

SPATIAL ASSESSMENT OF FLOOD VULNERABILITY IN RESETTLEMENT SITES IN NIGER STATE, NIGERIA.

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ABSTRACT

This research aims to examine the spatio-temporal characteristics of flooding and the implications of a sustainable resettlement scheme in Niger State, Nigeria. The methodology involves a literature review of existing data sources and a survey of affected areas. Geospatial techniques were adopted, and structural questionnaires were used to enlist information from the residents of the affected areas. The findings reveal that flooding is a major concern in Niger State, Nigeria. Specifically, in Gurmana community, about 25.58% of the total area is in a very high-risk area, 13.89% in a high-risk area, 11.51% in a moderate risk area and 15.67% are in no-risk areas. Similarly, 38.66% of the land in Akare is in a very high-risk area, 27.5% in a high-risk area, 9.85% in a moderate risk area, while 4.26% are in low-risk areas and 19.73% is no risk areas that now accommodate the new Akare. Additionally, in Maito, about 55.44% are on very high risk, 38.39% high risk while 4.32% moderate risk areas, 1.4% low risk areas and 0.45% are no risk areas. Furthermore, in Essan, about 57.02% are on very high risk, 30.67% high risk areas, 8.43% moderate risk areas whereas 2.86% and 1.02% are low and no risk areas respectively. The results unveil the high-level risk typical of the riverine communities, justifying the need for immediate proactive action for enhanced resilience across the wetland communities. The research recommends that government should implement the resettlement scheme to reduce the negative effects of flooding.

Keywords: Flooding; Resettlement; Vulnerability and Sustainability

INTRODUCTION

Flood, according to Sanjay and Naveen (2015) refers to huge amount of water reaching land in a short span of time, causing land surface to be submerged under water at a place where land surface is usually not covered with water. Flood has been variously defined: Kirkby (2016) sees a flood as existing when the discharge of a river or watercourse cannot be accommodated within the margins of its normal channel, so then water spreads over adjoining grounds on which crops or valuable properties are destroyed; a flood is any water in an area that is not normally submerged. Clarice, (2014) present that a flood is also usually an overflow of an expanse of water that submerges land and inflow of tide into land. Resettlement schemes are increasingly regarded as an important strategy to cater for displaced populations (Tan, 2018). Many countries embark on resettlement schemes to provide housing, livelihood sources and other services (e.g., potable water, schools, health

facilities) needed to host the displaced population in their new locations. Despite these good intentions, research has consistently shown that many resettlement schemes could perform poorly due to implementation challenges and/or inadequate knowledge of the socio-cultural context within which livelihood programs are carried out (Abbute, 2015).

Sustainability is the capacity to endure in a relatively ongoing way across various domains of life (James *et al.*, 2015). In the 21st century, it refers generally to the capacity for Earth's biosphere and human civilization to co-exist. Sustainability has also been described as "meeting the needs of the present generation without compromising the ability of future generations to meet their needs" (Brundtland, 2014). Sustainability is not only one of the principles of engagement in development planning process but also a challenge in most developing countries. In planning circles, the notion of development is often equated to

sustainable development, which is simply seen as development that meets the need of the present without comprising that of the future generation (Bruntland, 2014).

The Sustainability of resettlement has one underlying goal of reinstating affected inhabitants quickly into their old lives (cultural, economic and physical aspects), and if possible, more improved and lasting situations. Achieving this goal comes with implicit and explicit challenges that arise because of land acquisition, compensation and integrating resettle communities into their new home through community participation. In the process, housing, community structures and systems, social networks, and social services can be disrupted (Raschid-Sally *et al.*, 2018).

Many communities in Nigeria suffered colossal loss 2012 owing to the unexpected flood disaster that ravaged some parts of Nigeria and Niger State in particular. This could have been avoided or mitigated if we clearly identified and recognized the peculiarity of risk we are exposed to base on our geographical positioning. It does not really matter how you pay deaf ears to the sound and presence of those risks; one thing that is clear is that they will surely occur whether you plan for them or not. Establishment of a resettlement will help mitigate the effects and facilitate quick and better recovery. Resettlement of people can either be forced or voluntary. Disasters, such as wars, floods and earthquakes, among others, are some of the reasons that could force Man to move out of an area that he is familiar with, to resettle in an entirely new area. Government acquisition of land for development projects is another cause. All over the world resettlement programs abound, Nigeria is no exception to these phenomena. Most programs involve Government decisions, which leave the affected people with very little room to manoeuvre (Ajibola, 2019).

According to Abbute (2013), resettlement might have humanitarian and ecological

consequences. Unless carefully planned, the scheme will extinguish the flora and the fauna and will accelerate soil erosion and hence deplete the ecology." This environmental depletion reduces the environment's ability to produce biomass for food and household energy. This also undermines prospects to fight poverty and achieve sustainable development (FDRE, 2010). In the literature, there are many research works about the planning and implementation processes of the resettlement program in Nigeria. However, there is a gap in analysing sustainability of the resettlement scheme in Nigeria. This research project, therefore, attempts to analyse the challenges associated to with the sustainability of the resettlement scheme in Niger State, Nigeria in order to come up with theoretical and practical explanations based on scientific evidences.

Statement of the Research Problem

Many environmental problems threaten the world (Oyegbile 2018). Flooding is considered to be the most devastating natural disaster worldwide (Komolafe *et al.*, 2019). Peduzzi *et al.* (2019) maintain that 'the rate of flood occurrence in recent times has been unprecedented, with 70 million people globally exposed to flooding every year, and more than 800 million living in flood-prone areas. Rentschler and Salhab (2020) estimate that '1.47 billion people, or 19% of the world population, are directly exposed to substantial risks during 1-in-100-year flood events. In developing countries, flooding results from climate change, excessive precipitation, building on waterways, sea-level rise, soil moisture regime, dam operations, especially along borders, uncontrolled rapid population growth, inadequate preparedness, and lack of political will (Adetunji and Oyeleye 2017).

Resettlement initiatives have been employed by many African governments to respond to the mismatch of population numbers and environmental conditions *inter alia*, to cope with landscapes which could not sufficiently

nurture their inhabitants (Stellmacher and Eguavoen, 2017). In Nigeria, the majority of the population lives in rural areas and are vulnerable to environmental challenges. Unfortunately, scholarly assessment of resettlement in Nigeria has critiqued a number of issues; paramount among them are issues of participation, compensation, livelihood and the level of infrastructure development. (Adefarati, 2015).

Riverine areas of Niger State have suffered floods for decades; the three (3) most recent ones are in 2008, 2009, 2012 and 2018. This caused displacement of people from their usual dwelling places resulting into varying impacts on infrastructure, crops, health, education, environment as well as damage to property (NSEMA, Assessment of Floods Report, 2013). The general problem of the communities is the frequent flood disaster that occurs yearly and it has been a serious problem which claims a lot of lives and properties. A lot of money has been sunk in developing a resettlement scheme like New Bussa, New Gbajibo, New Muregi and New Akare by providing infrastructure facilities, yet the community are not ready to move away from the disaster-prone areas. Some noticeable challenges of resettlement schemes are the cost required for implementation of full resettlement programme could exceed the financial capacity of the State or may be the planning process involved in the resettlement was not properly managed and implemented. Some other outstanding problems that affect the resettlement are the absence of social infrastructure in the settlement sites. For example, in the absence of schools, health facilities, motorable roads, communication networks, etc., could make the life of resettles burdensome. Problems associated with these and similar other factors could create a challenge not only on the target group but also on the country's economy, host communities and the natural environment.

Though there are studies on resettlement planning and implementation, to what extent the resettlers developed assets (physical, social, financial, human and natural) and secured their livelihoods is not known. It seems that the resettlement programme is affecting the environment negatively because it is easily observed that deforestation, overgrazing of lands, etc. are problems in Nigeria particularly in the resettlement areas which recur from time to time. Therefore, this study aims to fill these knowledge gaps and analysis the challenges associated to sustainability of resettlement schemes in Niger State.

Study Area

The State lies on latitude 8° to 11°:30' North and Longitude 03° 30' to 07° 40' East. The State is bordered to the North by Zamfara State, to the West by Kebbi State, to the South by Kogi State, to the South West by Kwara State, to the North-East by Kaduna State and to the South East by FCT. The State also has an international boundary with the Republic of Benin along Agwara and Borgu LGAs to the North West. In the present political zoning system, it is within the North Central Zone and occupies it covers an area of 76,363 square kilometres. The state has three senatorial districts, namely: Zone A, Zone B and Zone C. Figure 1.1 shows a map of the study area.

Flood vulnerability of the terrain and the communities based on their locations were classified into Highly vulnerable (all the land and communities within the 5 and 3 buffer zone on Niger and Kaduna rivers respectively), Vulnerable (all the land and communities located in the plains as well as those within 10 and 5 kilometers buffer along Rivers Niger and Kaduna respectively), Marginally vulnerable (all the land and communities located in the Upland areas of the terrain and Not vulnerable (all the land and communities located in the highland areas).

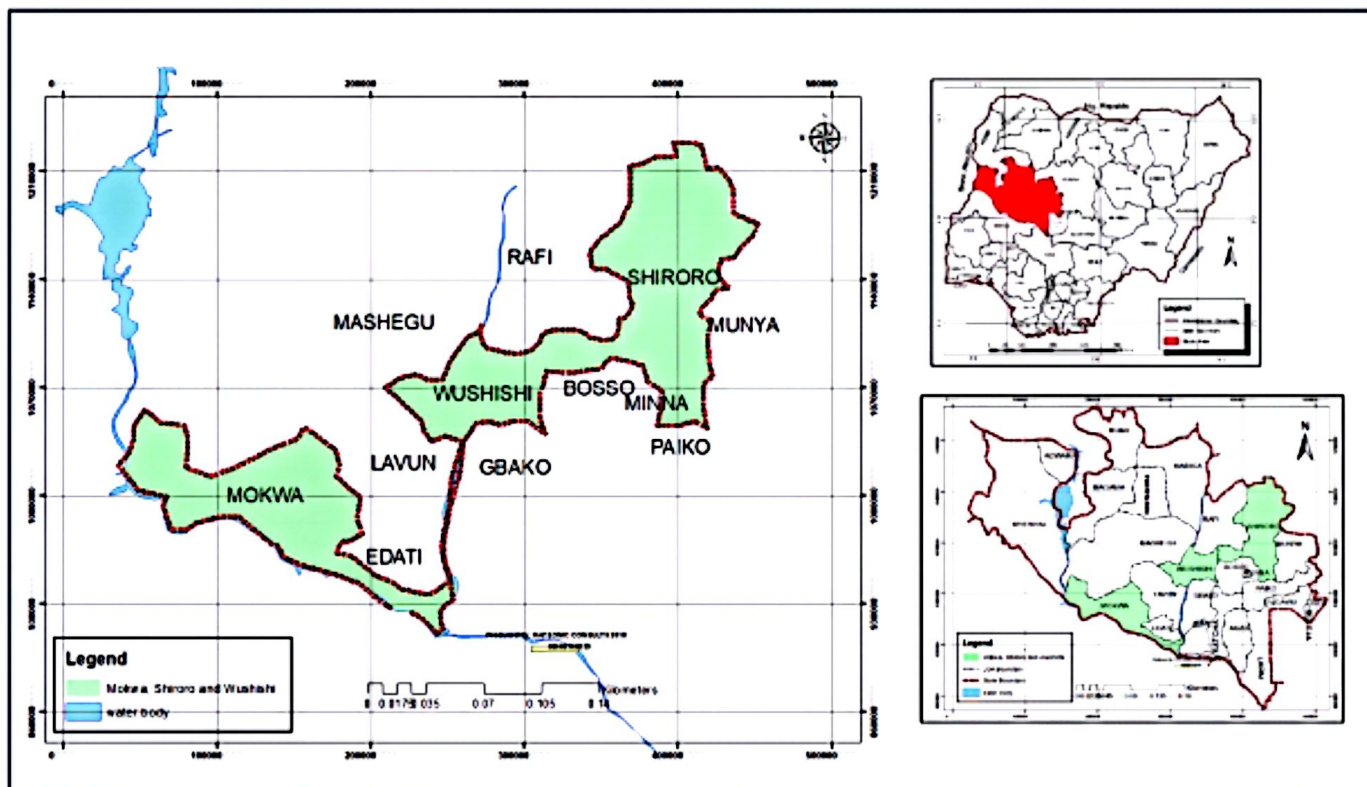


Figure 1.1: Selected LGA for the Study area

Source: NIGIS, 2023

MATERIALS AND METHODS

The study is designed to collect information from all parameters that are needed to solve the research problems. The research made use of both theoretical and investigative method for collection of data; also, data were collected from residents of riverine communities. This provides opportunity to assess the perception of the people regarding flood disaster in their communities and resettlement plan implication for sustainable resettlement in Niger State. In this study, both secondary and primary sources of data were used, and quantitative and qualitative research techniques were adopted to achieve the stated objectives. A Field survey was carried out, and structural questionnaire was administered to the residents of the selected communities, Remote sensing and GIS techniques were employed in achieving the stated objectives.

A total number of 7263 household were identified in the study area. From the total of 7263 households in the study area, 6% which is approximately 454 were administered.

Therefore, the calculated sample size using the above equation is 435. Based on household population 6.2% of the calculated sample size was given to each of the selected communities under study based on their household population.

Simple descriptive statistics were used for analysis of the data collected. The Statistical Package for Social Sciences (SPSS) application software's were used for analysis, Descriptive statistic which frequency and percentage were used. ArcGIS 10.8 were used to develop the spatial map of flood vulnerable areas and also to determine the suitable hotspot for resettlement, satellite imagery of the study areas was analysis using various classification techniques to achieve the objective. Sufer 10 was used to develop the Digital Terrain Model (DTM) of the study area, by integrating the GPS coordinates of the areas in to Sufer software (x, y and z) and plotting the DEM of the areas. Result was presented in Tables, Charts and Maps.

RESULTS AND DISCUSSION

Spatial Maps Flood Vulnerable Areas in Some Parts of Niger State.

A flood vulnerability map was generated from the generated DEM map, the buffer maps and the locations of the communities. To generate flood vulnerability map of the study area, Digital Elevation Model of the areas were developed. The DEM of the study area ranges from very low elevation to areas of high elevation as shown in figure 2. The flood vulnerability map indicates that the elevation ranges between 32m to 370m above mean sea level. However, the lowest sample locations are Gbajibo (between 6070m) above sea level and Muregi as Akare community reside on moderate elevation (77m and above) while Gurmana is on a fairly high location above (200m) in the study area. These reveals the locational vulnerability of the communities.

The vulnerability map of the sampled locations using five classes show; Very high,

High, Moderate, Low and No risk areas (Figure 2). The north eastern part is generally dominated with no risk and low risk areas; thus, Gurmana should generally be a low-risk zones due to its terrain but the risk is intensified by vast wetland that surround the community to the West.

The southern areas comprising of Muregi and Gusuru communities are generally high risk and very high-risk zones while the central areas (Akare community) are on moderate risk zone but the risk is escalated by the backflow of River Kaduna that generally forces River Mariga to over flow its bank. As Arooba and Sheikh (2017) conclude that the situation requires concerted efforts instead of perfunctory actions for protection, conservation and minimization of unconstructive impact on this invaluable wetland ecosystem.

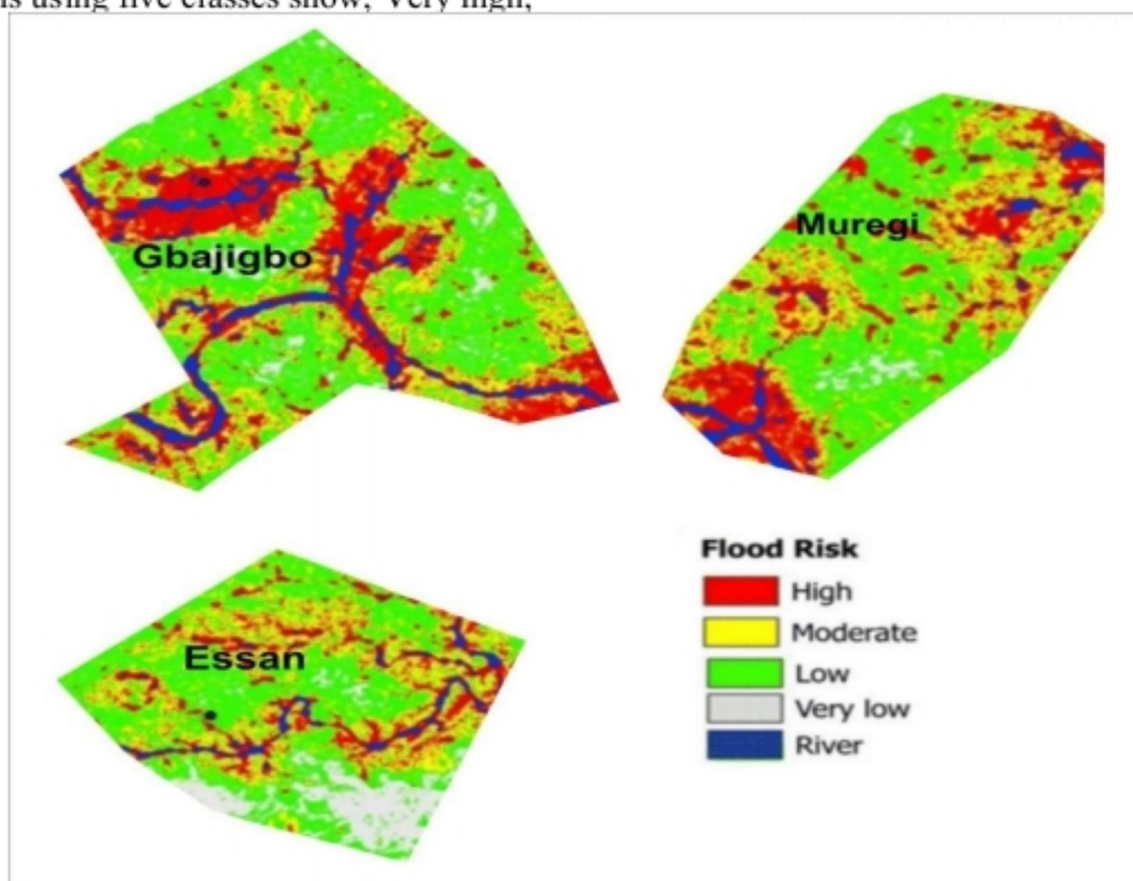


Figure 2: Flood Vulnerability Map of Gbajigbo, Muregi and Essan Communities

Source: Authors Analysis, 2023

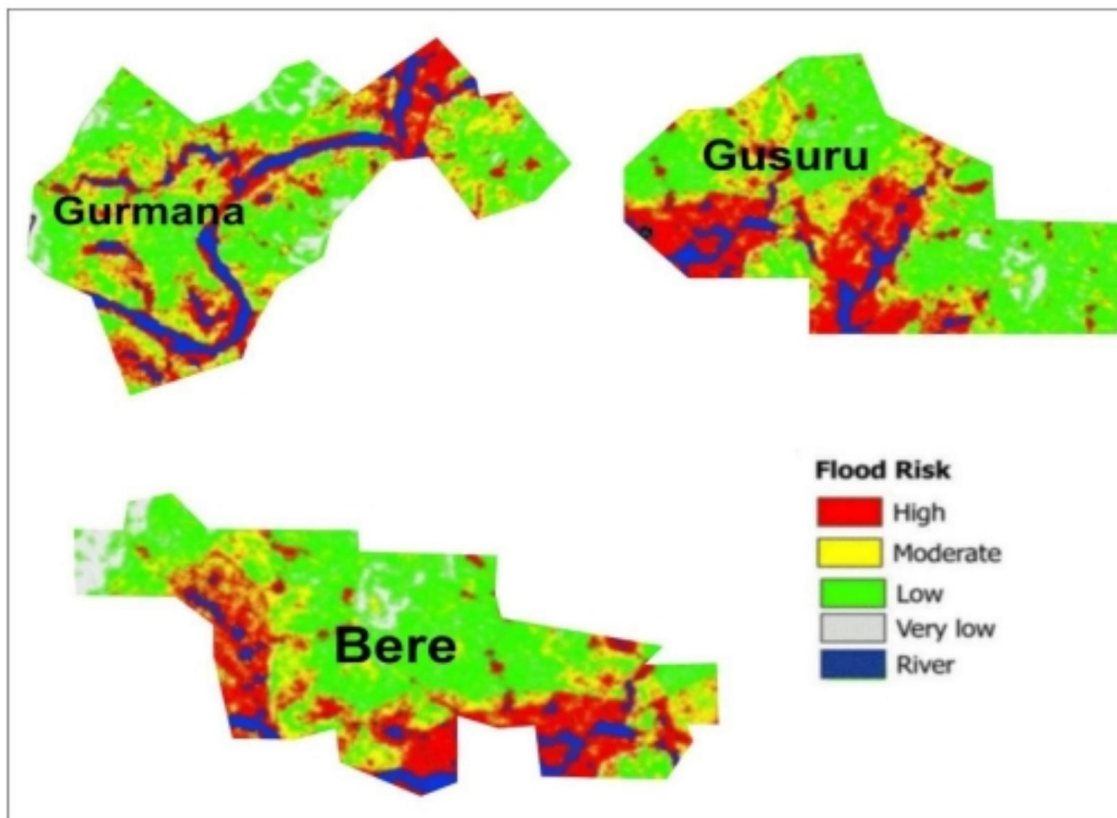


Figure 3: Flood Vulnerability Map of Gurmana, Gusuru and Bere Communities
Source: Authors Analysis, 2023

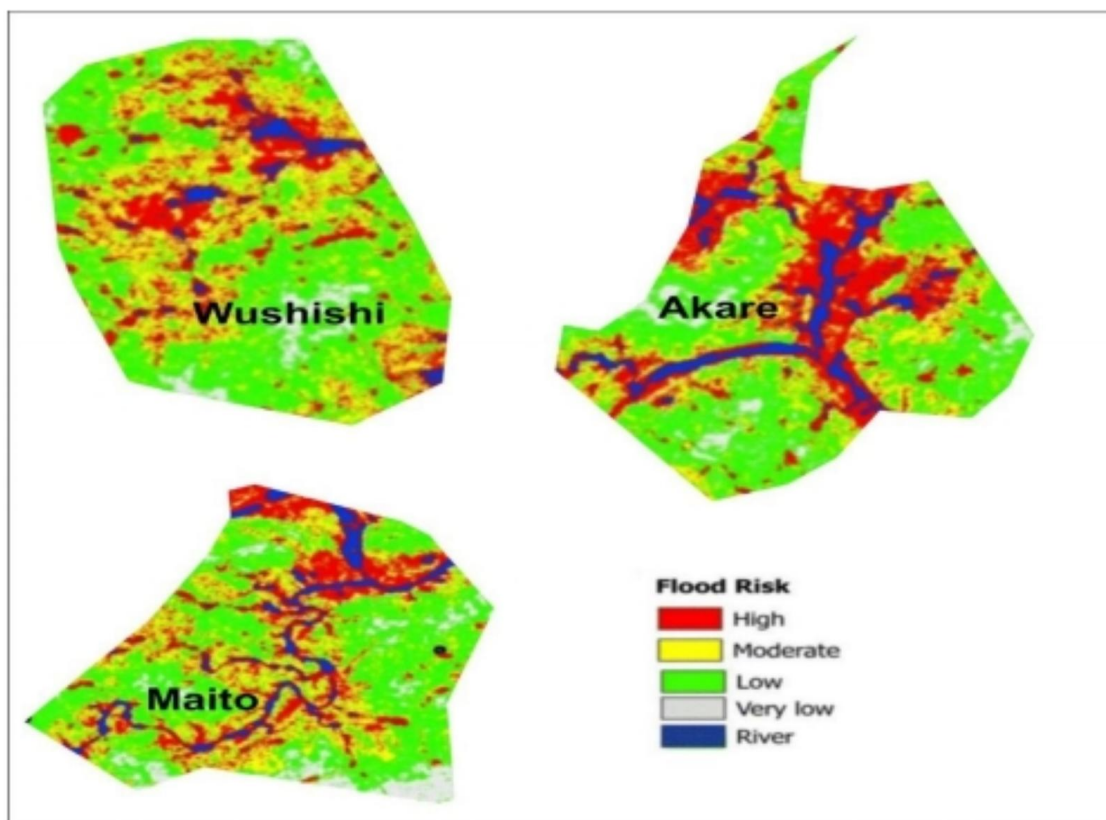


Figure 4: Flood Vulnerability Map of Wushishi, Akare and Maito Communities
Source: Authors Analysis, 2023

Specifically, in Gurmana community about 52.58% of the total area is on very high-risk areas, 13.89% high risk area, 11.51% moderate risk area and 15.67% are no risk areas. Similarly, 38.66% of the land in Akare is on very high-risk area, 27.5% high risk area, 9.85% moderate risk area while 4.26% low risk areas and 19.73% is no risk areas that now accommodate the new Akare. Additionally, in Maito about 55.44% are on very high-risk, 38.39% high risk while 4.32% moderate risk areas, 1.4% low risk areas and 0.45% are no risk areas. Furthermore, in Essan, about 57.02% are on very high risk, 30.67% high risk areas, 8.43% moderate risk areas whereas 2.86% and 1.02% are low and no risk areas respectively.

This result unveils the high-level risk typical of the riverine communities; justifying the need for immediate proactive (environment-friendly and structural) action for enhanced resilience across the wetland communities. There is a need to identify the risk in flood-prone areas to support decisions for risk management, from high-level planning proposals to detailed design.

CONCLUSION

The resultant land use land cover trend and slope of the riverine wetland ecosystem are fundamental non-climate drivers that are acting synergistically to threaten human livelihood across the wetland ecosystem. The risk levels across riverine wetland ecosystem signalled the high vulnerability of vital resources and socio-economic livelihood typical of the downstream communities. The developed suitability map showed that large proportion of the wetland ecosystem are threaten by flood and thus not suitable. This can be used by the Local Government Areas, extension workers and communities to prepare flood mitigation, adaptation and early warning schemes for enhanced resilience as

path way towards disaster risk reduction and enhanced livelihood.

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DETERMINE THE NUMBER OF PEOPLE IMPACTED BY FLOODING IN NIGER STATE OF NIGERIA.

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ABSTRACT

The flooding in Niger state has affected a significant population of people, with its devastating impact felt by both rural and urban communities. According to recent reports, the number of affected individuals has reached an alarming number, with thousands being forced to evacuate their homes and seek shelter in temporary camps. The flooding has caused severe damage to infrastructure and disrupted the daily lives of the affected population. As a result, this paper established the population of people affected by flooding in the study area. This study will utilize a descriptive research design to systematically collect data on the population affected by flooding. It involves collecting numerical data to quantify the extent of the population affected. The target population for this study will comprise individuals residing in flood-prone areas of Niger State. This includes: Muregi, Gbajibo, Essan, Gurmana, Gusuru, Bere, Akare, Wushishi and Maito. Population records and Structured questionnaires were used. Descriptive statistics was use to provide an overview of the population affected by flooding. The findings revealed that a projected population of about 16,211 people are vulnerable to flooding, 10,302 people are more vulnerable to flooding, 9,721 people are very vulnerable to flooding, 10,396 people are highly vulnerable to flood, while 6,396 people are extremely vulnerable to flood. The study conclude that flood is a natural disaster, man contributes significantly to its occurrence due to his involvement in activities that disrupt the environment like encroachment of human activities on floodplains and violations of building regulations. It thereby recommends that Settlements that are within or adjacent to the areas vulnerable to flooding should be resettled to most suitable areas identified in the study.

Keywords: Population, People, Affected, Floods and Niger State

INTRODUCTION

Niger State, located in the central region of Nigeria, is known for its extensive river systems and rich agricultural landscape. However, the state is also susceptible to flooding, particularly during the rainy season. This natural disaster significantly impacts the population, displacing thousands of residents, destroying homes, and affecting livelihoods (James *et al.*, 2015). Flooding in Niger State is primarily caused by heavy rainfall, river overflow, and inadequate drainage systems. The annual wet season, typically occurring between June and September, brings torrential downpours that often exceed the capacity of local rivers and streams. The Niger River, one of the longest rivers in Africa, runs through the state, and its periodic overflow can lead to significant

flooding in surrounding communities. Urban areas, particularly those lacking proper infrastructure, face the brunt of such natural disasters.

As of recent reports, significant flooding in Niger State has affected over 200,000 individuals, with many displaced from their homes and local communities (Ajibola, 2019). The floods impact different demographic groups, including vulnerable populations such as women, children, and the elderly. Displacement often leads to overcrowding in temporary shelters and camps, where basic amenities become scarce (Ojobe *et al.*, 2021). The provision of food, clean water, and healthcare becomes critical, as there are heightened risks of waterborne diseases and malnutrition. The economic impact of flooding is substantial, with the

agricultural sector being particularly hard hit. Niger State is a major contributor to food production in Nigeria, and flooding destroys crops, disrupts planting seasons, and leads to food shortages. Farmers often lose their livelihoods, exacerbating poverty levels in affected communities. The loss of livestock due to flooding further elevates the economic strain on families that depend on agriculture and animal husbandry for survival (Egbenta and Falana, 2020).

The population's vulnerability to flooding is compounded by socio-economic factors. Many residents in rural and peri-urban areas live below the poverty line, making it challenging to invest in protective measures or recover from disasters. Additionally, limited access to education and information hampers community preparedness for flooding events. Awareness campaigns on the risks of flooding, proper drainage maintenance, and the importance of sustainable land use practices are crucial to enhancing community resilience (Anunobi, 2015).

Statement of Problem

Riverine areas of Niger State have suffered floods for decades; the four (4) most recent ones are in 2008, 2009, 2012 and 2018. This caused displacement of people from their usual dwelling places resulting into varying impacts on infrastructure, crops, health, education, environment as well as damage to property (NSEMA, Assessment of Floods Report, 2013). The general problem of the communities is the frequent flood disaster that occurs yearly and it has been a serious problem which claims a lot of lives and properties. A lot of money has been sunk in developing a resettlement scheme like New Bussa, New Gbajibo, New Muregi and New Akare by providing infrastructure facilities, yet the community are not ready to move away from the disaster-prone areas. Some noticeable challenges of resettlement schemes are the cost required for implementation of full resettlement programme could exceed the financial capacity of the State or may be the planning

process involved in the resettlement was not properly managed and implemented. Some other outstanding problems that affect the resettlement are the absence of social infrastructure in the settlement sites. For example in the absence of schools, health facilities, motorable roads, communication networks, etc., could make the life of resettles burdensome. Problems associated with these and similar other factors could create a challenge not only on the target group but also on the country's economy, host communities and the natural environment.

In Nigeria, several studies have been carried out on flood resettlement for instance the resettlement of a 50,000 multi-ethnic population of Bussa resettlement, as a result of the construction of Kainji Dam in 1964 into a modern town called New Bussa (Gana *et al.*, 2019). Seventeen out of two hundred and thirty-nine (239) beneficiaries were resettled in the first two years under cash compensation approach, this proved unsuccessful as the beneficiaries did very little to construct their own houses (Ahmadu *et al.*, 2022). Also, a study by Saidu (2015) confirms that, lack of community involvement in the decision-making process creates communication barrier between the beneficiaries and the scheme administrators of Loko resettlement scheme in Adamawa State, hence the resettlement impediments. Furthermore, communities in Jebba Lake Basin were resettled farther away from the shore of the River Niger with a total of 1,374 houses built during the resettlement scheme in the 21 resettled communities around the Basin (Ojobe *et al.*, 2021). Because of non-involvement of the community, the beneficiaries complained that the size of the spaces provided are small (Egbenta and Falana, 2020). Few studies were carried out on population of people affected by flooding in Niger State. Therefore, this study aims to fill these knowledge gaps and analysis the population of people affected by flooding in the study area.

Aim of the study

The aim of the study is to establish the population of people affected by flooding in the study area.

Study Area

The State lies on latitude 8° to 11° 30' North and Longitude 03° 30' to 07° 40' East. The State is bordered to the North by Zamfara State, West by Kebbi State, South by Kogi State, South West by Kwara State, North-East by Kaduna State and South East by FCT. The State also has an International Boundary with the Republic of Benin along Agwara and Borgu LGAs to the North West. In the present political zoning system, it is within the North Central Zone, and occupies It covers an area of 76,363 square kilometres.

The state has three senatorial districts namely: Zone A, Zone B and Zone C. Figure 1.1 shows a map of the study area.

The state is named after the River Niger. Two of Nigeria's major hydroelectric power stations, the Kainji Dam and Shiroro Dam, are located in Niger State, along with the new Zungeru Dam. The Jebba Dam straddles the border of Niger state and Kwara state. The famous Gurara Falls is in Niger State, and Gurara Local Government Area is named after the Gurara River, on whose course the fall is situated. Also situated there is Kainji National Park, the largest National Park of Nigeria, which contains Kainji Lake, the Borgu Game Reserve and the Zungeru Game Reserve (NS, 1999).

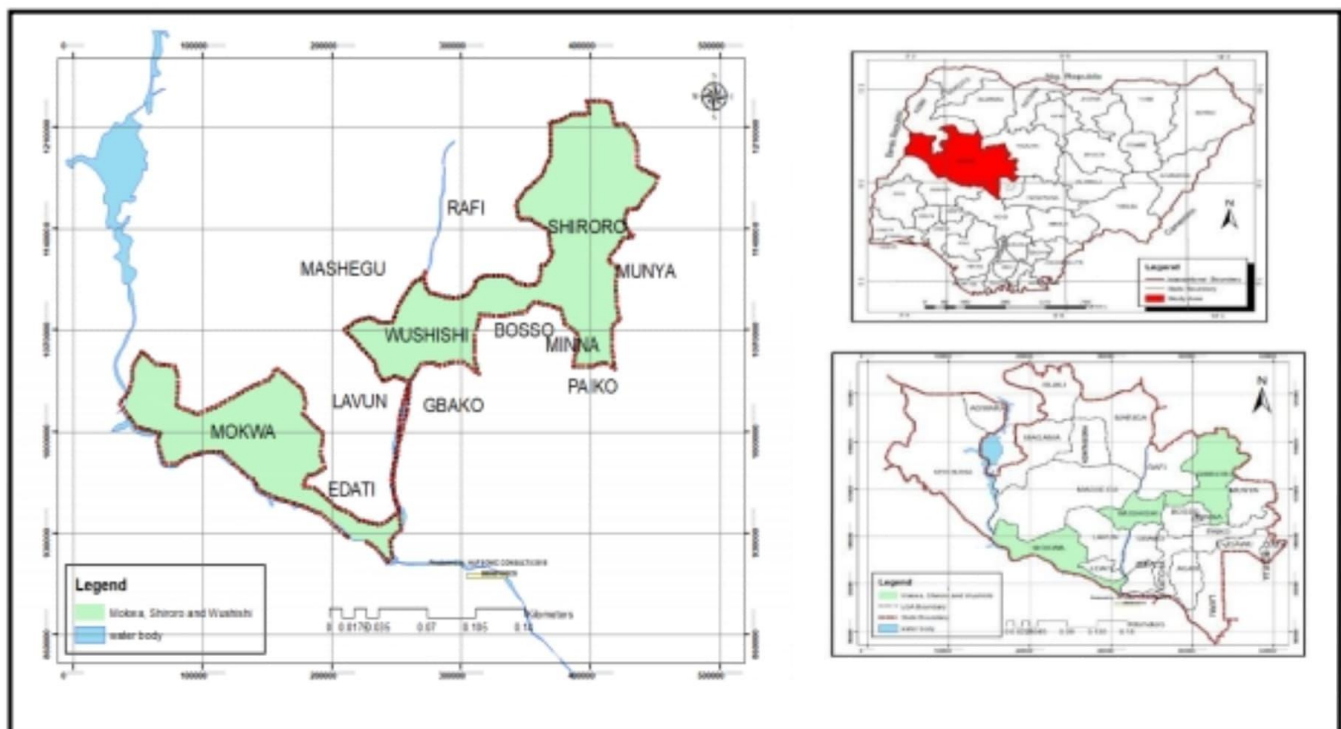


Figure 1: Selected LGA for the Study area
Source: NIGIS, 2023

METHODOLOGY

This study will utilize a descriptive research design to systematically collect data on the population affected by flooding. It involves collecting numerical data to quantify the extent of the population affected. Data were gathered through narratives and contextual information related to the flooding incidents and their effects on individuals and

communities. The target population for this study will comprise individuals residing in flood-prone areas of Niger State. This includes: Muregi, Gbajibo, Essan, Gurmana, Gusuru, Bere, Akare, Wushishi and Maito. The Population of the study area comprises of nine (9) communities, three (3) in in each zone was 53,027 according to projected population from National Population

Commission (2022). Therefore, the total population of the study area were used as sample frame for this research.

Table 1: Population of the sampled communities

S/NO	Community	Projected Population
1	Muregi	3367
2	Gbajibo	5843
3	Essan	6906
4	Gurmana	4387
5	Gusuru	3315
6	Bere	7332
7	Akare	8667
8	Wushishi	11367
9	Maito	1843
	Total	53,027

Source: NPC 2023

A stratified random sampling method was adopted to ensure representation from various demographics within the affected areas. The population was stratified based on socio-economic status, age, gender, and geographical location. Cochran formula was used, an appropriate sample size will be calculated to ensure statistical significance, resulting in a sample of approximately 400 households.

Structured questionnaires were distributed to the sampled households. The questionnaires include: Demographic information (age, gender, occupation, etc.); Assessment of flooding impact (property damage, displacement, economic loss, etc.) and Recovery status and needs following flooding events. The quantitative data obtained from surveys was analyzed using statistical software such as SPSS. Descriptive statistics (frequencies, percentages, means) was calculated to provide an overview of the population affected by flooding. Inferential statistics, such as chi-square tests, may be employed to determine relationships between demographic variables and flooding impact.

RESULT OF FINDINGS

Population of People Affected by Flooding in the Study Area

In order to determine the population at risk of flood in the study area, point location of communities affected in the study area were overlaid on the flood vulnerability map as recommended by the United Nations Environment Programme (UNEP, 1998) and localities that fall within the zones were noted and their 2006 population figures was projected to the year 2023. This method was adopted because population data by wards that would have given detailed information was unavailable as at the time of this research. This information is shown in Table 2

Table 2: Population of the sampled communities

S/NO	Community	Projected Population
1	Muregi	3367
2	Gbajibo	5843
3	Essan	6906
4	Gurmana	4387
5	Gusuru	3315
6	Bere	7332
7	Akare	8667
8	Wushishi	11367
9	Maito	1843
	Total	53,027

Source: Authors Field Survey, 2024

The projected population figures generated were based on projection that assumed the population of the communities with a population increase rate of 3% per annum. From the results, it was revealed that a projected population of about 16,211 people are vulnerable to flooding, 10,302 people are more vulnerable to flooding, 9,721 people are very vulnerable to flooding, 10,396 people are highly vulnerable to flood, while 6,396 people are extremely vulnerable to flood.

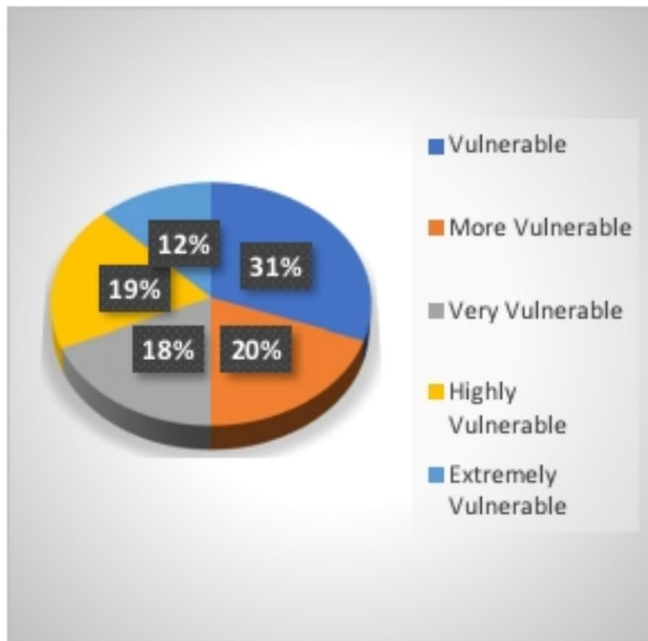


Figure 2: Percentage of vulnerable people affected by floods

Source: Authors Field Survey, 2024

The field study carried out revealed that the residents of the communities have a long history of settlement along the river banks in the study area with most of the resident engaging majorly in farming and fishing along the rivers. Mud houses are seen constructed on these lands and occupied by the resident, and in recent years few houses have been replaced by concrete bricks in the study area.

Vulnerability Level of Population Affected by Floods

Population distribution is considered as one of the instrumental components of vulnerability determination of floods. Higher sensitivity is expected in population with poor living conditions such as malnutrition, overcrowding and inadequate access to health facilities. Four different indicators of flood vulnerability were considered to analysis population affected by flooding in the study areas, the indicators are population density, female population density, literate rate and employment rate (Table 3).

Table 3: Matrix for flood vulnerability indicators

Flood Vulnerability Indicators	Population Density	Female Population Density
Population Density	1	2
Female Population Density	0.5	1
Literacy Rate	0.25	0.33
Employment Rate	0.17	0.17
Total		

Source: Authors Field Survey, 2024

Population Density

The population density distribution is one of the instrumental components of vulnerability to floods. The higher the population density is, the higher the likelihood of life and economic losses. Population density was given the highest weight (Table 3). Figure 3 shows the population density map of the study area. The population density is categorized into the five density classes of very low, low, medium, high, and very high population densities. The most densely populated area in the area has a population range of 178–204 persons per square kilometre and is situated Gbajibo, Wushishi and Essan, while the lowest populated zone has a population density of 78–165 persons per square kilometre. Other areas with a very high population density are Gurumana and Akere. The analysis reveals a very low population density, and most of them are situated in Maito, Bere and Muregi. These very low and low population densities render them less vulnerable to flood disasters.

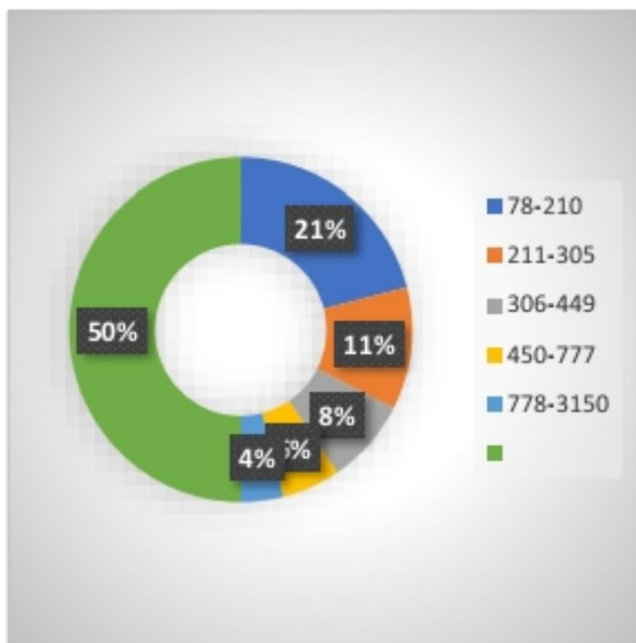


Figure 3: Population density map of the study area

Source: Authors Analysis, 2024

Female Population Density

The female population density of an area determines the area vulnerability to natural disasters such as floods. Women are perceived to be at a high risk amongst the vulnerable population. Figure 4.15 presents the female population density map of the study area. It is worth noting from the figure that entire areas have a very low female population density, 40–105 females/square kilometre. A very high female population density can be found in the central Zone A and Zone C. A moderate female population density can be found in Zone B of the study area.

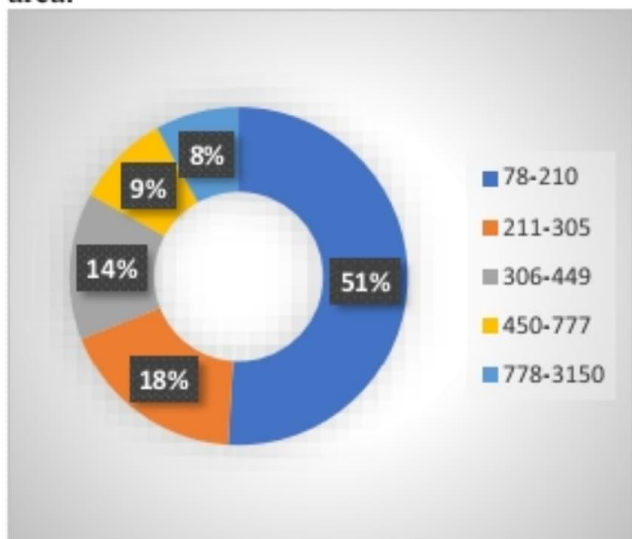


Figure 4: Female population Density map

Source: Authors Analysis, 2024

DISCUSSION OF FINDINGS

The projected population figures generated were based on projection that assumed the population of the communities with a population increase rate of 3% per annum. From the results, it was revealed that a projected population of about 16,211 people are vulnerable to flooding, 10,302 people are more vulnerable to flooding, 9,721 people are very vulnerable to flooding, 10,396 people are highly vulnerable to flood, while 6,396 people are extremely vulnerable to flood.

Population distribution is considered as one of the instrumental components of vulnerability determination of floods. Higher sensitivity is expected in population with poor living conditions such as malnutrition, overcrowding and inadequate access to health facilities. Four different indicators of flood vulnerability were considered to analysis population affected by flooding in the study areas, the indicators are population density, female population density, literate rate and employment rate

The population density distribution is one of the instrumental components of vulnerability to floods. The higher the population density is, the higher the likelihood of life and economic losses is population density was given the highest weight. The population density is categorized into the five density classes of very low, low, medium, high, and very high population densities. The most densely populated area in the area has a population range of 178–204 persons per square kilometre and is situated Gbajibo, Wushishi and Essan, while the lowest populated zone has a population density of 78–165 persons per square kilometre. Other areas with a very high population density are Gurumana and Akere. The analysis reveals a very low population density, and most of them are situated in Maito, Bere and Muregi. These very low and low population densities render them less vulnerable to flood disasters.

CONCLUSION AND RECOMMENDATIONS

The findings showed that the communities that lie along the river banks of River Niger and River Kaduna with low elevation are all prone to flood hazard. This means that all the buildings, populace, the farming and planting activities and other facilities found within the area are at great risk of flood hazard. The study also revealed that a projected population of about 16,211 people are vulnerable to flooding, 10,302 people are more vulnerable to flooding, 9,721 people are very vulnerable to flooding, 10,396 people are highly vulnerable to flood, while 6,396 people are extremely vulnerable to flood. Thus, it can be concluded from this study that although flood is a natural disaster, man contributes significantly to its occurrence due to his involvement in activities that disrupt the environment like encroachment of human activities on floodplains and violations of building regulations. It thereby recommends that Settlements that are within or adjacent to the areas vulnerable to flooding should be resettled to most suitable areas identified in the study. Where possible, the state government should set aside plots of land for the re-settlement of people vulnerable to flood.

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