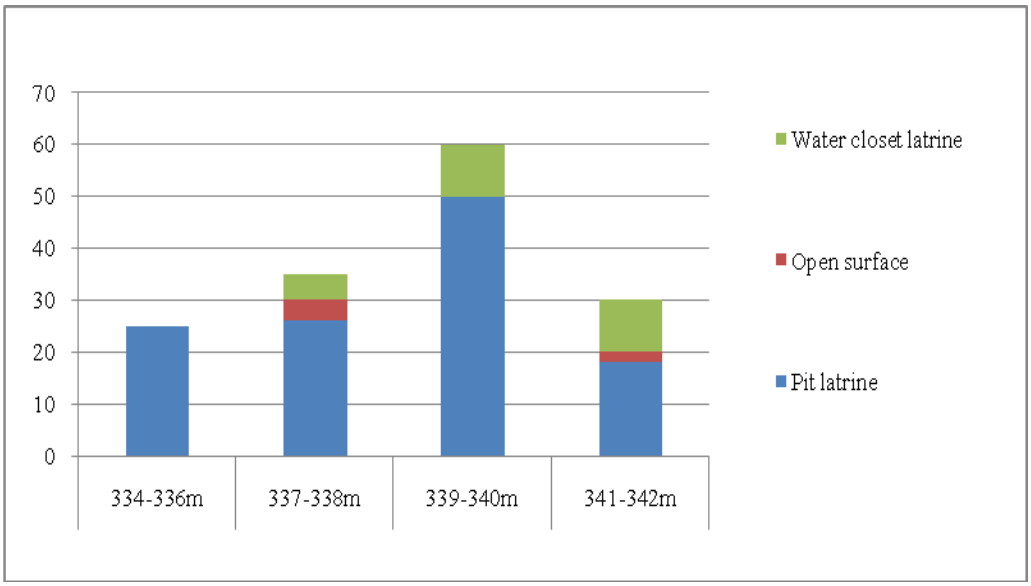


Source: *Primary survey, 2019*

ISBN : 978-81-943584-6-6

The figure 8 showed the distribution of respondents' sources of domestic water. The result showed that the most common source of domestic water resource within this area is wash boreholes that are commonly dug across all the relief zones.

Figure 9: Distribution of toilet system categories



Source: *Primary survey, 2019*

About 79 percent of the respondents use pit latrine toilet system, which usually out flowed and subsequently resulted to contamination during flood and other disasters. Moreover, about 87 percent of the respondents obtain their water for domestic purposes from wash-borehole, therefore, these contaminations poses a lot of health and life threatening danger to humans as well as other living organisms.

3.4 Vulnerability to flood risk

The present also study examined the vulnerability of Gashua and environ to flood disaster through quantification of allied-flood risks and impacts within environmental as well as socioeconomic contexts. These risks and impacts are influenced by either personal or group characteristics in terms of their capacity to anticipate and cope.

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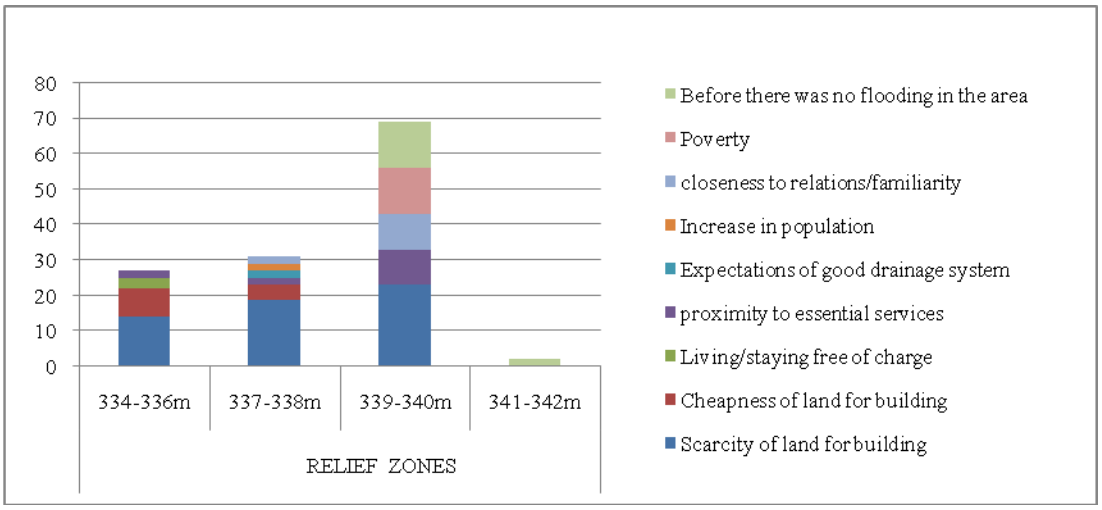
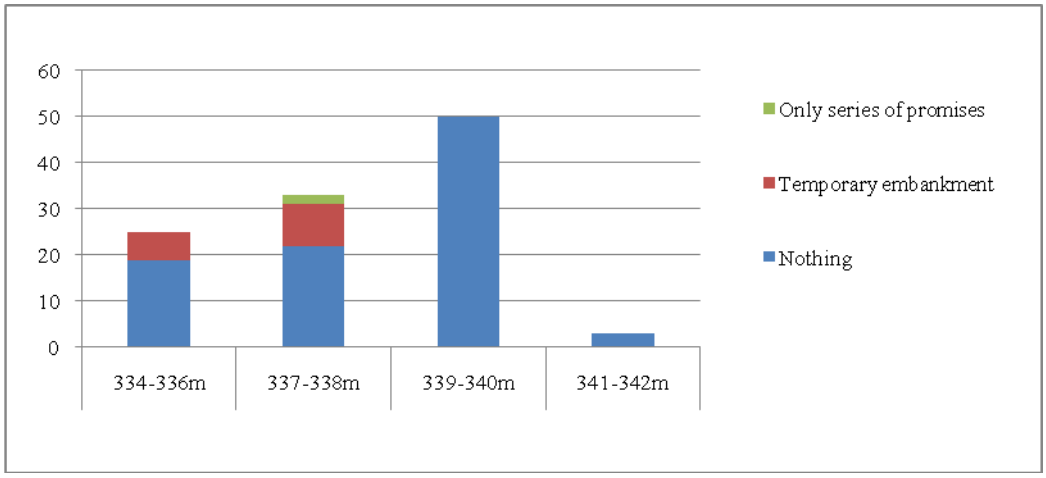
Figure 10: Vulnerability to flood risk and other allied issues



Source: *Primary Survey, 2019*

The figure 10 assesses the vulnerability of Gashua to flood on basis of the region experience on flood, poverty, proximity to basic services and relations, population increase, cheaper land as well as land use pattern. The result showed that land is actually scarce in across the relief zones of Gashua (334-336m, 337-338m and 339-340m above sea level). Moreover, another important issue discovered is that the relief zone "339-340m above is found to be safest zone for human settlement and was followed by altitude 341-342m above sea level.

Figure 11: Distribution of attempts of quenching flood

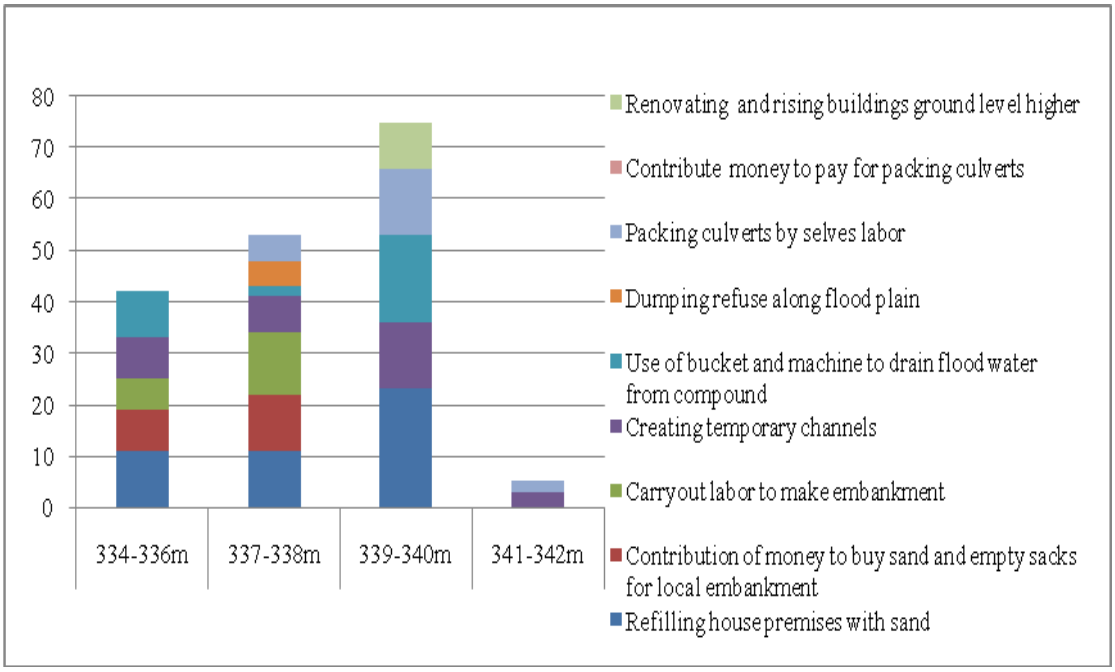


Source: *Primary Survey, 2019*

ISBN : 978-81-943584-6-6

The figure 11 showed concurrent attempts in quenching of flood disaster within this region of Chad Basin. The results showed that though the people of this region occasionally mounts temporary embankments along the flood prone areas, however, this study understand that majority of the people do nothing. This mostly associated with their believed that Government (at mostly state and local level) will come to their rescue.

Figure 12: Management of flood disaster per relief zone



Source: *Primary Survey, 2019*

The figure 12 showed the various techniques used in the management of flood disaster as well as other related issues. The result showed that when flood occurred in this region, use of buckets and other related container to drain water within people premises is the most common technique used. Other popular technique especially within the 334-336m and 337-338m is use of various embankments; such as sand bags and other related materials. However, this region is also found to be less active on precaution measures such as packing of drainage and culvert blockages caused by indiscriminate waste disposal along water ways.

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Figure 13: Pictures of flood impact and various management initiatives

Source: *Primary Survey, 2019*

4. Discussions

It is very common globally that most riverine' communities are found to be easily prone to flood disaster. It was until the year 2012, flood disaster for the first time became a national disaster in Nigeria, and Anambra state was identified as one of the most affected states (Nkeki, 2013). In general, the river floods are caused either by rainfall of extra-tropical or frontal character, as experienced in temperate latitudes, or by large tropical atmospheric depressions with moisture-laden winds, moving from a maritime environment onto and across a land mass (for instance, seasonal monsoons in Asia and line squalls on the west coast of Africa).

Human activities in Gashua general area of Chad Basin have profoundly changed the land. In particular, land use and land management change affect the hydrology that determines flood hazard, water resources (for human and environmental needs) and the transport and dilution of pollutants (Howard & Christopher, 2009). Heavy seasonal rainfall in this region usually causes the soil to be saturated and also the river to overflows that consequently lead to flood disaster. Hence, longer term fluctuations are less recognized phenomenon in this region.

This study understands that there is a serious relationship between relief and occurrence of flooding in the areas; the flood risk vulnerability in the region with exception of only areas located between relief zone 339-342m, almost 100 percent of respondents in other relief zones reported to have been experiencing flood disasters. The study discovered that all areas of Gashua on relief zones of about 334-336m, 337-338m and 339-340m above sea level are highly vulnerable to flood risk almost on annual basis. The early settlers of the Gashua town are mostly living in higher

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altitude relief zones but these areas are mostly not having well connected drainage channels to drained the region' water excesses. Though, the people reported the receipt of allied flood disaster warning, hence, with their respective limited choices, people do ignore these warnings.

The people of Gashua have reported mammoth loss of properties worth millions of naira as well as displacement from impact of flood disaster annually. Thus, these flood disaster effects is largely proportional to altitude as discovered by the present study. Moreover, people also reported that other effects of flooding in the area includes pollution, disease outbreak, loss of lives, distress, hindrance to movement of both vehicles and people. The study also uncovered that both torrential and stream overflow causes flood disaster in Gashua. It was understood that lower relief zones were affected by flood disaster associated with river Yobe while areas at higher relief zones are largely affected by torrential rainfall allied flooding.

One of major issues that were compounding this region allied flood disaster is the inadequacy and inefficiency of the region drainage systems that are associated with blockage. Moreover, the study also comprehended that the declining discharges of river Yobe has significantly enable urban land use to encroach the flood plains, especially at Karambanin Afuno and parts of Takari/Zango residential areas. Various flood Management must be acknowledged within this region. For example, individuals, communities as well as governments are playing various roles in coping with and mitigating the flood disaster and vulnerability in their areas respectively.

At individuals level, residents raised their buildings above the submerge level, sucking the flooded water using pumping machines, while some sand filled the flood plains before erecting their structures. At community level, people dredged drainage channels, digging temporary drainage channels, dumping of refuse along flood plains that serves as soil filling among others. While those living close to river create temporary embankments every rainy season by using soil fill bags, sticks and ropes. Thus, the residents are not satisfied with government and non-governmental efforts in addressing these problems. This study further revealed that streets that have tarred roads and drainage channels are less affected than those without tarred roads and drainage channels. Therefore, quenching of flood in this region must require individual, communal as well as institutional untiring participation.

5. Conclusion

In conclusion, this study concludes that most of the flood disaster around the riverside communities of Chad Basin in Nigeria is product of both riverbank overflow as well as torrential sources which were often accelerated by poor and inefficient drainage systems, construction of houses and building on flood plains in addition to poor urban planning. Moreover, throughout Gashua town, the lowland areas within altitudes 334-336 meters above sea level (such as Filin Tanda pond) are found to be most vulnerable areas to flood risk disaster, where as higher elevated

areas on 339-340m and 341-342m above sea level are the safest areas in terms of any flood disaster; for instance Unguwar Sarki and Kara.

Moreover, areas with poor street layouts and blocked drainage outlets experiences flood disaster almost every rainy season. Therefore, the study suggested various techniques that have the capabilities of mitigating flood disaster within Gashua town. These techniques include regular urban land use expansion suitability analysis, urban renewal to upgrade the sub-standard structures, construction of township wards and efficient drainage channels, introduction of early flood detection and warning centre, modification of homes and businesses to help them withstand floods, increasing spending on flood defense units, restoration of river Yobe courses as well as protection of wetlands through introduction of trees strategically. The findings of this study can be used as flood risk warnings, land use suitability and flood management strategy to both decision makers and the individuals.

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