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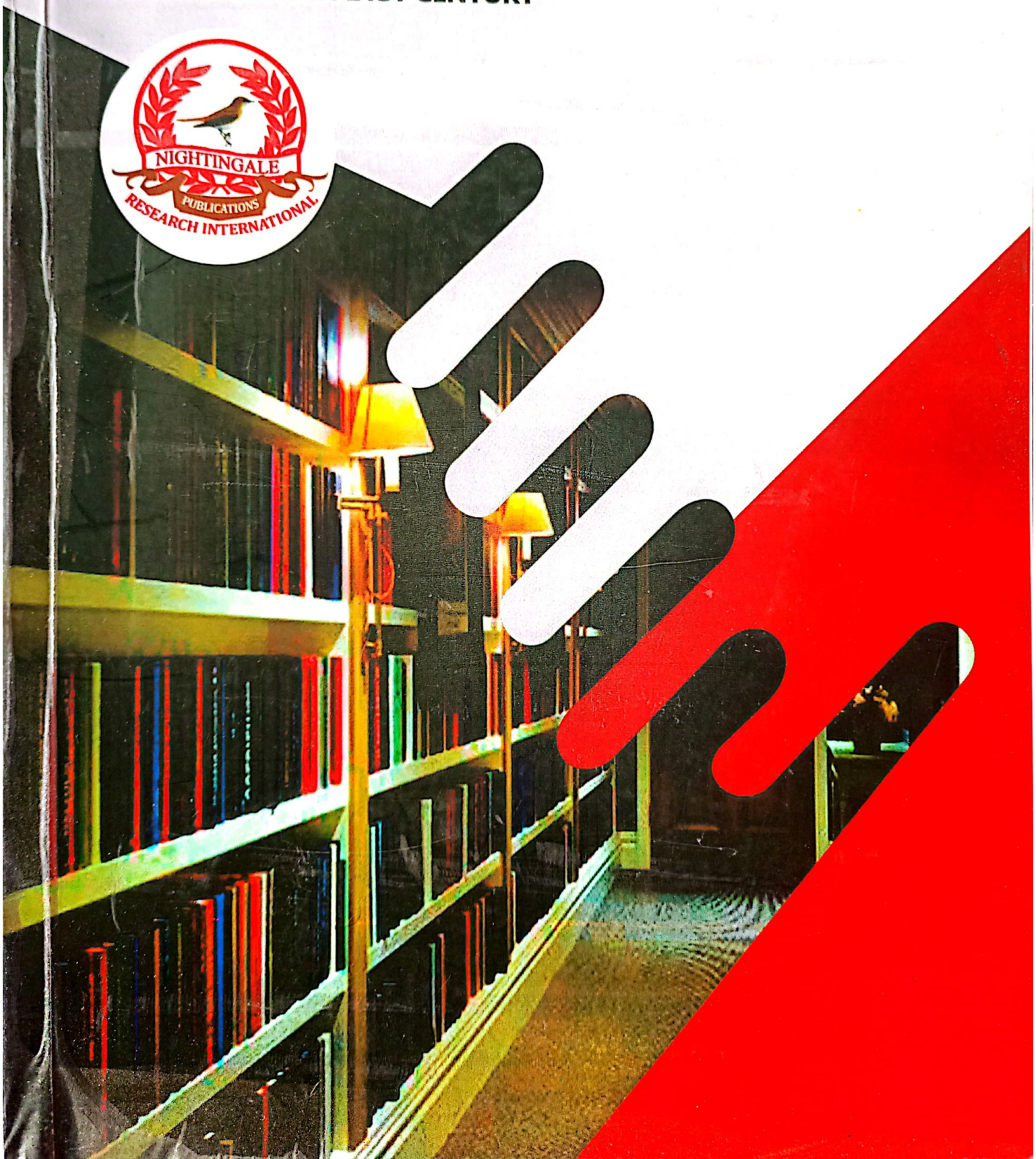
THE GLOBAL REFOCUSING ON AFRICAN DEVELOPMENTS: CHALLENGES AND OPPORTUNITIES IN 21ST CENTURY



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SHIRORO DAM FLOOD DISASTER MANAGEMENT STRATEGIES AND THEIR EFFECTS ON RIPARIAN COMMUNITIES WITH A VIEW TO EVOLVING ALTERNATIVE MANAGEMENT STRATEGIES

DR. INUWA GARBA KUTA[1]; ABDULKADIR NASIRU [2]

[1]Department of Geography, Federal University of Technology Minna. [2]Newgate University Minna

Abstract

This study examined the Shiroro dam flood disaster management strategies and their effects on riparian communities with a view to evolving alternative management strategies. To achieve this therefore, data were sourced from the gazettes, internet facilities, text books, journals, published and unpublished thesis from University library etc. with regards to flood management strategies and the effects of flood in both upstream and downstream sectors of the dam internationally and locally. Others include such as Landsat ETM+ and Landsat SRTM. The result shows that farmland/crops submerge ranked the highest from 156 (30%) of the respondents, collapse of buildings and displacement ranked second from 149 (28%) of the respondents, property destruction ranked third from 103 (20%) of the respondents. loss of lives ranked fourth from 97 (18%) of the respondents and loss of animals ranked the least from 21 (4%) of the respondents. The finding shows 30 meter buffer distance along the floodplain area and it reveals that Guni, Gussoro and Danchitagi are within the high risk zone which makes them vulnerable to flood they need to move to higher ground. The result also shows 50 meter buffer distance along the floodplain area and it reveals that all the sample points are within the high risk zone which makes them vulnerable to flood. They need to move to higher ground for safety. The study concluded that despite the impact of Shiroro dam on the riparian communities, the majority of the respondents are not ready to move inland away from the high vulnerable areas and this is due to economic and cultural advantages except for those in new Akare which is 12kilometers away from the flood plain. These communities have also been witnessing flood before the dam was constructed but now, the frequency of the flood have been increasing over time. It's therefore recommended that community based flood preparedness and management should be a high priority in physical therapy practice management in all the affected communities such as Guni, Zumba, Gusoro, Akare, Kwata (Wushishi), Wuya Kede and Danchitagi.

***Keywords:** Shiroro Dam, Flood Disaster, and Riparian Communities*

INTRODUCTION

Floods according to Sanjay and Naveen (2015) refer to huge amounts of water reaching land in a short span of time, causing land surface to be submerged under water at places, where land surface is usually not covered with water. Floods could be caused by nature or human activities or a combination of both. Floods are caused by discharge of huge volumes of water in a short span of time, at a rate such that the water cannot be carried away from the scene of discharge (Sanjay and Naveen, 2015). Flooding impacts a large area wherein entire district or states might be flooded. However, sometimes, flooding is very local, i.e. limited to just one city or parts of it. Most often, the localised flooding is caused due to human activities, rather than natural phenomenon. A natural phenomenon might seem like immediate trigger, but in reality, this is caused by human activity. There are some places which get flooded almost every year; one of such example is Bangladesh.

International Water Power and Dam Construction (IWPDC) (2011) offered definitions of dam as an enlarged natural or artificial lake, storage pond or impoundment created using a lock to store water.

Dams can be created by controlling a stream that drains an existing body of water. They can also be constructed in river valleys and gorge as in the case of Shiroro dam on Kaduna River and Shiroro gorge. Alternatively, a dam can be built by excavating flat ground and/or constructing retaining walls and levees. IWPDC (2011) added that, dams can be used in a number of ways to control how water flows through downstream waterways:

(i) Downstream water supply (ii) Irrigation (iii) Flood control (iv) Canals (v) Recreation

The impacts of hydropower dam on culture have been widely documented in different parts of Africa. For example, Inskeep (2000) documented the impact of Pikirayi dam on ancestral landscape and the concomitant psychological trauma resulting in mental health problem in Zambia. Kinahan (2000) in Angola has also studied the impacts of hydro dams on the Himba pastoralist and the over 4,000 year's archival history. Hassan (2000) examined the impacts of Aswan high dam on Nubian monuments and cultural heritage in Egypt and Sudan. Brandt (2000) also reported a negative dam impact in 2 World Bank sponsored dams in Somalia and Ethiopia respectively; about 600 archeological sites were destroyed in Somalia; while several pre-historic stones and pottery materials were recovered from dam sites in Ethiopia.

Niger State is one of the largest States in terms of landmass. It is over 10% of the landmass of Nigeria. The State has population of about 3, 950, 490 people (NPC, 2006). The topography is undulating with numerous rivers and streams crisscrossing the state, the major ones being the Niger, Kaduna, Gurara, Gbako, and Munya. The State houses the three (3) Hydro power dams in the country namely; Kainji, Jebba on the River Niger and Shiroro on the Kaduna River (Garba and Mohammed, 2011). Another one is under construction on the Kaduna River at Zungeru, downstream of Shiroro dam.

The operations of the three hydro-power dams in Niger State i.e. Kainji, Jebba and Shiroro, is believed to be causing enormous negative environmental impact on the communities at the upstream and downstream sectors of the dams. Consequently, flood disaster in Niger State has become an annual event, resulting in heavy losses of human and animal lives, damage to buildings, farms and fishing ponds, erosion of large parcels of land, displacement of people from their original settlements and host of other socio-economic hazards.

In Nigeria especially Niger State with three large HP dams this is particularly so, as the river banks are used for farming and are inhabited by farming communities. However, the emphasis of this study is on the effect of flooding at the communities located downstream and upstream of Shiroro HP dam which is believed to be attributed to the poor flood management strategies put in place by Shiroro HP authority hence, mission for this study.

With reference to global climate change which possibly causes heavy downpour, river erosion have led to upstream dam sedimentation, overflowing and large volume of water into Shiroro dam from the main river and its tributaries which may have been causing upstream spill over (back flow) water and also force the dam managers to release large volume of water to downstream sector in order to safe the dam from collapse. In the course of doing that, the downstream communities are exposed to river bank over flow into their houses, farmlands, displacement etc. Similarly, with increasing population in the study area, human activities through deforestation due to farming, fuel wood demand, grazing and local mining at the upstream sector may lose the soil for easy runoff and erosion causing upstream sedimentation thus, back flow flood (Lawal and Nagya, 2009).

The Kaduna River serves as a main source of drinking water supply in the communities located along the valley and the quality of the water at downstream contains hydrocarbon due to the operation of the dam which leads to high incidence of diarrhea (Lawal and Nagya, 2009). Flood disaster in Niger State has become an annual event since 1986 to the present day. This situation became worse from 1998 and 2012 when the three hydroelectric stations i.e. Kainji, Jebba and Shiroro Hydroelectric Power Stations

causes massive spillage of water regularly downstream during the rainy seasons (Salami and Sule, 2010; NEMA, 2012). The 2012 flood in Nigeria killed 363 people and affected an estimated total of 7 million people with an estimated damage worth ₦2.6 trillion and termed to be the worst floods in 40 years (NEMA, 2012).

Despite the fact that some studies focused on environmental impact of Shiroro dam in some communities downstream, there is therefore the need to pay attention to the study of flood control strategies and their effects to both upstream and downstream sectors due to spilled over and spilled down water from the Shiroro reservoir. The aim of this study was to examine the Shiroro dam flood disaster management strategies and their effects on riparian communities with a view to evolving alternative management strategies.

The Study Area

Shiroro Hydroelectric Dam is situated in confluence between Rivers Kaduna and Dinya within Shiroro Local Government Area of Niger State. The lake is located on River Kaduna at the Confluence of Kaduna River and Dinya River. The lake is located on Latitude 8°51'01"N to 10°20'04"N and Longitude 5°50'01"E to 07°10'41"E (See Figure 1) Kaduna River is the major River feeding the lake. The River takes its source from the west and Northwest of Jos Plateau. The river flows westward from the plateau at an elevation of 1,500 metres to 1,800 metres through Kaduna town at an elevation of 633metres, the major left hand tributaries of the Kaduna River at the upstream of Shiroro reservoir are the River Sarkin/Pawa and River Dinya. They rise from hilly areas within the basement complex plains near Kaduna (Garba and Mohammed, 2011).

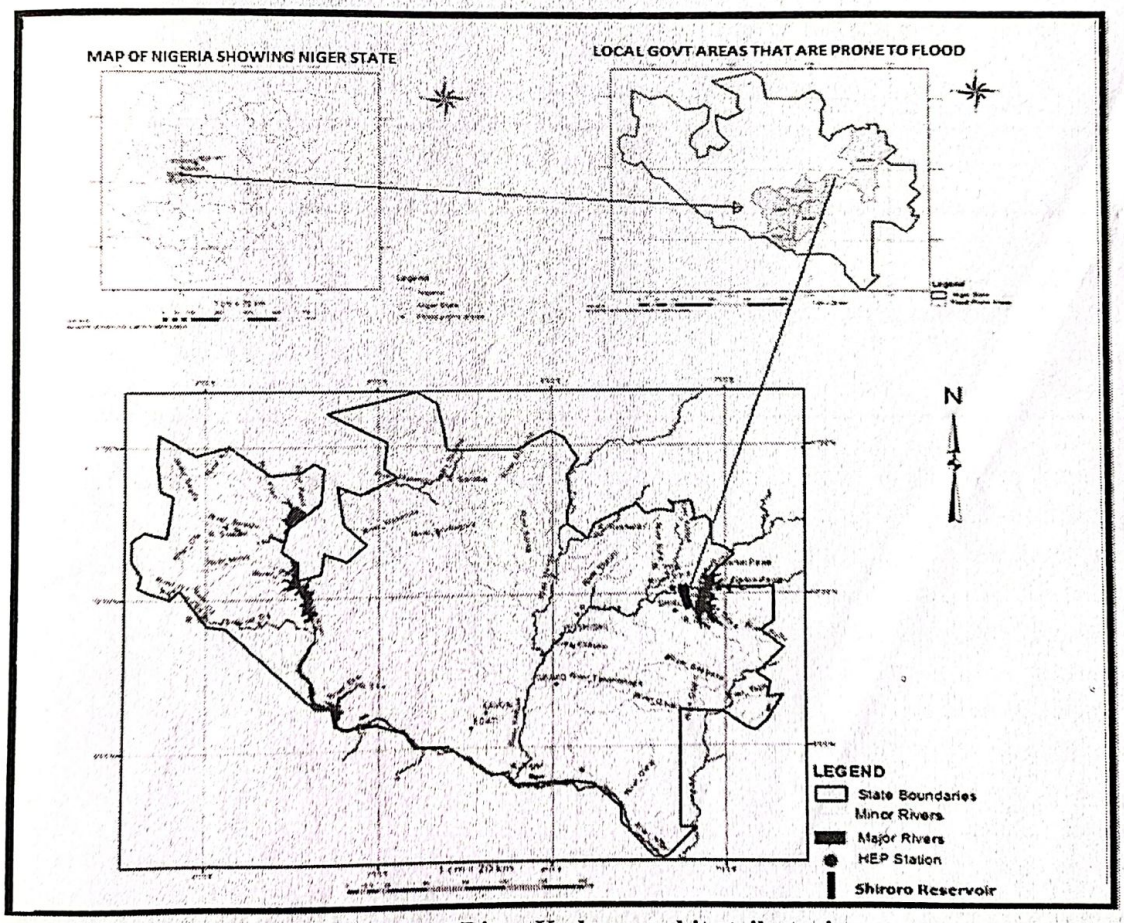


Figure 1: Location of Shiroro dam on River Kaduna and its tributaries

MATERIALS AND METHODS

The primary sources included reconnaissance survey, questionnaire administration and purposive selection of affected communities and respondents of the study area. In order to develop detailed and comprehensive literature review, the information can be obtained from written documents. To achieve this therefore, data were sourced from the gazettes, internet facilities, text books, journals, published and unpublished thesis from University library etc. with regards to flood management strategies and the effects of flood in both upstream and downstream sectors of the dam internationally and locally. Others include such as Landsat ETM$^+$ and Landsat SRTM.

To evolve an alternate management strategies to flood hazards in the affected communities: flood risk maps were evolved in order to delineate highly, moderately, and low vulnerably areas where an appropriate buffer for revisiting resettlement exercise were recommended to the authorities concerned. Therefore, the use of remote sensing technique i.e. Landsat ETM 2007, Arc GIS 10.1 and Digital Elevation Model (DEM) to identify the level of terrain (topography) helped to achieve the study aim by delineating highly, moderately and low risk areas and to provide an appropriate buffer as coping management zones for each affected community. All these data were acquired from NARSDA. Two flow charts were also evolved of riparian community for effective and efficient flood coping strategies.

Results and Discussions

Effects and Challenges of Flood in the Riparian Communities

This section deals with the severity of flood during its occurrences, its damages, relief assistance and the kind relief assistance given after flood occurrences, prevalent health risk associated with the flood occurrence and benefits associated with flood after its occurrences. The severities of flood occurrences in the riparian communities are severe, moderate and very severe.

Table 1: Severities of Flood

Options	Guni	Gussoro	Zumba	Wuya Kede	Akare	Danchitagi	Kwata (in Wushishi)	Percentage
Severe	8	10	7	12	19	15	20	91 (17.3%)
Moderate	21	17	28	33	24	51	22	196 (37.3%)
Very severe	46	24	37	51	33	25	23	239 (45.4%)
Others	0	0	0	0	0	0	0	(0%)

As shown in Table 1 in terms of that severity from view of the respondents, very severe ranked the highest from 239 (45.4%) of the respondents and this where in Kwata, Akare, Danchitagi and Wuya Kede, moderate ranked second from 196 (37.3%) of the respondents and this was in Gussoro while severe ranked the least from 91 (17.3%) of the respondents and this was in Guni and Zumba. The people of the study area loss about ₦2 billion in 2012 flood alone and As reported by Lawal and Nagya (1999), properties worth over five million naira were destroyed due to the occurrence of flood at Mokwa, Wushishi, Shiroro and its environs in 1997 and 1998. The implication of severity of flood occurrences in the study area indicates that the situation is very dire which has leads to various degrees of damages. The damages of flood occurrences in the riparian communities include collapse of buildings and displacement, property destruction, loss of lives, farmland/crops submerge and loss of animals as indicated in Plate I to III of this study.

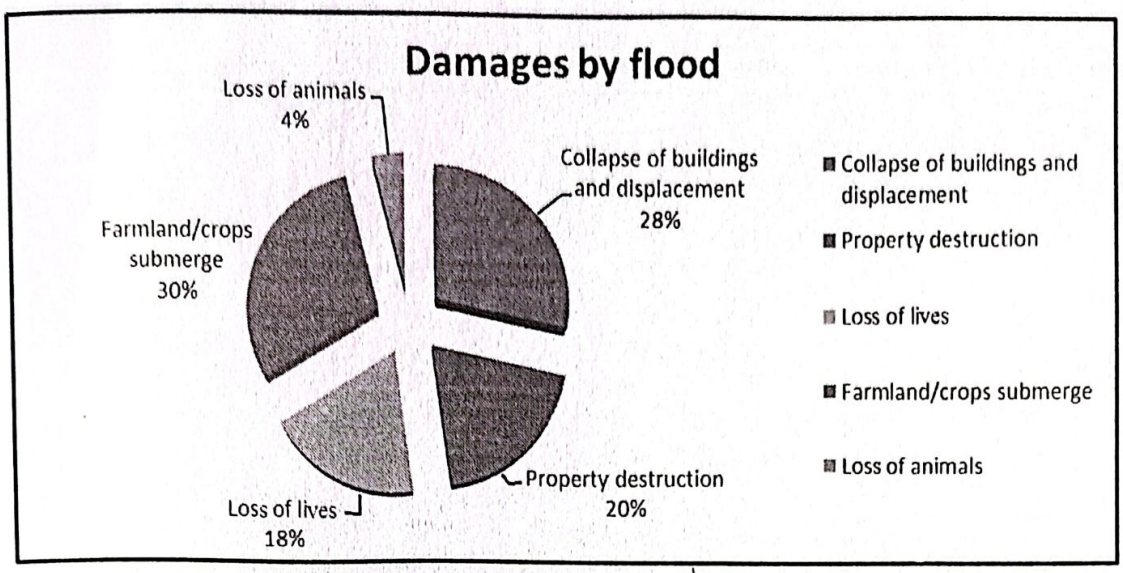


Figure 2: Damages by Flood Occurrence in the Study Area

Damages as a result of flood occurrences in the study area were of different classes and magnitude as indicated in Figure 2. Farmland/crops submerge ranked the highest from 156 (30%) of the respondents, collapse of buildings and displacement ranked second from 149 (28%) of the respondents, property destruction ranked third from 103 (20%) of the respondents, loss of lives ranked fourth from 97 (18%) of the respondents and loss of animals ranked the least from 21 (4%) of the respondents. The people of the study area loss an estimated ₦850 million in farmland/crop submerge and livestock in 2012 flood. They also loss ₦1.095 billion in infrastructural destruction (property destruction and collapse of building and displacement). Business centres, water and sanitation were also affected and the people loss an estimated ₦55 million. The implication of damages as a result of flood occurrence in the study area is low standard of living, inadequate food security and environmental degradation.

Field survey and observation were carried out in the study area and the following flood damages were captured through photographs.

Plate 1: Incident of 2015 Shiroro Dam Spill over (Backflow) flood at Zumba upstream community causing yam farm to be submerged

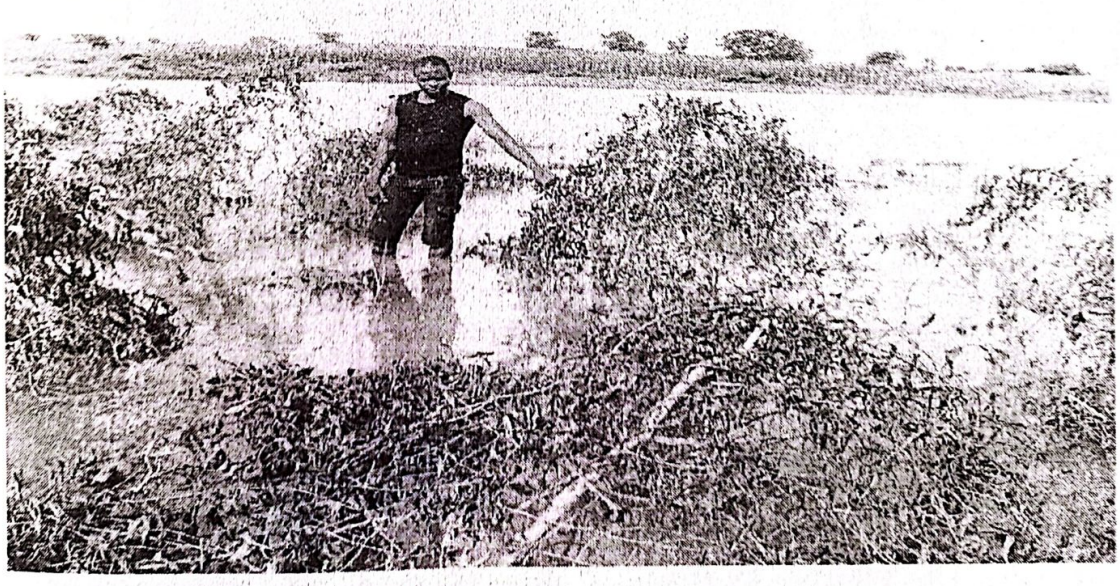


Plate II: Submerged Sugar Cane farm at Guni Community due to 2015 Shiroro Dam spill over (Backflow) Flood

Plate III: Submerged Maize Farm at Galadinman/Kogo Community due to 2015 Shiroro Dam spill over Flood

Figure 3 shows the flood vulnerability map of Akare and Kwata towns with total land cover of 1000.49km^2. High risk zone is 523.34km^2 (52.31%), moderate risk zone is 523.73 (32.36%) and the low risk zone 153.42 (15.33%). From the result obtained, it shows that more than half of the area studied is prone to flooding and only a small area of Akare and Kwata are located in the low risk zone.

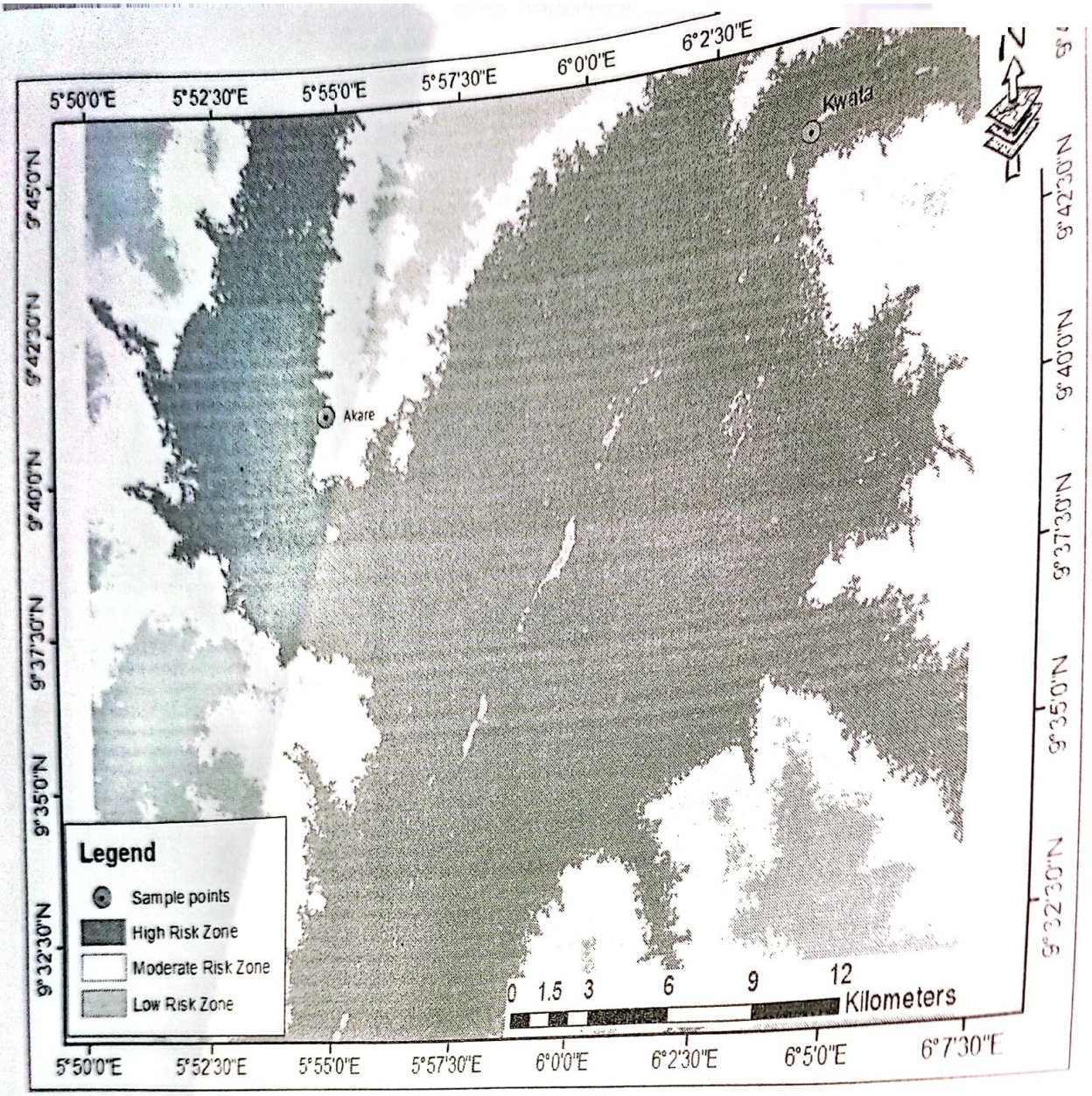


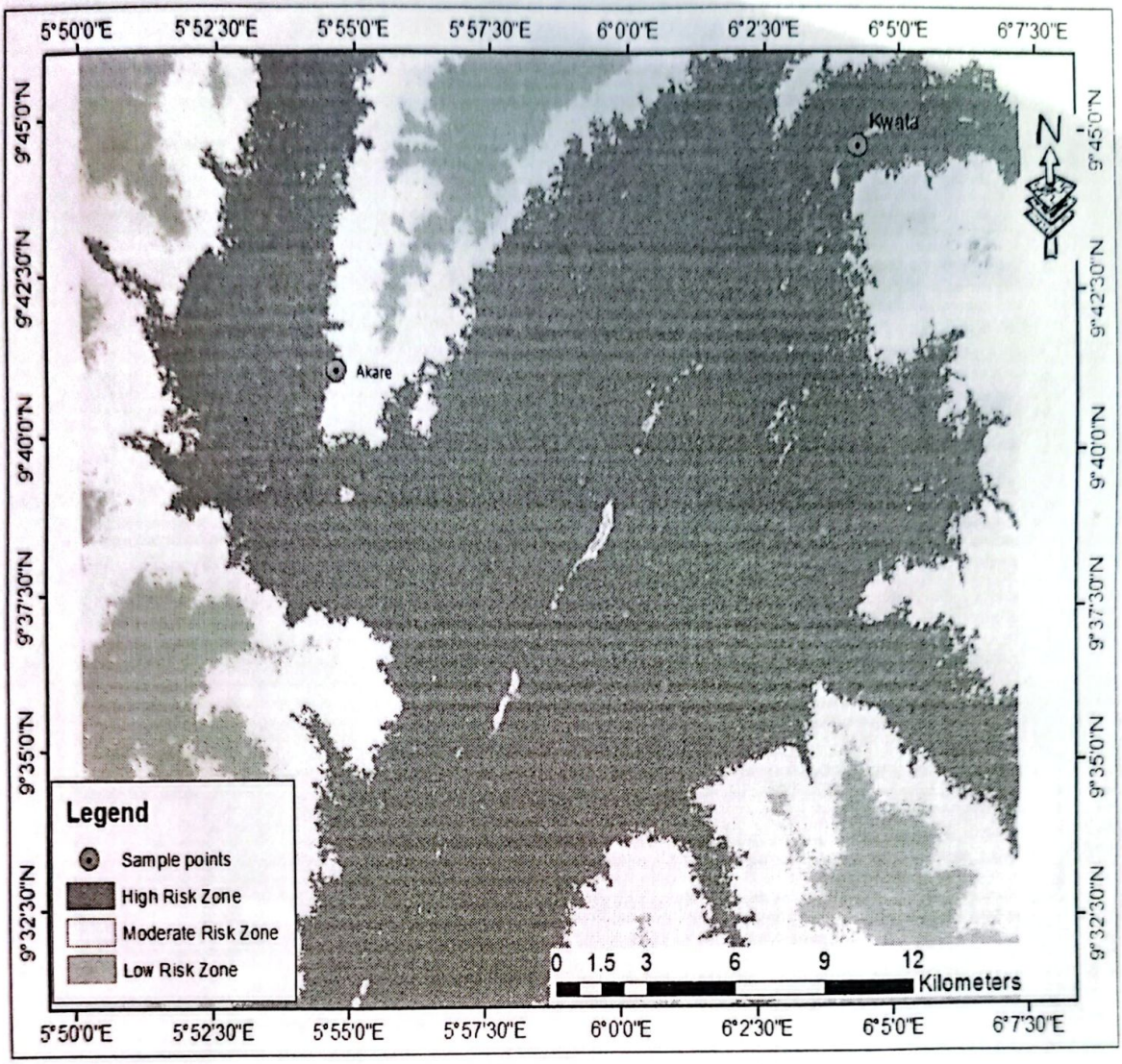
Fig 3: Flood Risk Level and Percentage Coverage of Akare and Kwata
Source: Author (2017)

Table 2: Flood risk level and percentage coverage of Akare and Kwata

S/N	Risk	Area (Km^2)	Percentage (%) of the Area
1	High Risk Zone	523.34	52.31
2	Moderate Risk Zone	323.73	32.36
3	Low Risk Zone	153.42	15.33
	Total	1000.49	100

Source: Field Survey, 2017

Figure 4 shows the flood vulnerability map of Wuya Kede and Danchitagi towns with total coverage of 892.80km^2. High risk zone is 581.97 (65.18%), moderate risk zone is 273.
the low risk zone 37.77 (4.23%). From the result obtained, it shows that
prone to flooding and only a small area of Danchitagi, Wuya Ke
risk zones.



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3	Low Risk Zone	153.42	15.33
	Total	1000.49	100

Source: Field Survey, 2017

Figure 4 shows the flood vulnerability map of Wuya Kede and Danchitagi towns with total land coverage of 892.80km^2. High risk zone is 581.97 (65.18%), moderate risk zone is 273.06 (30.58%) and the low risk zone 37.77 (4.23%). From the result obtained, it shows that more than half of the area is prone to flooding and only a small area of Danchitagi, Wuya Kede are located in the moderate and low risk zones.

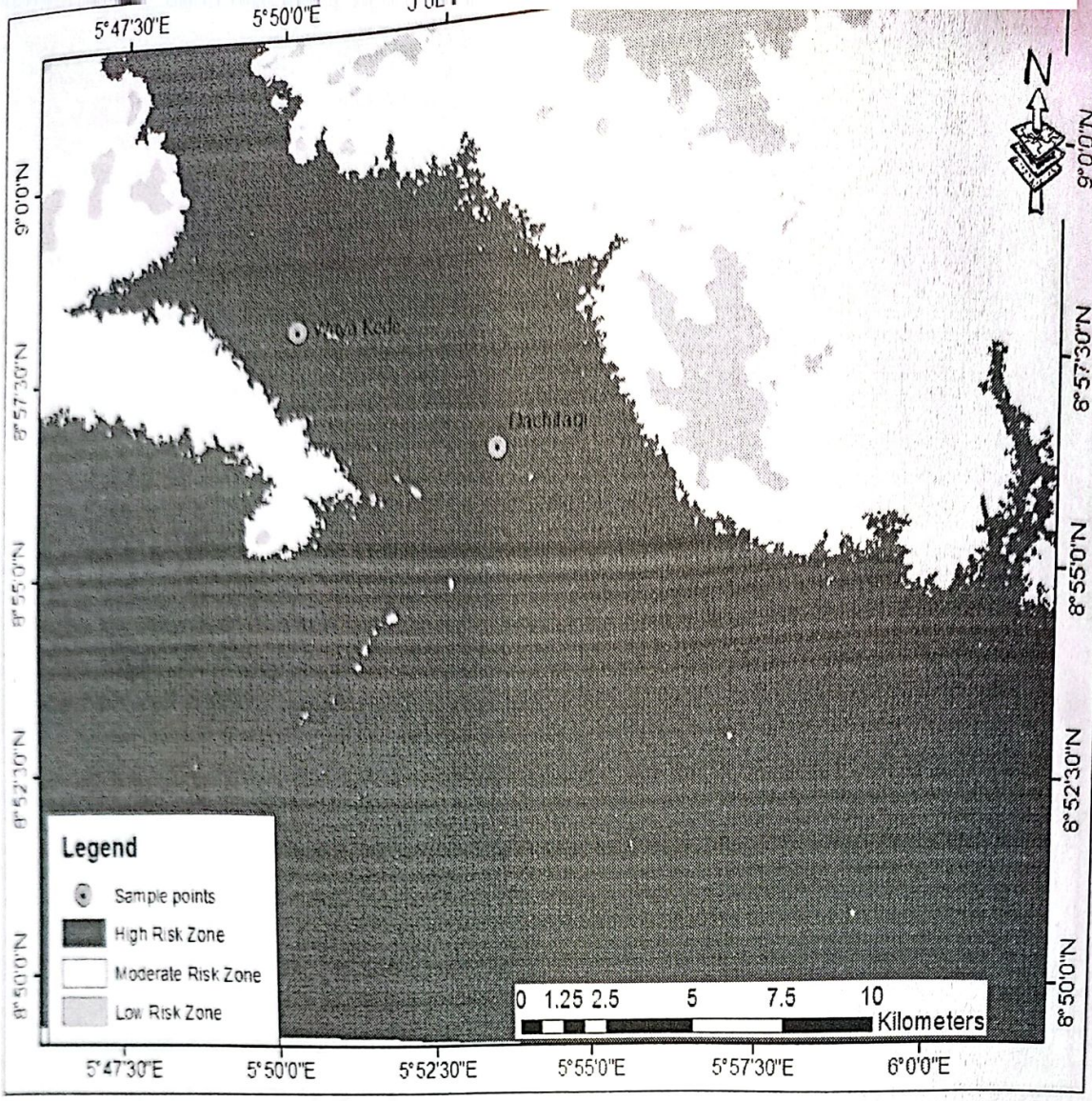

Fig 4: Flood Risk Level and Percentage Coverage of Danchitagi and Wuya Kede

Table 3: Flood Risk Level and Percentage Coverage of Danchitagi and Wuya Kede

S/N	Risk	Area (Km^2)	Percentage (%) of the Area
1	High Risk Zone	581.97	65.18
2	Moderate Risk Zone	273.06	30.58
3	Low Risk Zone	37.77	4.23
	Total	892.80	100

Source: Author (2017)

As indicated in Table 3, Danchitagi and Wuya Kede are located within the high risk zone which has made them highly vulnerable to flooding during rainy season and when Shiroro dam authority releases large volumes of water downstream.

Figure 5 shows the flood vulnerability map of Guni town with total land coverage of 484.78km^2. High risk zone is 144.74 (29.86%), moderate risk zone is 221.10 (45.61%) and the low risk zone 118.94 (24.53%). From the result obtained, it shows that about half of the area is in the moderate risk zone on the flood plain, and only a small area of Guni is located in the high risk zone on the flood plain.

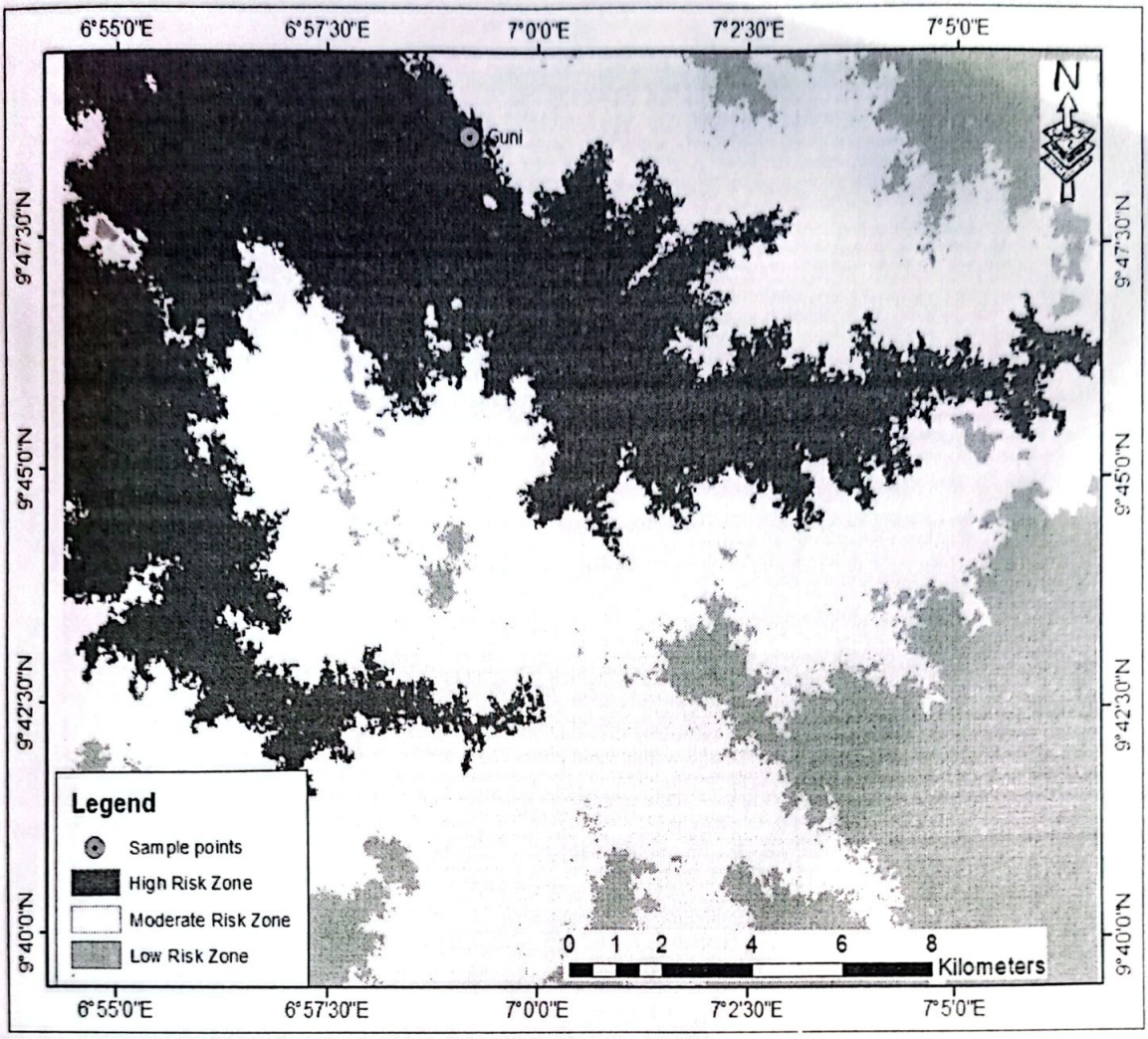

Figure 5: Flood Risk Map and Percentage Coverage of Guni

Table 4: Flood Risk Level and Percentage Coverage of Guni

S/N	Risk	Area (Km^2)	Percentage (%) of the Area
1	High Risk Zone	144.74	29.86
2	Moderate Risk Zone	221.10	45.61
3	Low Risk Zone	118.94	24.53
	Total	484.78	100

Source: Author (2017)

Figure 6 shows the flood vulnerability map of Gussoro and Zumba towns with total land coverage of 207.57km^2. High risk zone is 117.98 (56.84%), moderate risk zone is 81.08 (39.06%) and the low risk zone 8.51 (4.10%). From the result obtained, it shows that about half of the area is in the high risk zone of the flood plain, and only a small area of Gussoro and old Zumba are located in the low risk zone of the flood plain.

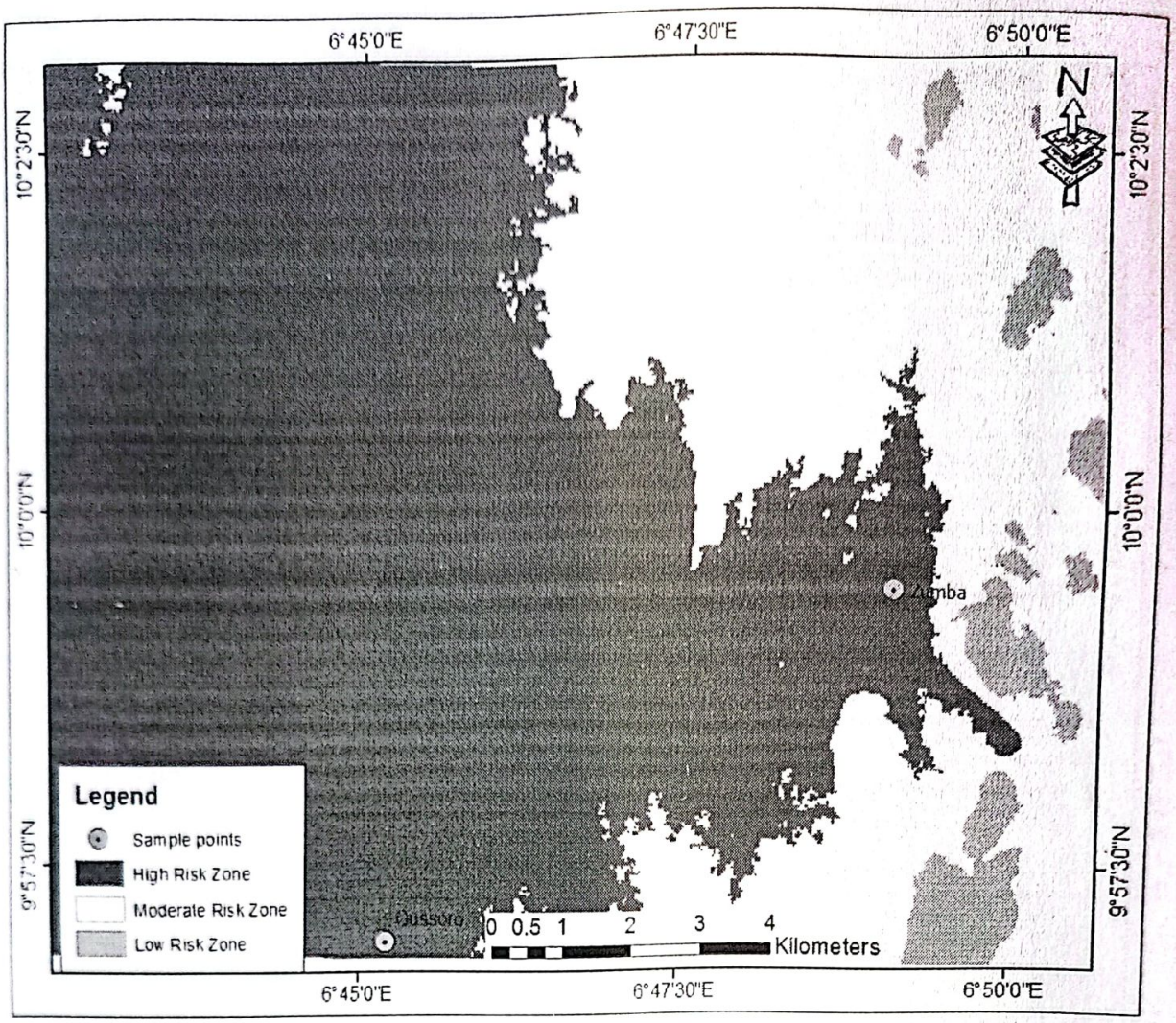

Figure 6: Flood Risk Map and Percentage Coverage of Gussoro and Zumba

Table 5: Flood Risk Level and Percentage Coverage of Gussoro and Zumba

S/N	Risk	Area (Km^2)	Percentage(%) of the Area
1	High Risk Zone	117.98	56.84
2	Moderate Risk Zone	81.08	39.06
3	Low Risk Zone	8.51	4.10
	Total	207.57	100

The analyses show that more than 80% of the sample points of the study area are located in high risk zone which makes those sample points vulnerable to flooding during rainy season. Urgent evacuation of the people during floods and permanent relocation of the six (6) out seven (7) sample points in the high and moderate risk zones to higher terrain areas will be needed.

Apart from zoning the selected sample points in the study area as a alternate management strategy to flood hazards in the affected communities, some of the respondents have started dry season rice farming which will go far in alleviating the socio-economic effects of flood hazards as indicated in Plate IV. This dry season rice farming has touched countless lives by increasing the standard of living of the farmers and equally their food security.

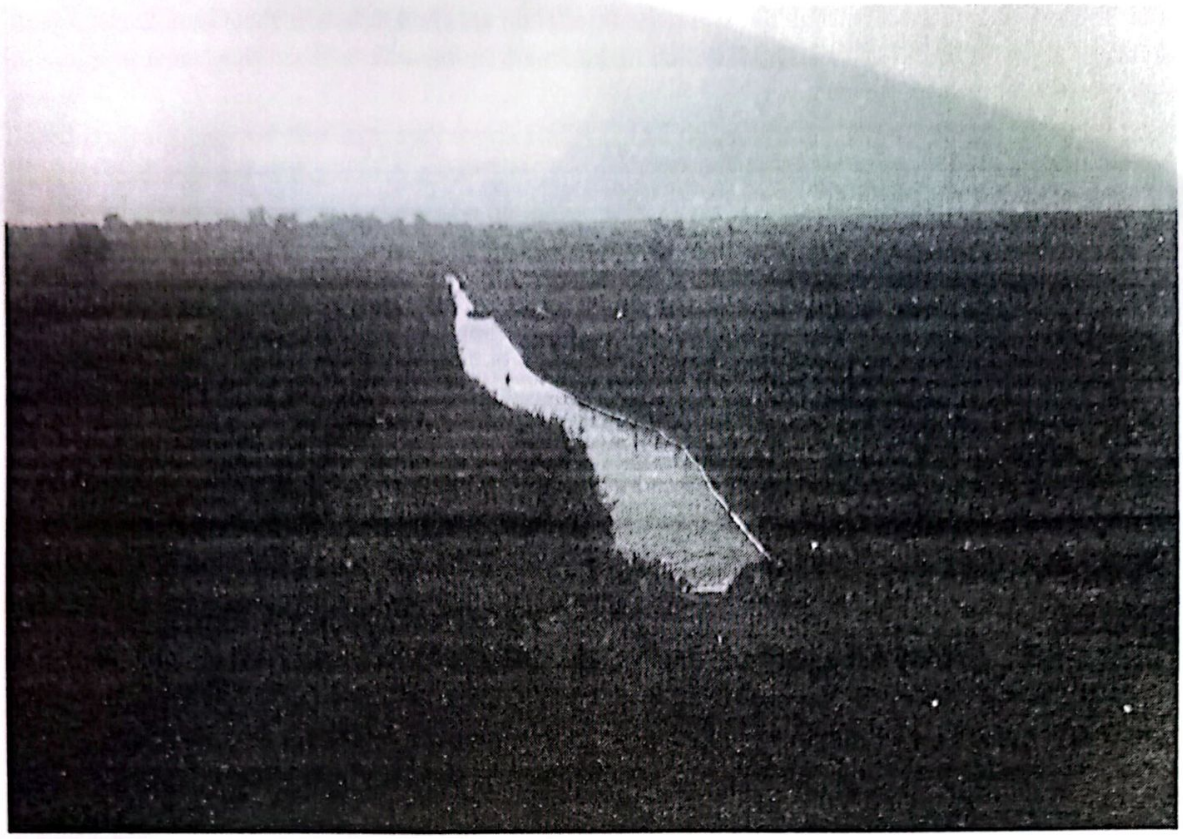

Plate IV: Dry Season Rice Farm in Wuya Kede

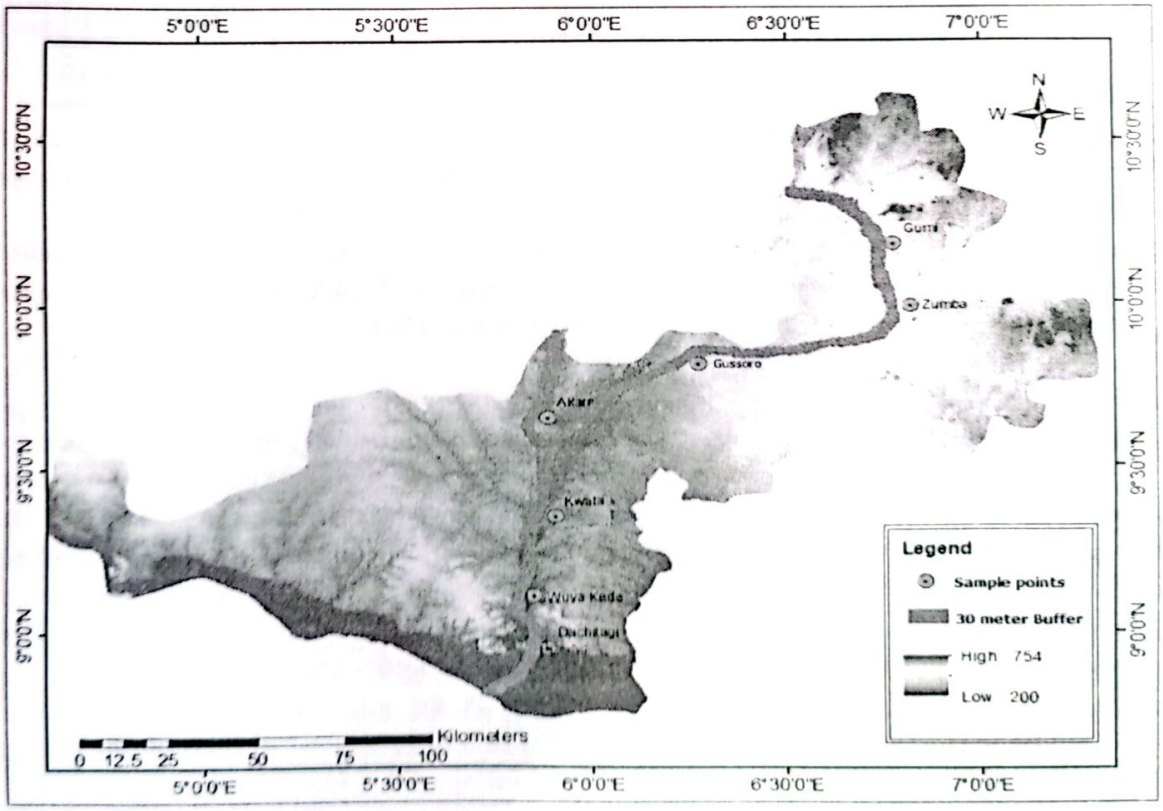

Figure 7: 30 Meter Buffer Distance along the Floodplain Area

Figure 7 shows 30 meter buffer distance along the floodplain area and it reveals that Guni, Gussoro and Danchitagi are within the high risk zone which makes them vulnerable to flood they need to move to higher ground.

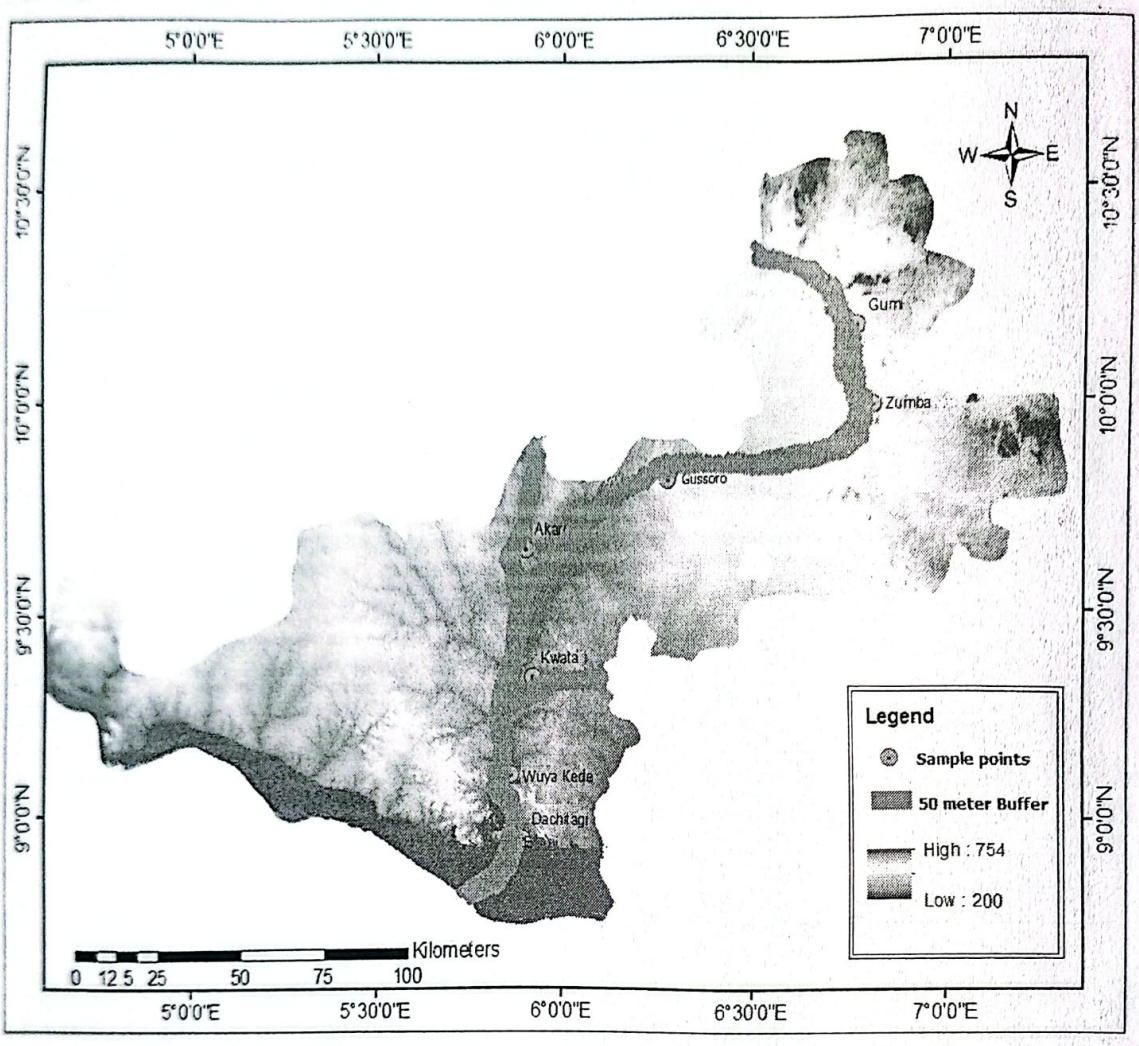

Figure 8: 50 Meter Buffer Distance along the Floodplain Area

Figure 8 shows 50 meter buffer distance along the floodplain area and it reveals that all the sample points are within the high risk zone which makes them vulnerable to flood. They need to move to higher ground for safety. This agreed with the research work of Adeaga (2008).

Conclusion

The study concluded that despite the impact of Shiroro dam on the riparian communities, the majority of the respondents are not ready to move inland away from the high vulnerable areas and this is due to economic and cultural advantages except for those in new Akare which is 12kilometers away from the flood plain. These communities have also been witnessing flood before the dam was constructed but now, the frequency of the flood have been increasing over time. The Riparian communities suffer huge losses (properties worth more than ₦5 million in 1998 and ₦2 billion in 2012 were loss) during wet season as a result of flood which are mainly during the month of June to October.

This study also concluded that flood coping strategies in the study area include relocation of houses/farmlands, erosion control through ridges crossing along the slope on farmland, sand bag filling, diversion of flood water to drainages and others. The finding of this study shows that the sampled communities are all vulnerable to flooding when they occurred. Furthermore, 50 meter buffer distance

along the major river revealed that all the sample points were within the high risk zone which makes them vulnerable to flood when it covered 30 meter from river bank and they need to move to higher ground.

Based on summary of findings and conclusion of this study, the following were recommended to enhance management of flood in riparian communities of Shiroro dam, Nigeria. Community based flood preparedness and management should be a high priority in physical therapy practice management in all the affected communities such as Guni, Zumba, Gusoro, Akare, Kwata (Wushishi), Wuya Kede and Danchitagi. In line of the above, the riparian communities can embark on structural work like, local channelization, embankment protection, roads and bridges construction as community efforts. The Niger State government, private and non-governmental organizations that are involved in flood control strategies on riparian communities of Shiroro dam, Nigeria should imbibe the use of Geographic Information System (GIS) for data generation and decision making so as to minimize the problems of human interventions in major decision makings. This implies that the staffs of such organizations should be well trained on the use of GIS for data generation and decision making.

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