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ASSESSING THE IMPACTS OF FLOOD ON THE COMMUNITIES IN DUTSIN-MA LOCAL GOVERNMENT AREA, KATSINA STATE, NIGERIA

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ABSTRACT

Floods is one of the most disturbing environmental hazards in Dutsin Ma Local Government Area of Katsina State, Nigeria. The resulting effect is on property loss, economy and the environment. On this basis, this research was carried out to evaluate flood risk areas in Dutsin-ma local government area of Katsina State. a questionnaire survey gathered information regarding flood in the research area. geospatial approaches were used to obtain Satellite imagery of 2020 from United States Geological Survey (USGS) Google Earth platform. Multi Criteria Evaluation approach was used to develop flood risk-vulnerability map for the Dutsin-Ma. Findings from this study shows that 19% of the respondents believed that relocating people to higher grounds is the best way to mitigate the impact of flood, about 22.8% of the respondents believed that construction and maintenance of new drainages is a good option. Result for vulnerability assessment shows that Makera South, Makera North, Garhi East, Garhi West, Sakarya, Kitibawa, Gandi and Makwanta are identified as very high-risk areas. Other high-risk areas include Gidan Gamawa, Garin Mallam, Koranwaya, Wawaye, Zaki, Dage, Taka, Korafawa, Unguwan Nassarawa, Gago, Mawashi and Karki. The study recommended that Distribution of adequate relief materials and public enlightenment would assist to reduce the impact of in the study area. Result of this study can be beneficial to relevant professional bodies and agencies such as town planners, land use land cover planners, emergency, and contingency planners and the general public for control and management of flood.

Keywords: Flood, Flood risk, Multi-criteria evaluation, GIS

INTRODUCTION

Flood disaster is not a recent phenomenon in Dutsin ma because it has social, economic, and health implications on the entire environment, which is both the social and biophysical environment. People in the Local Government have been experiencing sometimes enormous its destructive tendencies. Flood disasters in the Dutsin ma Local Government have devastated infrastructure like as roads and bridges, as well as claiming lives and causing degradation of land such as gully and sheet erosion, landslides, water quality deterioration, and changes in land use It is also documented to affect the health condition of residents, trade and business activities and education among many others (Adeloye, and Rustum, 2011). Anthropogenic activities such as settlements and infrastructure construction have serious impacts on the environment, especially their impact on land use change in the areas of those settlements and infrastructure and even the neighboring communities and the whole region among others (Wheater and Evans, 2019). Land use change is one of the main drivers of flood events, biodiversity loss as well as habitat loss (Marmula, 2011).

Anthropogenic land use changes can also bring about loss of agricultural lands, can result to land degradation such as reduced soil fertility, sheet and gully erosion, loss of forest and vegetation cover which can also result to increase in the rate of erosion, desertification, loss of ecosystem services, loss of wetlands which are important ecosystems, loss of soil nutrients, loss of native species including medical herbs and shrubs (Aboud, 2002).

Flood events account for roughly 90% of natural hazards that cause damage in the Dutsin ma (Adeloye, and Rustum, 2011). Floods in the Dutsin Ma have become a common and recurring occurrence, wreaking havoc on livelihoods and infrastructural development, particularly in agricultural lands near the Zobe irrigation project site. Unfortunately, some people are affected more than others, particularly in villages such as Shema, Kagara, and Kuki, as well as in the main Dutsin Ma town, in such a way that recovery is improbable without external assistance. Both the main town of Dutsin Ma and the villages have experienced catastrophic flooding at various times, resulting in the loss of life and the ruin of property and infrastructure.

Because of the devastating nature of floods, there is an urgent need for adequate flood research, which is currently lacking in the developing world, particularly in Africa, as well as adequate funding for flood control and flood management infrastructure, early warning systems, and public education about floods and their destructive tendencies, as well as mitigation measures to address the problem (Sumit, 2018). As a result, there is a critical need for adequate flood information to assist policymakers in making the best decisions and selecting the best options.

Umar and Muazu (2017) investigated community perceptions of flood hazard and adaptation techniques in Hayin Gada, in the Dutsin Ma Local Government Area. Flood and Climate Variability and Change, Impacts Strategies in Dutsina Ma Local Government Area were explored in another research, such as Abaje (2015). Zakaria (2020) investigated flood risks prevalence in a few key areas in Dutsina, Dutsin Ma Local Government Area. All of this research was restricted to a narrow area of Dutsin Ma or its environs. Some previous researchers ignored the significant role played by land use change and pay little attention to the

impact of flooding on the natural and built environment, but this study covers the entire Local Government Area and considers a variety of factors that influence flood risk.

MATERIALS AND METHODS

Study Area

Dutsin-Ma local government is located at latitude 12°27'N and 12.46°45'N and longitude 7°29'E and 7° 49'E of the meridian (see Figure 1). It is located in south of the state capital Katsina. It shares common boundary with kurfi local government in the north, Charanchi local government in the northeast, Kankia local government in the east, Matazu local government by the south and Dan Musa local government the west (Sagir, 2015).

The LGA has an area of 527 km². Dutsin ma local government forms part of the extensive plains of the Hausa land, plains generally rise gently to 600m sea level. The drainage system of the study areas is characterized by rivers that are generally seasonal in nature, containing water in their channel during the rainy season and has little or no water in the dry season.

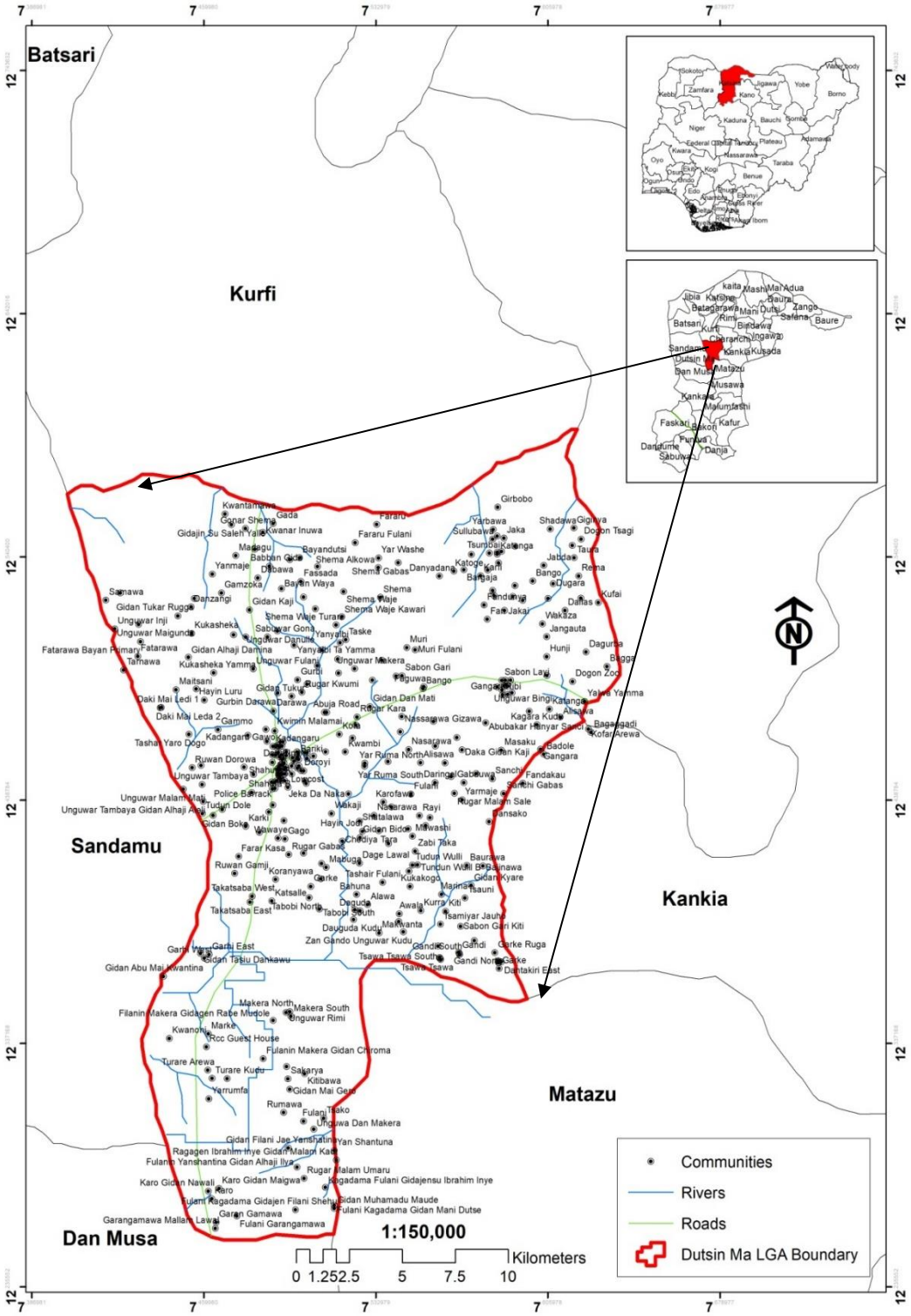

Figure 1: Map of Dutsin-Ma LGA

The annual total rainfall ranges between 500.38mm to 1199mm, and while the dry season is mostly from November to April. The region experiences relatively cool weather from November to March with daily maximum 24°C - 33°C and minimum of 16°C – 24°C. The relative humidity hardly goes beyond 20- 25% but in some cases, during the dry season in years with very low rainfall diurnal values may fall to as low as 10%. But in the wet season it goes to over60%. (Misam, 2007). The LGA has a population of 169,671 at the 2006 census (NPC, 2006).

Sources of Data

For this study, geospatial approaches were employed, with secondary datasets being the most common, as well as a questionnaire survey and interviews. The Multi Criteria Evaluation approach was chosen due to its importance, particularly in investigating land allocation and breaking it down into parts in order to understand flood risk problems and make a decision. The permission facilitates the integration of diverse datasets for the purpose of creating a flood risk-vulnerability map for the Dutsin-Ma. The following secondary data provided a larger basis for the study:

2020 Satellite imagery: downloaded from United States Geological Survey (USGS) Google Earth platform

DEM: acquired from elevation data downloaded collected from the NASA Shuttle `Radar Topographic Mission (SRTM).

Slope and elevation map: processed from the DEM

Rainfall data: Famine Early Warning Systems Network (FEWS NET/ USGS CHIRPS) and UN Climate Research Unit (CRU)

LGA boundary and communities: acquired from the Katsina State Urban Planning and Development Authority.

Water bodies Shapefiles and roads: digitized from the satellite imagery.

Soil map: soil data obtained from the Food and Agriculture Organization (FAO) Harmonized World Soil Database (Zanuwa, Abdulmumini and Abdulkadir, 2018).

Questionnaire Analysis: Having gathered the data through the administration of questionnaires, the collected data were coded, tabulated, and analyzed according to the research questions and objectives. The data were analyzed statistically using SPSS (Statistical Package for Social Sciences) version 23, and the simple percentage method was the major analytical tools used for this research project.

During the reconnaissance survey, a map of the entire Study Area was used to choose the sample for administering the questionnaire, with regions with frequent floods given special priority using information from villages and ward chiefs. The National Population Commission provided the population density map. The 400 respondents were chosen using a cluster random sampling method based on the sample size computed using Chochran's algorithm for sample size computation. Individuals were then chosen at random using a two-stage systematic random sampling procedure.

Impact of Flooding in the Study Area

Table 1: Respondents Socio-demographics

Socio-Demography	Options	Frequency	Percentage
Gender	Male	281	70.3
	Female	119	29.8
	Total	**400**	**100.0**
Age	1- 19 years	29	7.3
	20 - 39 years	99	24.8
	40 - 59 years	182	45.5
	60 - 79 years	56	14.0
	above 79	34	8.5
	Total	**400**	**100.0**
Occupation	Student	131	32.8
	Civil Servant	76	19.0
	Farmer	66	16.5
	Trader	92	23.0
	Other	35	8.8
	Total	**400**	**100.0**
Time of Stay in the Community	< 1 year	16	4.0
	1 - 10 years	42	10.5
	11 - 20 years	68	17.0
	21 - 30 years	89	22.3
	Above 30 years	185	46.3
	Total	**400**	**100.0**

Source: Author (2020)

The result on Table 1 shows that majority of the respondents that took part in the survey are male 281(70.3%), between 40 – 49 years 182(45.5%), students 131(32.8%) and have stayed in the community for more than 30 years 85(46.3%).

Impact of Flood on Health

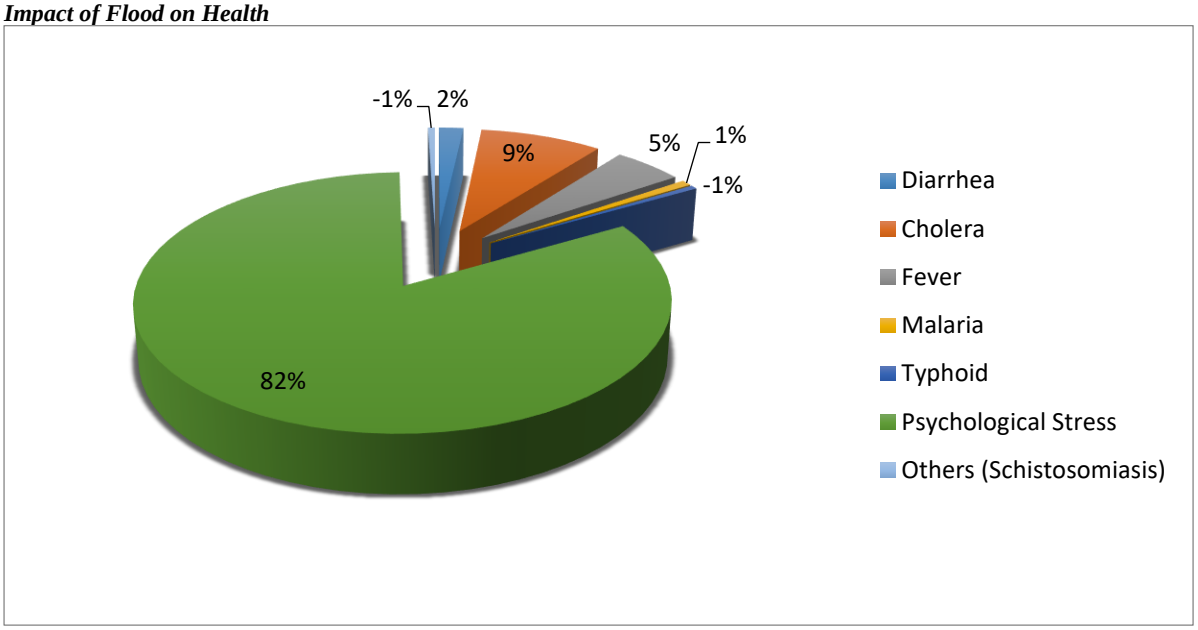

Figure 2: Impact of flood on health
Source: Author (2020)

Flooding has complicated health effects that are hard to directly link to the actual flood occurrence. The primary health consequences during and after the flood event are generally deaths, injuries such sprains, water-borne infections, and mental health disorders. Of the 400 participants, Figure 2 indicates 82% reported there was serious psychological stress, 9% cholera, 1% represents cases of typhoid, 0.5% stated malaria, 2% stated diarrhea while 5% stated fever and the remaining 0.5% stated others like (Schistosomiasis). The results of the study align with that of Alderman et al. (2012), who found that psychological distress has a prevalence of 8.6% to 53% and can persist for up to two years following a flood disaster. Furthermore, Louw et al. (2019) found in their study that stagnant and contaminated drinking water following a flood causes outbreaks of diarrhea, malaria, and typhoid fever.

Impact of Flood on Structures

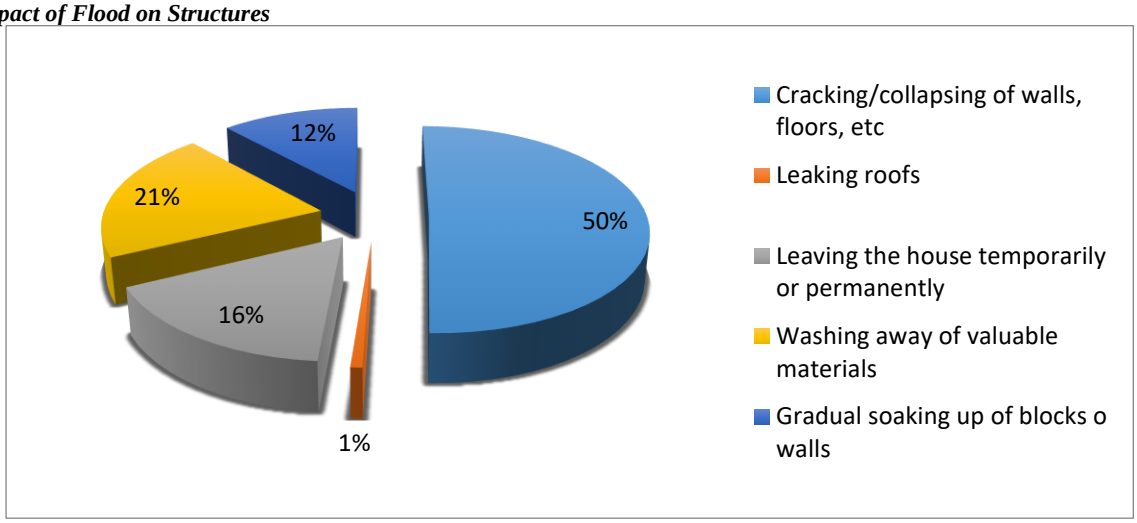

Figure 3: Sources of water affected by the floods
Source: Author (2020)

A portion of 50% of the respondents' homes collapsed or caved in as a result of the floods, as seen in Figure 3, which depicts the destructive impacts of floods on buildings and structures in the study area. 1% of the respondents reported having substantial damage to their homes, however several reported losing windows or doors and having damage to their structures' roofs. When the floods started, 16.0% of the respondents were forced to relocate, either temporarily or permanently, while the majority were not. 21% indicated washing away of valuable materials, gradual soaking up of blocks or walls, while 12% indicated gradual soaking up of blocks of walls. The outcome coincides with Oruonye's (2012) analysis of the losses and damages resulting from Taraba State's two major extreme flood events (August 7, 2005, and August 14, 2011), which found that 455 houses were partially affected by leaky roofs, structural cracks, and other issues, and that over 307 houses were completely destroyed.

Impact of Flood on Water

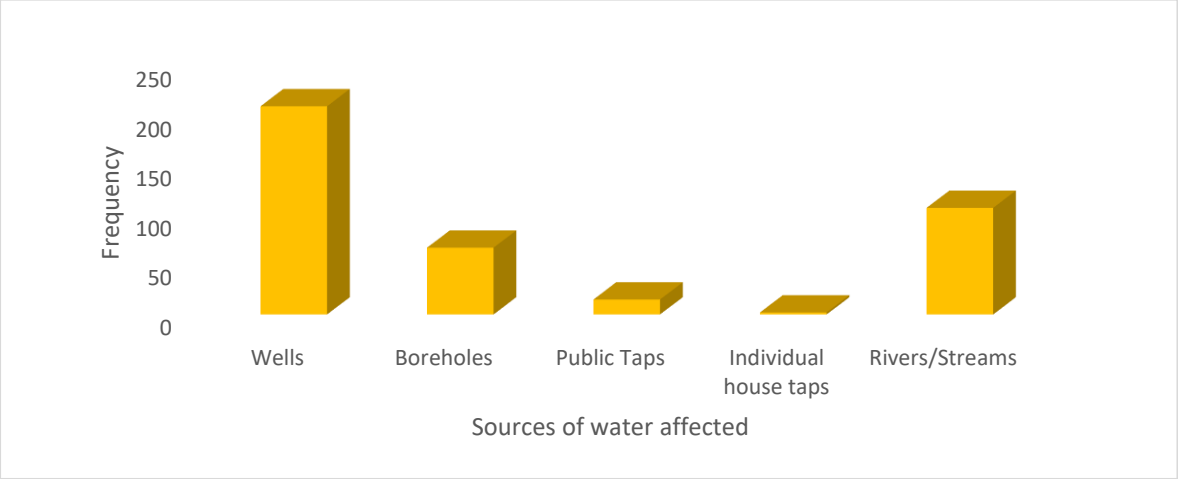

Figure 4: Source of water facilities got affected by the flood
Source: Author (2020)

Plate I: Sources of Water affected

Plate II: Sources of Water affected

All water sources are impacted by floods when they happen, according to the respondents. Open and closed wells are the water sources most impacted by floods as stated by 52.3% of respondents. On the other hand, 16.8% of respondents, or 67 out of the total, stated that they were using boreholes (Figure 4), 3.8% representing 15 of the respondents stated public taps, 0.5% representing 2 of the respondents stated individual house taps and 26.8% representing 107 of the respondent's stated rivers/streams. A typical view on how flood affect water sanitation is shown in Plate I and Plate II. The findings are in agreement with that of Oruonye (2012), where after flooding, the flood entirely buried and contaminated the boreholes utilized for water supply in the study region. The contamination of the wells and boreholes caused the municipal water supply to be cut off for more than two weeks.

Effects of floods on trade/business

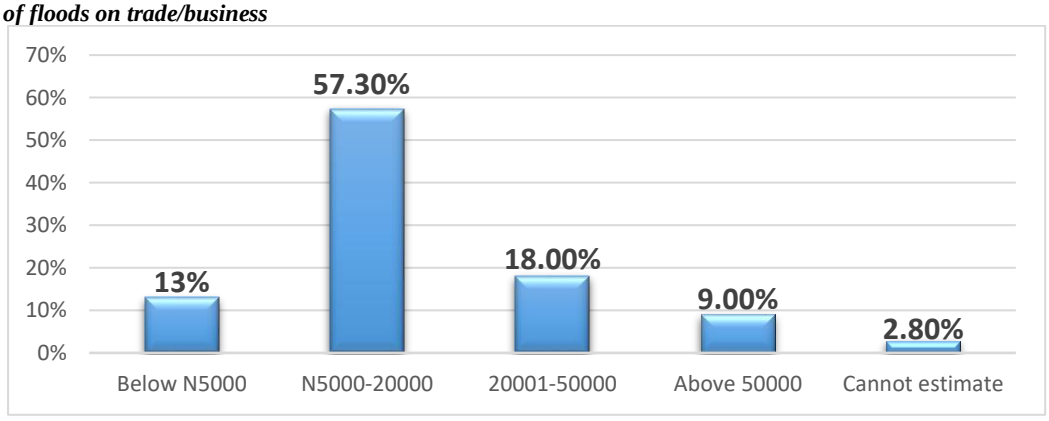

Figure 5: Effects of flooding on income
Source: Author (2020)

A total of 400 respondents who ran businesses or traded in the neighborhood provided an estimate of the money and revenue they believed they had lost as a result of the annual flooding in the area, as shown in Figure 5. The estimate was given by 57.3% as being between ₦5,000 and ₦ 20,000, 18% indicated between ₦ 20000-50000, 13% Stated below ₦ 5000, 9% Stated above ₦ 50000 whiles 2.8% could not clearly estimate the cost.

Effects of flood on trade and business

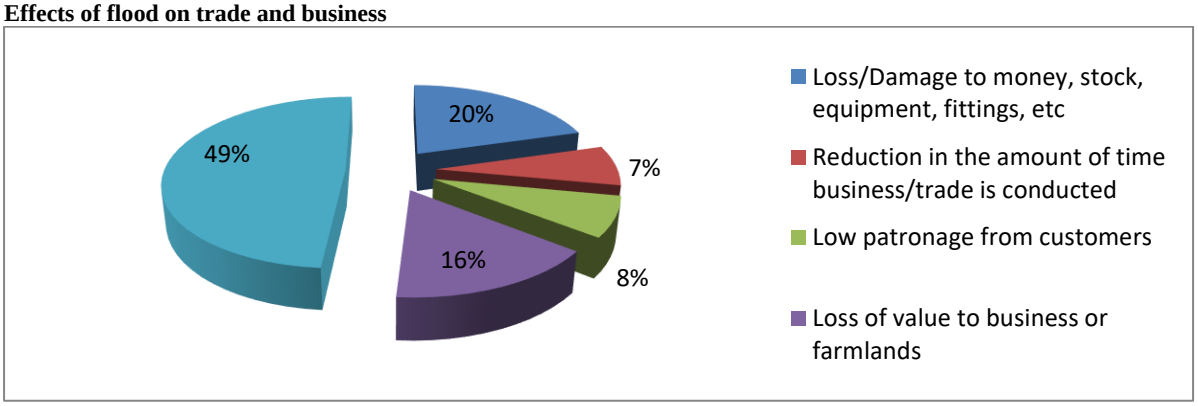

Figure 6: Effects of flood on trade and business
Source: Author (2020)

Plate III: Effects of Flood on Trade and Business

As seen by the results for Figure 6, respondents were also questioned about how floods affected the community's commerce and business operations, as seen in the above table. 20% of respondents reported loss or damage to buildings, money, stock, equipment, fittings, etc. In contrast, 7% reported a reduction in the amount of time that business or trade is conducted; 8% reported low customer patronage; 16% reported loss of value to business or farmlands; and 49.0% reported that shops and trade sites are temporarily closed when flooding occurs. According to other business owners, floodwaters completely or partially submerged their buildings and premises. A lot of them also experienced equipment and stock issues. Floods cause disruptions to routine company operations and working hours. Forcible company closures have an impact on certain businesses, which results in lost sales. Certain businesses experienced an indirect impact from the floods as a result of their clients, suppliers, and staff all being hit. Additionally, the media and locals have a bad impression of some parts of the town that are frequently hit by floods. The belief that all businesses are affected when flooding strikes in a region where histories of flooding exist drives away customers. This results in reduced business patronage, particularly during the wet season. The outcome corresponds with the research conducted by Adeloye & Rustum (2011), which found that floods can disrupt social services and commercial operations, potentially severely harming the local economy. Tawari & Abowei (2012) also reaffirmed that floods can result in the loss of valuable goods and the forced relocation of people from their homes and places of business. Lastly, according to a study by Solaja and Soyewo (2015), flooding accounts for 10.9% of the overall variation in business and population displacement. As seen in Plate III, floodwater pouring into the buildings not only weakens the building foundation over time but also ruins all the goods and equipment inside the stores. The flooded paths make it difficult for residents to commute to and from work. Time, money, and labor are among the resources needed to repair the damage caused by floods.

Flood Management

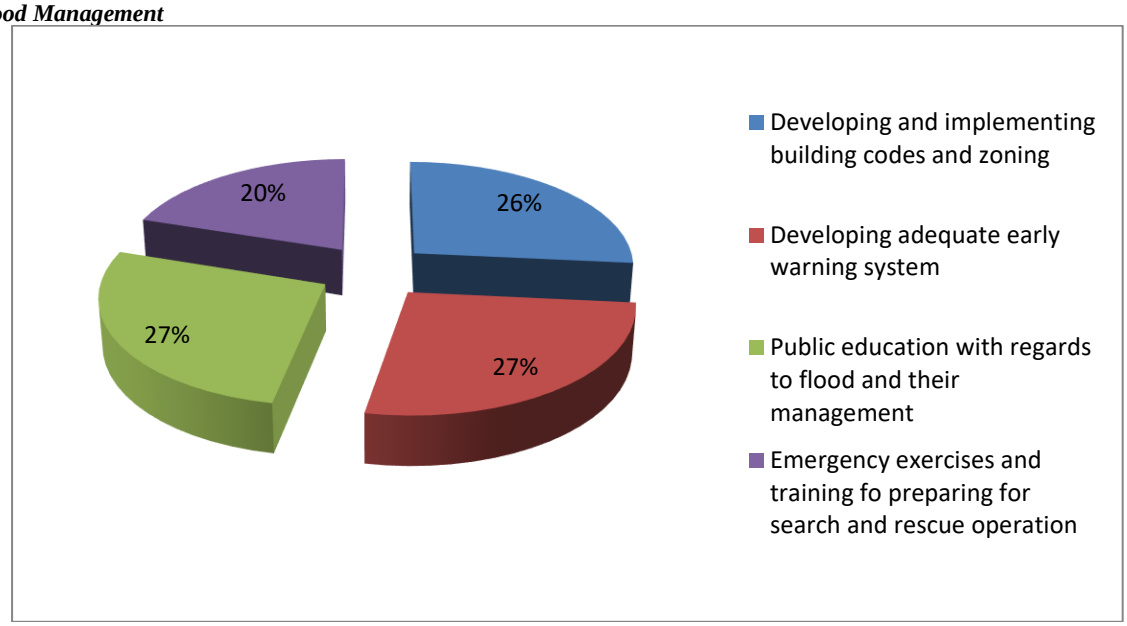

Figure 7: Mitigation Strategies
Source: Author (2020)

As a consequence of the floods, 26% of the respondents recommended creating and enforcing zoning and building standards, according to the results from Figure 7. Developing a sufficient early warning system was stated by 27% of the respondents. Twenty percent of respondents mentioned emergency drills and training to get ready for search and rescue operations, whilst 27% mentioned public education on floods and how to manage them. The research area's flood management might make use of the findings presented in Figure 7.

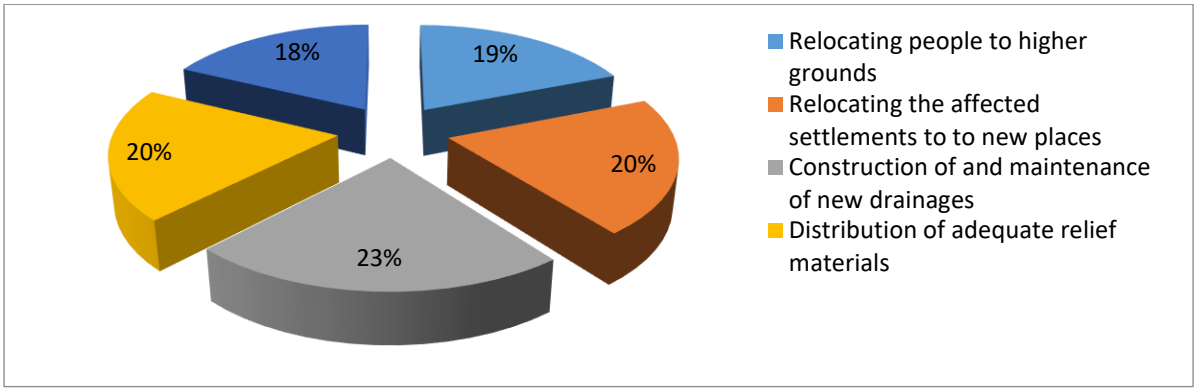

Figure 8: Approaches to flood prevention
Source: Author (2020)

Result presented in Figure 8 shows that 19% of the respondents had suggested relocating people to higher grounds as a result of the floods. 20% of the respondents said relocating the affected settlements to new places to affected victims, 23% stated construction of and maintenance of new drainages, 20% stated distribution of adequate relief materials while the remaining 18% indicated public enlightenment on flood and flood management. These results agree with those of Obeta (2014), who came to the conclusion that early warning systems and flood forecasts, prevention through smart urban design, evaluation of the extent of floods, rescue and evacuation, provision of relief, post-flood impact assessment, recovery, and rehabilitation is all necessary for effective flood management. Ajayi et al. (2012) recommended raising public awareness and sensitization to the true risks of flooding and reviewing current laws and regulations on the delimitation of setbacks to comply with the rivers' natural flood plain. Akintola and Ikwuyatum (2012) similarly stated in their study that a preparedness plan consists of phases covering pre-flood and post-flood disaster activities; the former includes prevention, preparedness and mitigation while the latter consists of emergency response (rescue and relief), rehabilitation, and recovery (reconstructions).

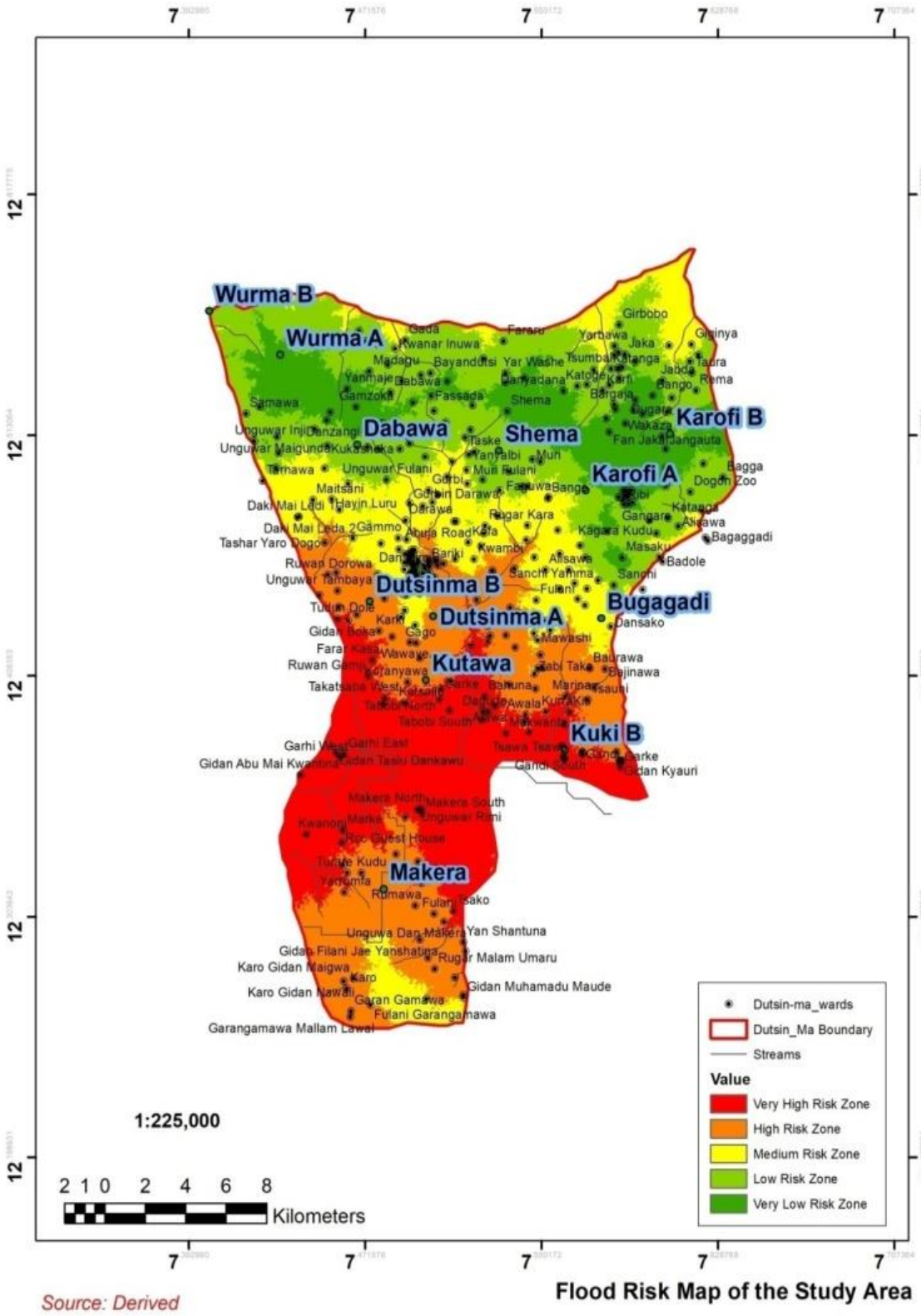

Figure 9: Flood Risk Map of Dutsin Ma LGA

Thematic Layer	Index Values	Rank	Evaluation	Area in Hectares	Area in %
Land Cover	Built Up Land	5	Very High-Risk Zones	516.12	0.98
	Continuous Cropland	4	High Risk Zones	7612.32	14.45
	Fallow lands / Pasture	3	Moderate Risk Zones	15773.37	29.95

Cultivated lands with trees and shrubs	2	Low Risk Zones	26601.91	50.51
Water Bodies	1	Very Low Risk Zones	2162.34	4.11
			52666.06	**100.00**

CONCLUSION

The communities that are at very high risk of flood are Makera South, Makera North, Garhi East, Garhi West, Sakarya, Kitibawa, Gandi and Makwanta occupying 516.12 Ha (0.98%) in Dutsin-ma, while the communities at high risk are Gidan Gamawa, Garin Mallam, Koranwaya, Wawaye, Gago, Zaki, Dage, Taka, Mabuga, Korafawa, Unguwan Nassarawa, Gago, Mawashi and Karki occupy 7612.32 Ha (14.45%) from the study, it was revealed that flood affects the respondent's health, water, means of livelihood, farming, and infrastructure. The results of this and related studies must be distributed to the end user, which include land use planners, stakeholders, emergency and contingency planners, and members of the community. By locating possible and targeted flood zones, escape routes, infrastructure associated to disasters, and the most effective flood mitigation techniques, this would help with flood planning. The results of this study demonstrate that the ability to use spatial data more effectively, coherently, and efficiently is advocated by disaster management. The flood risk map created by this study takes into account the effects of several factors. The causes of floods extend beyond hydrological features; therefore, a little period of precipitation data might not be enough to provide an effective graphic. However, the response of the ground surface is integrated. Some of the places receive very little rainfall but are nevertheless at risk because of the overall features of the ground cover and land use in those areas, as well as the kind of soil, drainage network characteristics, and slope nature. The methodology employed in this study has the advantage of being adaptable, provided that the required data is accessible.

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