IMPACTS OF FLOOD IN MANTA AND GALADIMA KOGO COMMUNITIES, SHIRORO LOCAL GOVERNMENT AREA, NIGER STATE, NIGERIA

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ABSTRACT

Flooding is a catastrophic hydro-climatological disaster causing destruction to thousands vulnerable communities worldwide. The aim of this study was to examine the causes of flood in Manta and Galadima Kogo communities, Shiroro Local Government Area, Niger State, Nigeria. The study adopted purposive sampling techniques in which two communities (Manta and Galadima Kogo) located in the flood prone area were selected for investigation through the application of Taro Yamane formula with 0.05 degree of freedom. A total of 400 questionnaires were administered to the respondents, and 34 years rainfall data were generated from Era5website. The data were subjected to statistical analysis using SPSS version 20.0 software. Results revealed that; an overflow from dam, heavy rainfall, human activities such as farming along the river banks and the flood plain scored 3.54, 3.27, and 3.12 respectively, and this contribute extremely to flooding in the study area, while inadequate vegetation cover and deforestation along the river banks had scored 2.51 and were regarded less serious contributing factors to flood occurrence in the study area. Destructions of crops and displacement of people were the major impacts of floods in the study area with Mean Score of 4.07 and 3.31 respectively. The study concludes that an overflow from dam, heavy rainfall and human activities such as farming along the river banks contribute extremely to flooding in the study area. The study therefore, recommends adoption of early warning system and flood forecasting for more effective mitigation strategies to flood disaster in the study area.

Keywords: Causes of flood, Manta, Galadima Kogo, Shiroro LGA, Communities

1.0 INTRODUCTION

Natural and human induced disasters and are occurring and becoming more frequents in recent times. Flood has being amongst the top ranked of this disasters causing havoc to communities where it is occurring. Ghosh and Ghosa (2020) observed that flood is occurring at an alarming rate. The major cause of flooding has been attributed to heavy precipitation for longer period, or precipitation with high intensity within short period of times leading to high runoff in rivers or on regions of low relief where build-up of surface water can occur (Alam *et al.,* 2020).

Deforestation of forests, drainage of wetlands, and urbanization are the main causes of rapid increase within the flow of rivers, giving rise to floods (Du, *et al.,* 2020). Construction of reservoir, additionally to changing river flow regime also can trigger a diversity of other negative consequences that promote flooding (Gumma *et al.*, 2020; Bule Hora and Hora, 2020).

According to Alfieri *et al*. (2017) current projections of the frequency of severe floods from large rivers is expected to increase consistently over the next years.

Flooding can be caused by variety of factors which include natural to man-made factors. The natural factors comprises of river overflow as a result of prolonged seasonal rainfall, rainstorm, snowmelt, dam-breaks, accumulation of rainwater in low-lying areas with a high water table, or inadequate storm drainage (Cirella *et al*. 2019). Principal causes of flood is the abnormal shift or statistical variations in the condition of weather combined with anthropogenic activities which give rise to changes in its phenomenon over time such as high or low precipitation, intense temperature among others. These changes could be in decreasing or increasing form which is referred to as climate change (Kysar, 2011).

According to Aderogba (2012), in Nigeria, flood accounts for the highest occurring natural hazards, with great consequences on the life and property. In Nigeria, flood is becoming yearly trend; which occurs in the form of river flood, coastal flood, flash floods and urban flood. Many states and cities have witnessed unusual and devastating flood disasters in the last few decades, undermining the government's capability to prevent such disasters (Aderogba, 2012).

Floods are among the most recurring and devastating natural hazards, impacting negatively on human lives and causing severe economic damage throughout the world (Salazar-Briones *et al*., 2020).

2.0 MATERIALS AND METHOD

The study area is located on a geographical coordinates between latitude 9° 58′ 00″ N to 9° 65′ 25″North and longitude 6° 51′ 00″ E to 6° 75′ 10″ East with a total land area of about 5,015km^2 and it has an elevation of about 500 meters above sea level, downstream of river Kaduna in Niger State

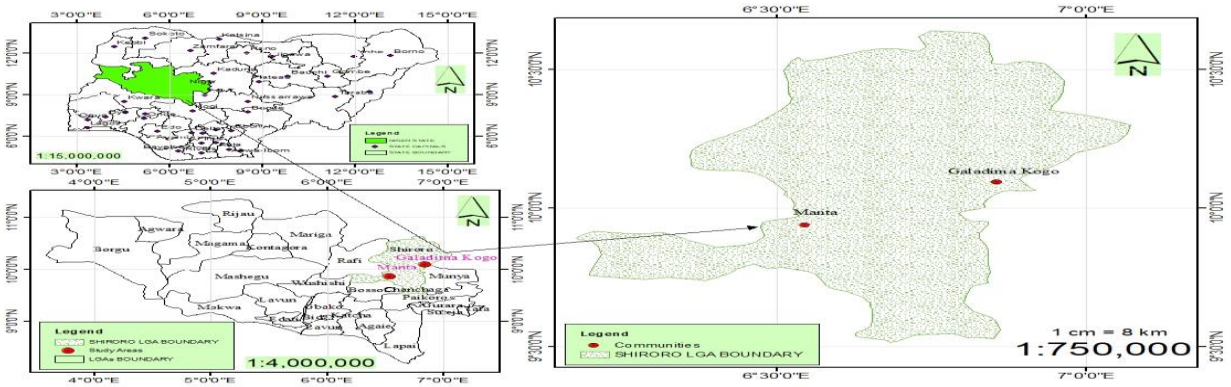

Figure 2: The Study Area (Manta and Galadima Kogo, Shiroro LGA, Niger State, Nigeria) Source: Department of Geography (Remote Sensing Unit) FUT Minna

The study adopted purposive sampling techniques in which two communities (Manta and Galadima Kogo) located in the flood prone area were selected for investigation through the application of Taro Yamane formula with 0.05 degree of freedom. A sample frame of inhabitants of the study area was generated from the projection of population from National population Commission (NPC) 2006 census figure of the study area by applying Taro Yamane formula adopted from (Du, *et al.,* 2020) with 0.05 degree of freedom. The projected population using the growth rate of 2.5% per annum was put at 269,482 people. Household heads, chiefs, women leaders, youth leaders and other leaders of organized groups were sampled for investigation.

The Taro Yamane formula is presented as follows;

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = Projected population sample size, N = Total size of projected population

1 = Constant, e = Error degree of tolerance 0.05, N= Total projected population of communities.

Population and Sampling Procedure

Where: n = Sample size, N = Size of Population, 1 = Constant, e = Error degree of tolerance 0.05

Therefore, $n = \frac{269{,}482}{1 + 269{,}482(0.05)^2}$

n = 400 respondents

Questionnaire administered to the respondents were analyzed using SPSS and presented on table and charts.

The causes of flood in the study area were measured using 5 point likert scale: 5=Strongly Agree, 4=Agree, 3= Intermediate, 2= Disagree, 1=Strongly Disagree. The decision line; Mean Score (MS) greater or equal to three (MS≥3) were major causes of flood in the study area, and Mean Score less than three (MS<3) were not major causes of flood in the study area.

Responses acquired from the questionnaire in respects to the community's mode of impacts of flooding and coping strategies to flood occurrence in the study area were also analyzed statistically using descriptive statistics, frequency and percentage which were presented in tables and charts.

3.0 RESULTS AND DISCUSSION

3.1 Causes of flood in the study area

The results of causes of flood in the study area revealed that; an overflow from dam, heavy rainfall, human activities such as farming along the river banks and the flood plain scored 3.54, 3.27, and 3.12 respectively as shown in Table 3.1.

Table 3.1: Causes of Flood in the Study Area

Causes of Flood	*5	4	3	2	1	MS
Overflow from Dam	66	38	48	91	144	3.54
Heavy Rainfall	68	70	43	102	104	3.27
Building/Farming Activities on floodplain	66	78	57	103	83	3.15
Low Vegetation Cover/Deforestation Along River Banks	85	151	63	46	42	2.51

Note: *5=Strongly agree, 4=Agree, 3=Intermediate, 2= Disagree, 1=Strongly disagree, MS=Mean Score

This contribute extremely to flooding in the study area, while inadequate vegetation cover and deforestation along the river banks had scored 2.51 and were regarded less serious contributing factors to flood occurrence in the study area.

The communities under study are rural communities and residing on vulnerable flood plain areas which made them highly susceptible to flood disasters as they exhibit low level of mitigation and adaptation strategies due to various factors such as low level of education and awareness on mitigating flood events, This results agreed with the finding of Zekouda *et al*. (2020) who observed that human impacts and climate variability likely constitute the main factors causing increasing or decreasing flood trends.

3.2 Trend in climatic parameter (Rainfall) in the study area

Annual rainfall distribution over the years in the study area has not been uniform. This is apparent in Figure 3.1, showing the variability which characterized annual rainfall distribution in the study area over a 34 years' period (1990-2023). Extreme values as shown in figure 3.1 were recorded in 2007, 2009, 2013, and 2020, at 1195.77mm, 1303.42 mm, 1200.01 mm, and 1210.90mm, respectively. This is an indication of high precipitation across the years. While in 1992, 1994, and 2002, low rainfall were recorded which are 948.78 mm 945.55 mm, and 713.81 mm, respectively, the lowest rainfall was however recorded in 2002 with a total of 713.81 mm.

The annual rainfall was nearly uniform in the year 1990-1999 oscillating around 950 mm, while in 2000 and 2001, there was an increase in the amount of annual rainfall above 1100 mm and then followed by a sharp decrease in 2002 to 713.81 mm. Between 2003-2023 the annual rainfall have being fluctuating and above 1000 mm as shown in figure 3.1

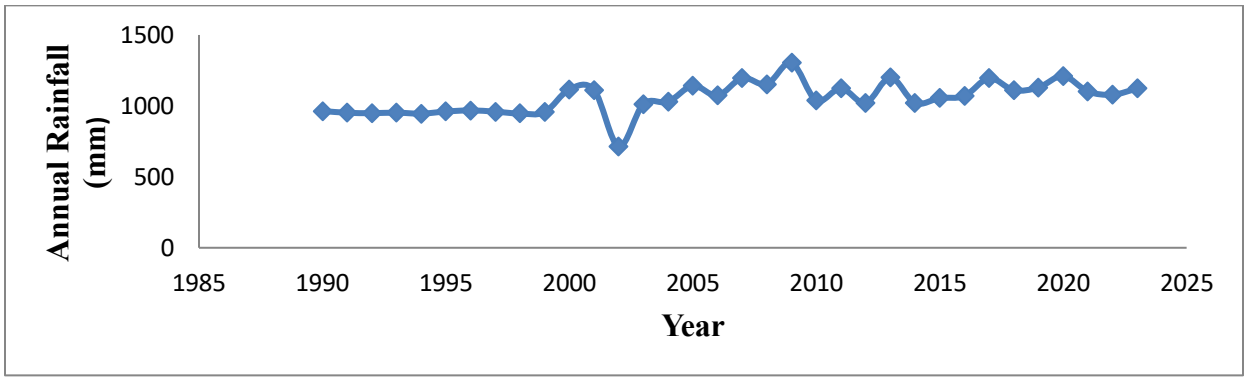

Figure 3.1: Annual Rainfall from 1990 to 2023
Source: Author's Analysis, 2023

The yearly variation in the amount of annual rainfall likely contributes to flood disasters in the study area. Rainfall variability in the study area contributes directly or indirectly to flood. However, the flooding in the communities do not really depends on the yearly annual rainfall as there could be positive trend in annual rainfall without necessarily leading to flood occurrence. However when the intensity of the precipitation is high and occurring for consecutive days, results to streams, rivers and dams to swell-up which increases the possibility of flood occurrence. In some cases, releasing of waters from dams are the major contributing factors to flooding in the study area which is in agreement with report of NEMA, (2020).

The mean annual rainfall variation in the study area from 1990-2023

The mean annual rainfall variation in the study area is shown in Figure 3.2, using Rainfall Anomalies Index (RAI) which revealed that in the year 2007, 2009, 2013, 2017, and 2020 have extreme positive mean annual RAI in the study area over the years under study. The high intensity rainfall usually results to flooding in vulnerable communities in the study area. The

negative mean annual RAI was recorded from 1990 to 1999, and 2002. However, irrespective of the negative RAI in the study area, flooding do also occur either due to the releasing or opening of the Shiroro dams to reduce excess water in the dam. However, the negatives anomalies indicate in some cases, indicates dry spell over the study area as shown in figure 3.2.

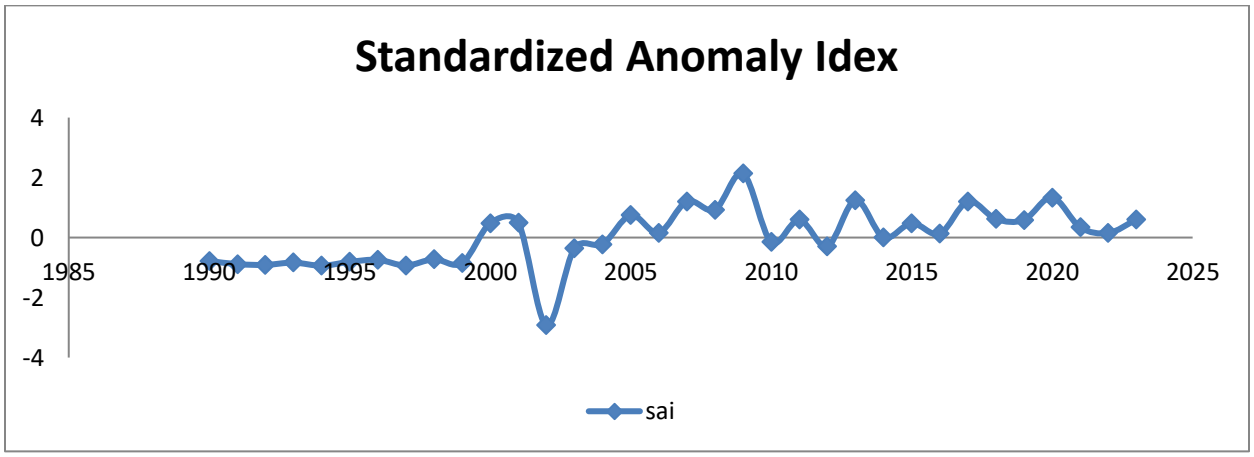

Figure 3.2: Mean Annual Rainfall of the Study Area
Source: Author's Analysis, 2023

3.3 Some significant events of flood that occurred in the study area

River Kaduna which passes through the study area primarily overflowed its banks as a result of heavy rainfall. However, the secondary cause was identified to be as a result of the opening of the Shiroro hydroelectric dam to release excess accumulated water due to heavy rainfall. In the year 1995, 1999, 2003, 2007, 2010, 2012, 2016 and 2019, flood events were attributed to the opening of the dam spillways to release excess water in the reservoir as a result of heavy rainfall, while in the year 2006, 2018, 2020 flood events were primarily due to the heavy rainfall in the study area. The floods events mainly occurred between month of August and September, when most parts of the study area received high intensity of rainfall which is usually torrential. This result is in agreement with Nigeria Hydrological Services Agency (NIHSA, 2023) Annual Flood Outlook (AFO) which identified and captured the study area amongst highly probable risk areas to 2022, 2020 floods, and previous flood events in 2018 and 2019. The results have been

validated using the daily rainfall data within which the flood events occurred or due to released water from dam.

The rainfall in (mm) within four days for the month of August 2019 was highly recorded at 37.32mm, 41.37mm to 41.94mm on the 18th, 19th and 21st respectively which was attributed to soil field capacity been attained. Equally, in 2020, in the month of September, heavy precipitation was recorded three times within five days of 21st, 23rd and 25th at 33.40mm, 28.51mm and 47.42mm respectively. In 2010 flood events, there were also three times high precipitation records within the month of September in four days which recorded above 25.4mm (29.98mm, 26.65mm and 31.64mm). This is in agreement with Bahago, *et al.* (2019), who observed that heavy rain greater than 25.4mm per day, induce floods when they occurred in a month about three or more times during the period of moisture surplus. Other months with record less than three times of high precipitation; or with wide range intervals; and having incident of flood event have been accorded with the release of excess water from the Shiroro hydroelectric dam.

Flooding in the study area has contributed immensely to destruction of crops and other available social amenities like bridges amongst others. It is important to note that a total of 9,967 km^2 of farmlands have been affected by the flood throughout the flood years flood in the study area.

3.4 Impacts of Flood on Livelihood of Inhabitant in the Study Area

Impacts of flood disasters in the study area were presented in Table 3.2, the result indicates that destructions of crops, displacement of people from their initial community, destruction of infrastructures, poor water quality due to contamination, as well as loss of farmlands; and improved in soil fertility, increased in fishing activities were major negative and positive effects of flood respectively on the livelihoods of the inhabitants of the study area with Mean Score

(MS) greater than 3.0, while low crop yield, loss of domestic animals, disease outbreaks has lesser effects of flood disasters with Mean Score (MS) less than 3.0 in Manta and Galadima Kogo communities.

Table 3.2: Impacts of Flood in the Study Area

Effect of flood	***5**	**4**	**3**	**2**	**1**	**MS**
Destruction of Crops	34	15	35	108	195	4.07
Displacement of People	64	92	24	73	134	3.31
Destruction of Social Infrastructures	78	94	23	74	118	3.16
Increase Fishing Activities	68	94	36	96	93	3.13
Loss of Farm Land	65	100	44	84	94	3.11
Improve Soil Fertility	67	104	48	81	87	3.04
Poor Water Quality	87	95	28	85	92	3.00
Low Yield of Crops	85	101	54	74	73	2.87
Disease Outbreak	90	159	37	52	49	2.51
Loss of Domestic Animals	108	127	54	54	44	2.48

Note: *5=Strongly agree, 4=Agree, 3=Intermediate, 2= Disagree, 1=Strongly disagree, MS=Mean Score
Source: Author's Analysis, 2023

The results agreed with the findings of Ochieng *et al.* (2017) who observed that floods continue to disrupt agricultural activities by drowning animals, washing away crops, killing humans and destroying basic infrastructure.

3.5 Coping Mechanism to Flood

The coping mechanism were identified and presented in Table 3.3, which indicates, using other source of income help to generate additional means of living to the farmers, moving away from flood prone areas, and dry season farming scored 3.43, 3.22, and 3.13 respectively and were considered as major coping strategies used by the respondents. While training of local volunteers, early warning system, use of local signs that's Indigenous Knowledge System (IKS) and listening to mass media scored 2.97, 2.66, 2.23, and 2.11 respectively and also considered least adopted means to cope with flood disasters. Poor early warning system also contributes to

effects of flood, due to the fact that when early warning system becomes late warning system, thus increasing the level of communities' susceptibility to flood.

Table 3.3: Farmers Coping Mechanism

Coping Mechanism	***5**	**4**	**3**	**2**	**1**	**MS**
Other Source of Income	64	71	29	82	141	3.43
Moving from Flood Prone Areas	57	122	13	70	125	3.22
Dry Season Farming	98	76	15	73	125	3.13
training Volunteers	69	108	49	86	75	2.97
Early Warning System	79	129	62	79	38	2.66
Availability of Flood Disaster Local Sign	104	175	42	46	20	2.23
Listening to Mass Media	102	209	26	32	18	2.11

Note: *5=Strongly agree, 4=Agree, 3=Intermediate, 2= Disagree, 1=Strongly disagree, MS=Mean Score

Source: Author's Analysis, 2023

Information related to future flood events do not get to the vulnerable communities on time thereby increasing the level of communities' susceptibility. The finding similarly conforms to the study of Shah *et al*. (2017) who stated that there is poor performance of early warning system due to lack of infrastructure and outdated information dissemination system which were considered as the key obstacles in mitigating floods.

Training of local volunteers with low mitigation strategies to flood disasters equally agreed with the findings of Aloma and Imoh (2018) who stated that, rural dwellers found in the various communities have resulted in a self-support effort by formation of local groups (volunteers) which account for few percent on responding to the impact of flooding as an adaptation measure towards flood disasters. Few local volunteers are trained to respond to the emergency situation in case of flood events.

Conclusion

The yearly variation in the amount of annual rainfall likely contributes to flood disasters in the study area. Rainfall variability in the study area contributes directly or indirectly to flood.

However, the flooding in the communities do not really depends on the yearly annual rainfall as there could be positive trend in annual rainfall without necessarily leading to flood occurrence. However when the intensity of the precipitation is high and occurring for consecutive days, results to streams, rivers and dams to swell-up which increases the possibility of flood occurrence. In some cases, releasing of waters from dams are the major contributing factors to flooding in the study area.

The results revealed that; an overflow from dam, heavy rainfall, human activities such as farming along the river banks and the flood plain contribute extremely to flooding in the study area.

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