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Administration of Flood Disasters Mitigation Strategies in Riverine Communities in Niger State, Nigeria

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Abstract. The problem of flooding in several communities in Niger State is becoming more worrisome and efforts and strategies at reducing the impact have become more costly with unsatisfactory outcomes. This study therefore, seeks the assessment of the administration of flood disaster mitigation strategies in riverine communities in Niger State. The specific objectives of the study were to identify the flood mitigation measures adopted in the study area, find out if the administration of flood mitigation methods have been effective in the study area; and know the challenges and prospects of effective administration of flood mitigation measures in three selected riverine communities of Mokwa, Rijau and Shiroro from the three Senatorial Zones of the State, with a total population of 983623 and a sample size of 400. The sample size was determined using 1967 Taro Yamane sample size determination formula. Findings from the study revealed that various mitigation strategies have been used over the years but without much impact due to poor awareness and community engagement and responses during flood disasters. The study concludes that the rate and impact of flood disasters in the selected riverine communities could be reduced if effectively administered through productive community awareness, engagement and quick responses during flood disasters. The recommendations are that, the communities should be productively engaged in the administration of the various flood mitigation strategies for quick and adequate responses during flood disasters.

Keywords: Flood, Disaster, Mitigation Strategies, Disaster Administration and Productive engagement

1. Introduction

Flood disasters pose significant threat to lives and property globally causing extensive damage to infrastructure, disrupting livelihoods, and endangering human lives. Climate change, unsound environmental behaviour, inadequate drainage infrastructure and uncoordinated urbanization, and deforestation are among the factors that triggers or exacerbate the occurrences of flooding. Consequently, frantic efforts have been made by government at federal, state and local levels to develop comprehensive strategies and approaches that focus on both mitigating the causes of flooding and implementing effective response measures when flood disasters occur. Mitigation measures by Niger State aimed at addressing the underlying causes of flooding have been developed and implemented over the years with minimal success. These initiatives involve the construction and maintenance of drainage systems, river channelization, public sensitization and floodplain management.

Nigeria had a historically threatening flood especially, 2002, 2012, and 2022 which affected extensive areas in 30 States, particularly in the country's southern regions, killing 400 people and uprooting 1.3 million more (Wu, Lu, Zhou, Chen, Xu, 2016; World Economy Forum 2023).

In 2012, Cameroun, a neighbor to Nigeria with 1,975 km long land border with Nigeria that connects to the Atlantic Ocean in the south and a triangular point with Chad in the north, opened its reservoir dam known as Lardo, which is situated in the northern province of Cameroun along the course of the Benue River (Agada & Nirupama, 2015). The construction of this dam in 1982 was intended to provide electricity to the northern part of the country and enable the irrigation of agricultural lands (Modo, 2023). It is expected that Nigeria would build another dam in the downstream to

accommodate excess water each time the water from Lardo Dam is released to reduce flooding and maximize other benefits of the dam. However, this has not been done. Since the dam was built, its releases of water occurred in the years 2002 and 2012, each time causing severe flooding in Nigeria (Agada & Nirupama, 2012).

Cumulatively, estimated billion-dollar investments were destroyed (World Economy Forum 2023). The flood destroyed billion-dollar investments made in agriculture and caused a rise in food prices and severe food shortages in Nigeria (Eme, Onyishi, Uche & Uche, 2023).

Nigeria saw the highest number of flood-related casualties as of October 6th, 2022, with 2 million people forced to flee their homes, 612 people lost their lives, 200,000 dwellings were damaged, and 7483 individuals contracted cholera or other waterborne illnesses (World Bank, 2024).

Niger State has not been left out of the issue of devastating floods due to its location in the North-Central part of Nigeria with several water bodies. The State's geographical location, characterized by low-level of water absorption clay soil and significant riverine terrain, makes it susceptible to flooding during heavy rainfall. The presence of River Kaduna, River Niger and the Baro river as well as the operation of Hydro-electricity dams in Kainji, Jebba, Shiroro and Zungeru have become a source great concern to the inhabitants of the riverine communities. Riverine communities like Baro, Agaie, Bida, etc, have remained highly vulnerable due to their location and proximity to the Niger-River valley and River Kaduna. Between 1999-2000, houses, schools, livestock, farmland and over 200,000 persons were displaced (Niger State Emergency Management Agency, 2000). Between 4th and 8th September 2024, the Global Data Institute Displacement Tracking Matrix (DTM), in collaboration with the National Emergency Management Agency (NEMA), the Niger State Emergency Management Agency (NSEMA), and the Nigerian Red Cross Society (NRCS), identified 71 locations in Niger State that were impacted by floods or received internally displaced persons (IDPs) due to the flooding.

In response to this recurring threat, various mitigation and response measures have been implemented to reduce the impact of flood disasters on the State and its inhabitants. Niger State Government, in collaboration with World Bank, Hydropower Producing Area Development Commission (HYPPADEC), Ecological Funds Office and other relevant agencies have embarked on projects to expand and rehabilitate existing drainage systems and construct new canals.

One notable reference highlighting the mitigation and proactive measures to flood disasters in Niger State is the "New Niger Development Agenda, (2024)" published by the Niger State Government under the monitoring and supervision of the "New Niger Development Project". This document outlines a comprehensive strategy for all developmental issues, disaster risk reduction, preparedness, response, and recovery, emphasizing the importance of coordination between government agencies, communities, and other stakeholders.

In a bid to cope and be proactive towards flood disasters in Niger State, some mitigation and preparedness strategies were designed and implemented both at State and local community levels. Among the strategies include the relocation of those residing on the river banks and flood plains, construction of drainages, clearing of drains before the commencement of the rainy season, enforcement of waste management and disposal laws, and establishment of Rapid Response Teams among others. However, continued efforts on public awareness campaigns, and sustainable practices are essential to ensure the long-term resilience of Niger State in the face of recurring flood disasters, hence, the need for more studies on the approaches to mitigating flood disaster risks in riverine areas cannot be overstressed.

1.1 Statement of the Problem

The increasing rate of government expenditure and efforts towards the administration and mitigation of flood disasters without corresponding impact on the residents of affected communities is increasingly worrisome. Annually, substantial budgetary allocation, sensitization and enlightenment on good environmental practices, as well as relocation from flood plains are made. In a not too recent report on flooding in Niger State by the International Organization on Migration (2024), Agaie local government area had the highest number of affected 4,436 or 27% individual from the affected population in the State. Mokwa followed with 2,133 or 13%. Bida recorded 2,000 individuals or 12%, while Katcha had 1,332 individuals or 8%. Kontagora had 1,030 individuals affected, accounting for 6%, and Borgu followed with 700 individuals or 4%. Munya also had 690 individuals or 4%, while Lavun had 568 or 3%. Rafi recorded 544 individuals, Gbako 525, Lapai 490, all making up 3% each. Mashegu had 450 or 3%,

Shiroro 437 or 3%, and Edati 360 or 2%. Suleja had 332 individuals or 2%; Gurara 300 or 2%; Agwara 192 or 1%; and Rijau had the lowest with 40 individuals, accounting for less than 1% (International Organization on Migration 2024; www.iomnigeriadtm@iom.int, Global Data Institute Displacement Tracking Matrix, 2024).

Similarly, specifically, on the 27th May 2025, Mokwa community in Mokwa Local Government Area of Niger State experienced a devastating flood leading to the loss of over 151 lives and millions of properties (Capacity Media Trust, 2025). In Mokwa, Rijau, Shiroro and several Local Government Areas of the State, devastating floods have become an annual phenomenon (Friend of the Environment (FOTE, 2024).

Despite several mitigating strategies from various scholars, flood disaster management has continued to be a big challenge and its negative impact on economic development, environmental sustainability and improving standard of living has continued to impede affected communities' progress and development. The analyses of these previous studies indicated a neglect of collaborative and productive community engagement in the administration of the formulation and implementation of flood disaster mitigation strategies. It is on this background that this study seeks the analysis of flood disaster mitigation approaches in riverine communities of Mokwa, Rijau and Shiroro in Niger State so as to identify the flood mitigation measures adopted in the study area, find out the effectiveness or otherwise flood disaster mitigation administration methods and know the challenges and prospects of effective flood disaster mitigation administration in the study area.

To realize these objectives, the pertinent questions put forward by the study are: What are the flood mitigation measures adopted in the study area? Which of the flood mitigation methods have been effective in the study area? What are the challenges and prospects of effective administration of flood disaster mitigation in the study area?

2. Literature Review and Theoretical Framework

2.1 Concept of Flood

Luino, (2016) defined flooding as the rising and overflowing of a body of water, especially onto normally dry land. It has different types/classes based on the water level, size, duration, wave strength, magnitude of destruction, cause(s), and area affected (Serinaldi, Loecker, Kilsby, & Bast, 2018).

2.2 Concept of Flood Disaster

Several definitions with regards to disaster exist. The World Health Organization (WHO, 2006) defines a disaster as "a sudden ecological phenomenon of sufficient magnitude to require external assistance". It is also defined as any event, typically occurring suddenly, that causes damage, ecological disruption, loss of human life, deterioration of health and health services, and which exceeds the capacity of the affected community on a scale sufficient to require outside assistance.

Flood Disaster and Risk Administration. Flood disaster and risk administration ranges from information gathering, and disaster and risk analysis to continuous societal disaster impact and risk assessment and adoption of policies (Sayers *et al*. 2013). This broad range of flood management is rather less considered during the formulation of preparedness and mitigation strategies, which has mostly constituted structural measures for flood mitigation. Negligence to enforce established frameworks and policies that enhance flood risk management contributes to the vast number of Niger State population living in flood-exposed and prone areas with the urban poor being the most vulnerable groups (Adelekan, 2016).
Flood control is changing the natural state of flooding via engineering measures, to reduce flood disaster. It was first applied to control floods when humans realized that floods were inevitable but manageable (Kundzewicz et al., 2019; Zevenbergen et al., 2020; Abdi-Dehkordi et al., 2021).

2.2.1 Causes of Flood Disasters

The causes of flood disasters in Niger State can be attributed to a combination of natural and human factors. These factors exacerbate the vulnerability of some of the communities to flood disasters. Some of the major causes of flood disasters include heavy rainfall, climate change, poor drainage systems, rapid urbanization and increased construction of buildings and roads, bad environmental practices by residents, deforestation and soil erosion and low soil absorptive capacity (Okafor *et al.,* 2020; Agwu et al., 2019; UNEP, 2018; Oyegbile, *et al.*, 2018, Ukpere *et al.,* 2018).

3. Impact of Flood Disasters in Nigeria

3.1 Poverty Perpetuation

Flood disasters have continued to be a part of the major

factors hindering Africa's growing population of city dwellers from escaping poverty, and stands in the way of the Sustainable Development Goals of achieving 'significant improvement' in the lives of urban slum dwellers' (Action Aid, 2022).

3.2 Degradation of Communities' Socio-Economic Lives

Bariweni, *et al.,* (2012) revealed that the floods of 2012 in Nigeria had a major impact on socioeconomic life for days, weeks and even months in some areas. Roads and buildings were submerged thereby halting movements and victims were trapped due to blockage of road and damaged bridges (Nzeh, *et al*. 2012 cited in Ifeanyi-Obi, *et al*. 2017).

3.3 Increases Transportation Costs and Travel Time

Describing the impacts of flooding in Nigeria, Odunuga, *et-al*., (2018) revealed that 81% of respondents surveyed reported increase in transportation costs and breakdown of vehicles making travel difficult. Adelekan & Asiyanbi (2016) reported that more than half of all respondents surveyed had experienced property and damage worth more than NGN 52,000 (USD 330), which is more than one month's income for three-quarters of the respondents.

3.4 Environmental and Infrastructural Degradation and Destruction

Flood disasters destroy available infrastructure like roads, electricity, communication facilities, culverts and bridges, health centers, pipe borne water etc, thereby, causing shortages and degradation to the few that are left. The consequence of these is over pressure on the available infrastructure aftermath flooding, more expenditure for replacement and refurbishment (Abubakar, *et al*., 2020).

3.5 Increases Health, Sanitation and Environmental Hazards

Flood disasters have a very negative effect on the health and environment of residents because flood waters normally mix with sewage and contaminate drinking water most especially, well water and streams which serve as major sources of drinking water to rural communities (Nnaji *et al*., 2020).

3.6 Possibilities in Effective Flood Disaster Administration

The prospects of effective flood disaster management in Niger State are promising, with potentials for significant improvements in mitigating the impacts of flooding and enhancing the resilience of the state. Several factors contribute to these prospects and they include but not limited to enhanced awareness and education, improved early warning systems, strengthened infrastructure, collaborative approach and climate change adaptation (Ologunorisa *et al*., 2021: Nnaji *et al*., 2020, Ibimilua & Okereke, 2019)

Post-flood disaster mitigation strategies are crucial for effective recovery and long-term resilience-building in the aftermath of flood disasters. These strategies aim to address the immediate needs of affected communities, restore essential services, mitigate future flood risks, and promote sustainable development. The following are key post-flood management strategies:
Disaster Preparedness: as defined by Siriwardhana *et-al*. (2021) as disaster preparedness is "a set of activities, measures, and capacities developed by governments, private sectors, communities, and individuals before a disaster, to support vulnerable populations to mitigate the impact of hazards and to enable their effective response and recovery including developing early warning systems, evacuation plans, formulating emergency preparedness plans, conducting education/training programs, and prepositioning resources". It involves daily practices giving an overview of the level of influence of hazard perception of citizens on responsive actions in the face of disasters (Hatori *et al*, 2023)

On a similar note, Appleby-Arnold *et al.* (2021) conclude that daily disaster preparedness behavior by individuals can be strengthened by community-individual collaboration through the establishment of the recommendations amongst which include:

- Family should set up emergency plans, simple reminders, easy communication medium, and convergence points in situations of disasters,
- Individuals should lookout for publicly displayed information on how to prepare for disasters and form a habit of reading and memorizing this information,
- Enquire for and attend community workshops on disaster preparedness programs,
- Create bonds with individuals of other cultural backgrounds to foster better communication during an evacuation,

- Inform other participants and trainers of personal skills during workshops that could be useful to the community during disaster response.

4. Empirical Review on Related Studies

Funmilayo, Roohollah, Taofeeq, and Zina (2025), assessed surface water flood mitigation strategies: a global comparative review. They asserted that discourse on climate change has brought to the fore the pressing need for improved flood management strategies and that recent trends indicate a surge in flooding incidents in residential areas, capable of potentially disrupting socio-economic activities and result in loss of lives. The study conducts a Systematic Literature Review (SLR) to comprehensively assess and compare various flood mitigation strategies employed in residential zoning practices globally. Findings from the study highlight several key areas, including the impact of strategies on flood susceptibility, the effectiveness of rainwater harvesting systems and green infrastructure in flood management, and the importance of sustainable urban development and ecological preservation. Proposed strategies, such as neighbourhood and site planning, regional planning, storm water management, green roofs, permeable pavements, and regulatory measures, offer valuable pathways for safeguarding water resources in urban planning efforts.

Ayuba, Muritala, Gilles, Nasir, and Luc Vechot (2024) conducted a survey on pre-disaster preparedness/prevention and mitigation strategies for floods using Lagos, Nigeria as a case study. They argued that climate change-induced phenomena are increasingly becoming frequent and intense causing global challenges and that urbanization and population growth continue to aggravate flood events, making building resilient cities a vital way to combat them. The study reviewed flood preparedness and mitigation strategies employed in developed countries to reveal flood risk management practices that promote resilience in these countries to allow adoption in struggling and developing countries such as Nigeria. The review from previous and current studies followed three methods consisting of inclusion and exclusion criteria, abstract screening, and full-text review. The findings from past studies present multifaceted measures taken to prepare for and mitigate floods and how they have enabled people and cities to live with floods, however, developing countries still face a major risk of a severe impact from flood inundation.

Mostafizur, *et-al* (2024) surveyed flood preparedness in rural flood-prone area: a holistic assessment approach in Bangladesh Despite the many fatalities and injuries, the study evaluated flood preparedness in the flood-prone rural region of Dowarabazar Upazila, Sunamganj District, Bangladesh. Cross-sectional survey was conducted in Dowarabazar, an Upazila of Sunamganj District, susceptible to flooding in northeastern Bangladesh. Residents of this Upazila who were at least 18 years old were included in the sample. An in-person field study was performed. Dowarabazar Upazila is situated between 24°58^{i} and 25°11^{i} North latitude and 91°240 and 91°43^{i} East longitude and encompasses an area of 263.35 square kilometers (Bangladesh Bureau of Statistics 2011). It is bordered to the north by the Indian state of Meghalaya. Along with its 228,460 inhabitants, Dowarabazar Upazila was home to 42,693 households (Bangladesh Bureau of Statistics 2011). Compared to the national average of 51.8%, its literacy rate (for those aged 7 and over) was 30.38% (Bangladesh Bureau of Statistics 2011).The field survey had 596 respondents. As required, the study implemented Spearman's rank correlation and multiple linear regressions. Most respondents warned that floods might affect their homes. Many participants reported receiving flood-related information from locals. Most participants reported not being notified of flood forecasts and warnings in their area. The majority indicated that they sought refuge in flood shelters. A significant portion of the participants in the study were unaware of flood preparedness. Loss minimization and adaptability are deficiencies. Concerning flood preparedness, gender, age, occupation, monthly income, multiple sources of income, and house type are all significant determinants. Recommendation from the study was that authorities should thus take these factors into account while enhancing flood preparedness. In addition to implementing measures such as improving livelihood patterns and conducting educational campaigns, it is imperative to construct holistic flood preparedness.

5. Theoretical Framework

5.1 Emergency Management Theory

Emergency Management Theory is a theory of disaster and risk management propounded by an American expert in Emergency Administration David McEntire, in 2004. This theory was formulated in a bid to provide a pragmatic, proactive and reactive all-in-one paradigm for management of disruptive and hazardous phenomena after the terrorist attacks on the Pentagon and World Trade Centre on 11 September, 2001 in United States of America. This theory holds that disastrous emergencies are inevitable in the society and have the tendency of causing unrecoverable

effects unless responsible, immediate and urgent measures are taken in the dimension of preventing, responding, recovering and mitigating issues of these emergencies. It states that unless these measures and the strategies of executing them are put in place, the society is doomed to be marred by unrecoverable emergency situations that will threaten its existence.

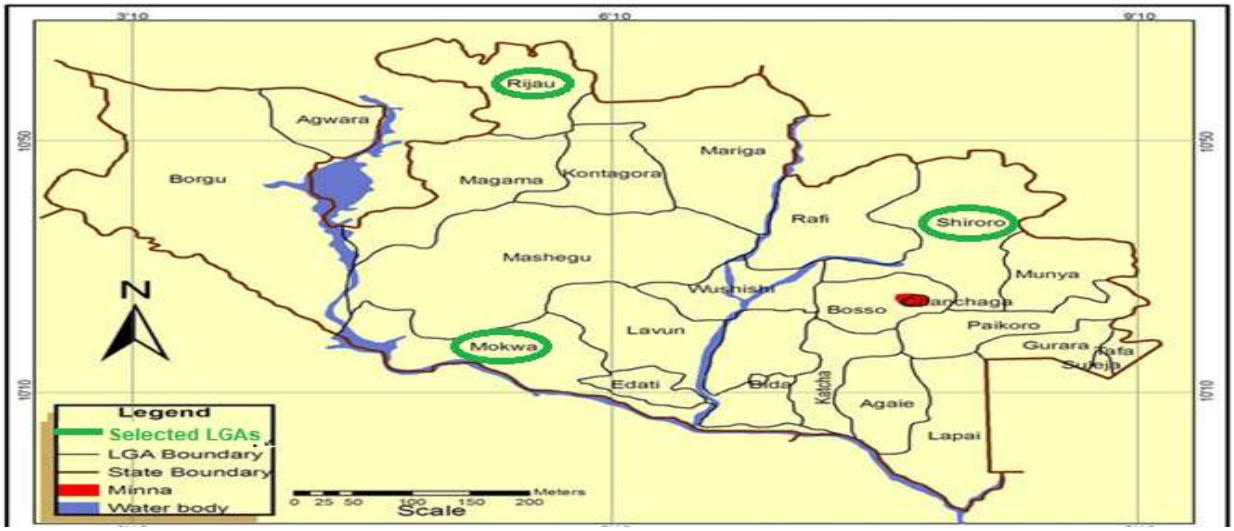
5.2 Thrust of Emergency Management Theory

The trust of EMT is Preparedness, pro-activeness, re-activeness and post-emergency actions. The theory holds that if the human species and society do not want to be likened to the extinct animal species, then they should evolve proactive, reactive and post-emergency occurrence measures and plans that will combat disastrous emergencies and their effects head-on. The measures to be adopted should be in line with the nature of the disaster and must conform to the following fundamental principles: Preparedness, Response, Recovery and Mitigation, (McEntire, 2004). This is to say that measures to be taken to curtail emergencies and their effects from ravaging and ruining the society should be measures taken pre-disaster occurrence in readiness for any eventuality of disastrous nature; measures taken to eliminate, suppress and/or reduce the effects of an already occurred disaster; measures taken to help the victims of disaster as at the time of disaster occurrence in terms disaster rescue; and measures taken to normalize the disaster affected area as well as disaster affected victims.

6. Research Methodology

The design adopted for this study is the descriptive survey design which involves the use of questionnaire for the collection of data. Under the survey research design, the primary data for this study was collected from 983263 population from Mokwa, Rijau and Shiroro Communities in Niger State

Map of Niger State, Nigeria showing selected Local Government Areas



Source: *www.nigerstate.gov.ng*

The population of the study comprises Mokwa 297,911, Shiroro 335,404, and Rijau 338,481 (3.5% World Bank annual projection from 2006 census).

To determine the sample Size, Taro Yamane (1967) formula was adopted as shown below:

$$\frac{n}{1 + N(e)^2} \qquad \frac{983623}{1+983623(0.005)^2} \qquad \frac{983623}{983624\ (0.0025)} \qquad \frac{983623}{2459} \qquad \frac{}{400} =$$

The sample size is therefore: 400

The sample size for each department is obtained using the formula below

$$\frac{\text{Total Number of each Department} \quad X \quad \text{Total Sample Size}}{\text{Total Number of Population}}$$

Table 2: below shows the specific Sample distribution.

S/n	Name of Community	Population	Sample Size/dept
1	Rijau	350,308	$\frac{350308 \times 400}{983623} = 142$
2	Mokwa	297,911	$\frac{297911 \times 400}{983623} = 121$
3	Shiroro	335,404	$\frac{335,404 \times 400}{986323} = 136$
	Total	986323	400

Source: *Field Survey; 2025*

Data were sourced from primary and secondary sources, analyzed, presented and hypotheses were tested using simple percentages, computer aided package known as Statistical Package for Social Sciences (SPSS):

7. Discussion and Summary of Major Findings

A total of 400 respondents were surveyed and 392(98%) respondents returned their questionnaires. 8(2%) didn't return their questionnaire duly completed. Among these respondents, 279(71.2%) were males and 113(28.8%) were females, 169(43%) are single, 127(32%) married, 49(13%) divorced, 19(5%) widowed and 28(7%) separated.

The age analysis of respondents showed that 290(73%) are between 18 - 47 years while 102 (27%) years are from 48 years and above.

On the question with regards to awareness on the flood mitigation measures adopted in selected communities in Niger State, 71(18%) strongly agreed, 34(9%) agreed, 4(1%) were neutral, 175 (45%) disagreed, while 108 (28%) strongly disagreed.
Also, on the respondents' level of awareness of the nature of flood mitigation measures adopted in their communities, 129(33%) favoured very high, 19(5%) favoured 6(2%) were neutral, 179 (46%) indicated low while 59 (15%) indicated a very low.

On the question with regards to the existences of differences in flood mitigation measures adopted in the selected communities, 90(23%) strongly agreed, 101(26%) agreed, 7(2%) were neutral, 123(31%) disagreed, while 71(18%) strongly disagreed.

On how whether local knowledge actually influences the respondents' participation in flood disaster mitigation in their community, 83(21%) strongly agreed, 93(24%) agreed, 50(11%) were neutral, 45(31%) disagreed while 121(31%).
On how effective are the flood mitigation methods in their communities, 77(20%) strongly agreed, 109(28%) agreed, 12(3%) were neutral, 89(23%) disagreed, while 105(27%) strongly disagreed.

With regards to whether community members get ready to respond to perceived flood events, 79 (20%), strongly agree, 75(19%) agree, 72(18%) were neutral, 91(23%) disagreed, while 75(19%) strongly disagreed.

On the challenges and prospects of effective flood mitigation measures in their communities, 141(20%) strongly agreed, 175(45%) agreed, 6(2%) were neutral, 39(10%) disagreed, while 31(8%) strongly disagreed.

With regards to any need for strengthening existing government policies/frameworks that promote and enhance sustainable flood disaster mitigation, 123(31%) strongly agreed, 179 (46%), agreed, 5(1%) were neutral, 53(14%) disagreed, while 32(8%) strongly disagreed.

8. Conclusion

The efforts towards flood disaster mitigation administration could be more effective via a combination of measures though with significant and productive community engagement. By engaging the community productively, riverine communities in Niger State can get involved in the formulation and implementation of Flood disaster mitigation approaches by taking ownership of such programmes. This will bring about effectiveness, efficiency and sustainability and eventually minimize the impacts of flood disasters, protect lives and property, and promote the well-being of the riverine communities.

9. Recommendations

Based on the discussion of mitigation and response measures to flood disasters in Rivers State, the following recommendations are suggested:

Infrastructural improvement and strengthening: there is need for infrastructure upgrade and strengthening as the current available infrastructure are obsolete, weak, deficient and inadequate. The various bridges, drainages, water channels and dams need to be strengthened and upgraded so as to be able to withstand the pressure arising from excess flow of water.

Pro-activeness: There is need for enhancing early warning signals for predictability, early evacuation and response. This could be through weather monitoring stations, and communication systems to alert residents and authorities about impending floods. Public awareness campaigns and sensitizations are also necessary to ensure the effectiveness of early warning signals.

Financial incentives and Insurance supports: the riverine communities that are vulnerable flooding could be organized into cooperative or action group so as to get a micro financial support to mitigate the impact of flood disaster on them. The can also be given the groups a small-scale insurance cover to compensate them in case of flood disaster and losses. Collaboration with financial and insurance institutions in this regard will help to develop affordable and accessible finance and insurance alternatives directed to the specific needs of riverine communities. The establishment of an emergency trust fund or programs to support affected individuals and communities during and after flood events will also go a long way in ameliorating flood disaster impact.

Enhanced productive community Engagement: effective and productive community engagement is pivotal for successful administration of flood disaster mitigation. This will promo will encourage community participation in decision-making processes, raise consciousness and awareness about flood risks, and provide training on emergency response procedures. It will also engender a sense of ownership and responsibility among community members and empower them to act proactively in order to reduce their exposure to flood disasters.

Deployment of innovation and technology: There is need for research efforts to understand the changing patterns and impacts of floods so as to develop applications that can assist residents of rural communities to identify impending flooding so as to foster innovation in flood management technologies and practices. This could be through advanced forecasting models and alternative decision models among others.

Environmental governance, administration and coordination: there is need for the enhancement of the coordination of the formulation, implementation, execution and enforcement of best environmental laws and practices. If properly administered, the enforcement of the various environmental laws and regulations will encourage compliance and eventually reduces environmental behaviours that increase flood disaster risks.

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