

**ASSESSING THE ROLES OF LOCAL COMMUNITIES IN SUSTAINABLE URBAN DRAINAGE FOR FLOOD MITIGATION IN AZARE, BAUCHI STATE, NIGERIA**

Muhammad Saidu<sup>1\*</sup>, Muhammed Amin Kodiya<sup>2</sup>, Mustapha Alhaji Modu<sup>3</sup>, Kelechi Friday Nkwocha<sup>4</sup>, Buba Wali<sup>5</sup> Harira Sadiq Ngoshe<sup>6</sup>

<sup>1</sup>Raw Materials Research and Development Council (RMRDC) Nigeria

<sup>2, 3 & 6</sup>Department of Geography, university of Maiduguri, Borno state Nigeria

<sup>4</sup>Department of Geography, Islamic University in Uganda

<sup>5</sup>Department of Urban and Regional Planning, Federal Polytechnic Kaltungo, Gombe state Nigeria.

Corresponding Author: [msaidyelwa@gmail.com](mailto:msaidyelwa@gmail.com)

---

**ABSTRACT**

Urban flooding is a growing concern exacerbated by inadequate drainage infrastructure and poor flood management practices in Azare. This research aimed at assessing the roles of local communities in sustainable urban drainage for flood mitigation in Azare, Bauchi state, Nigeria. It explores the extent to which community involvement contributes to the maintenance of drainage systems aimed at reducing flood risks as it has become recurrent event, having devastating effects on ecosystem, human livelihood and infrastructure. Data were collected using questionnaire, direct observation and interview involving community members, local authorities, and other stakeholders. Geospatial with majorly secondary datasets were also used for the study. The data were analysed using SPSS software and results were presented using descriptive statistics of frequency tables and content analysis. Majority (75%) of respondents confirmed that poor state of drainage was exacerbated by nonchalant attitudes of community members, mismanagement and indiscriminate waste disposal into drainages which led to blockage. The findings highlight that while local communities play an essential role in maintaining drainage infrastructure and raising flood awareness, limited resources, lack of technical knowledge, and minimal government support have restricted their capacity to implement long-term solutions. The findings also revealed that most of the respondents reported that efficient drainage systems aid in prevention of flood which is the major cause of water borne diseases in the study area. The study recommends that enhancing community participation, supported by government initiatives and capacity-building programs, is critical to achieving sustainable urban drainage and effective flood mitigation in the study area.

**Keywords:** Azare; Flood; drainage management; flood Mitigation

---

**INTRODUCTION**

Human activities such as agriculture, urbanization, and dam construction—carried out to meet infrastructure needs—have led to land use changes that increase flood risk and threaten ecosystem services in Azare. Flooding is a natural, recurring process with significant ecological benefits, but it can cause extensive damage in urbanized areas (Ibrahim, 2024). Urban expansion, in particular, plays a major role in worsening flood impacts. Alterations in land use, vegetation loss, higher rates of impervious surfaces, and urban encroachment contribute to increased runoff volumes and faster flow rates (Environmental Management Database, 2018). Although rapid urbanization is a recent trend, issues related to flooding and drainage have been intertwined with city development for centuries. Drainage infrastructure is a crucial component of urban life (Sowmya, 2024). When drainage systems fail, cities face heightened flood risk, potential environmental degradation,

disruptions in urban services, sanitation issues, and public health challenges (Belete, 2019). Throughout the history of urban development, rivers have served as essential resources, providing water supply, potential protection for urban areas, routes for transporting goods, and channels for waste disposal (Ladan, 2015). However, there is a paradox in the relationship between water and cities. While water is vital for urban life, the lack of adequate planning and infrastructure with urbanization often leads to the degradation of both urban areas and water resources (Asoegwu, 2019). As cities expanded, particularly during the industrial era, challenges related to urban growth intensified, leading to larger, more frequent urban floods (Olusegun, 2023). Various methods have since been developed to better manage water flow over time and space, but a more integrated and holistic approach is needed. Sustainable drainage solutions should incorporate urban renewal, river restoration, community involvement, and institutional support to ensure these solutions are widely accepted and maintained (Suleiman, 2021). In developing communities like Azare, stormwater drainage is considered a top priority for urban infrastructure, largely because homes are often built on unsuitable land. Many residents can only afford land near city centers to reduce travel costs, and as a result, often settle in areas unfit for habitation, or on land where they may be permitted to squat (Satterthwaite et al., 2017). In many cases, these settlements are located on steep slopes susceptible to erosion and landslides, or on low-lying, marshy lands prone to frequent flooding (Olajuyegbe et al., 2018). Flood-related challenges are widespread across Nigerian cities, particularly in Azare, where they carry significant social, economic, and health implications for the environment. Both land use changes and flood disasters remain critical topics in global environmental change research, policy development, and humanitarian aid. Residents in Azare have faced repeated flood events with severe impacts, resulting in the destruction of infrastructure like roads and bridges, loss of lives, damage to property, and land degradation, including gully erosion, landslides, and declining water quality. (Farida & Luwemba, 2022) These events have also disrupted health, business, education, and other aspects of community life (Adeleye & Rustum, 2019).

Numerous studies have examined the causes and impacts of flooding. For instance, Offiong and Eni (2017) found that rainfall duration significantly affects runoff volumes, contributing to infrastructure damage. Ahern et al. (2019) highlighted poor urban planning and the expansion of paved surfaces as key factors in the rising frequency of floods in Nigeria. Similarly, Adedeji et al. (2018) identified issues such as land use conflicts, increased surface paving, river channel encroachment, improper waste disposal, lack of physical development control, gaps in hydrological data, and cultural practices as primary causes of street flooding in Nigerian cities.

Ochere and Okeke (2017) specifically studied the social impacts and public perception of frequent flooding in Makurdi, revealing that these floods typically peak during the rainy season in August and September. Their findings further indicated that, beyond rainfall intensity, factors such as inadequate drainage, refuse disposal in water channels, local topography, river overflow, high water tables, urban expansion, and climate change also play significant roles in flood occurrence. Similarly, Abaje and Giwa (2018) in a study of urban flood in Kafanchnan town of Kaduna state showed that flood waters often jump artificial drains which are inadequate in some cases. In Azare, nearly 90 percent of natural hazards causing damages are caused by floods which are mostly related to drainage mismanagement and climate change (Doughlas et al; 2018). Floods in Azare have become recurrent phenomena, having devastating effects on ecosystem, human livelihoods and infrastructure. Unfortunately, the effect is felt more by some individuals than others, especially those depending mostly on cultivated land use in a way that recuperation is unlikely to be accomplished without external help. Azare have been affected by severe flooding resulting in loss of lives and of properties. Globally also floods cause about 69% of damages caused by natural disasters (Sule 2017). According to Senan et al, (2023) more than 70% of the causes of flood in Azare are directly related to mismanagement of drainages and poor land use practices, this is either due to strong relation between flood and land use practice or due to destructive nature of floods. There is therefore urgent need for adequate researches in the study area on floods which are currently lacking, there is need for adequate funding on drainage management for flood control in the area and there is also serious need for adequate information on flood events which would help policy makers take right decision and make best choices.

## **MATERIALS AND METHODS**

### **Study area**

Azare is situated within the Sudan Savanna ecological zone of Nigeria, and it lies approximately between Latitudes ( $11^{\circ}40'38''$  to  $11^{\circ}42'46''$  N) and Longitudes ( $10^{\circ}11'52''$  to  $10^{\circ}31'17''$  E) (Figure1). It covers an area of 1,436km<sup>2</sup>, it shares borders with Dambam Local Government to the east, Jamaare Local Government to the west, Misau Local Government to the south and Itas/Gadua Local Government to the north respectively (Abba & Rabi, 2017). The geology of the area composed of Quarternary Chad formation. But locally consists of Kerri-Kerri formation on top of Early Paleozoic Basement complex rocks. The local geology consists of sediments of unconformable overlying the Precambrian to Early Paleozoic Basement complex rocks (Dahuwa et al. 2024). The climate of Azare is tropical in nature, there are two distinct seasons, the wet and

dry seasons, the wet season begins in May/June and ends in September/October, the peak of the rain is in August, the annual total rainfall ranges from 500mm to 800mm. The dry season lasts between November and April with daily maximum of 24°C – 33°C and minimum of 16°C – 24°C (Ali, 2011; with elevation ranging from 382.4 m to 423.6m above sea level. The area is drained by river system such as River Jama'are which trails from River Gongola that originates in Jos Plateau area of the north central part of the country. It thwarts and transverses in southwest direction through Dass, Tafawa–Balewa, Bogoro, Bauchi and Kirfi and thence to Gombe state and to northeast direction through Jamaare, Zaki, Hadejia, Gashua and River Kumadugu Yobe in Yobe state.

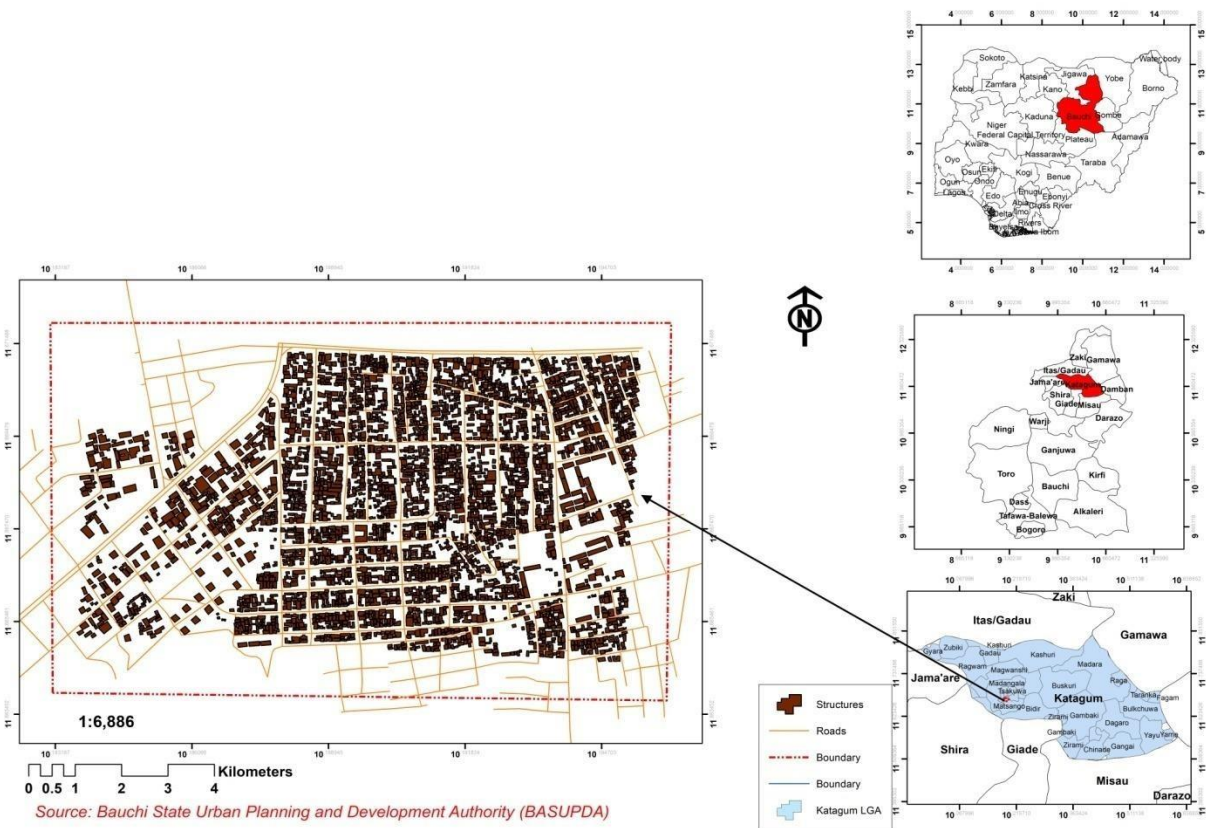


Figure 1: Location of Azare showing the study area Source: Google Earth Image, 2023.

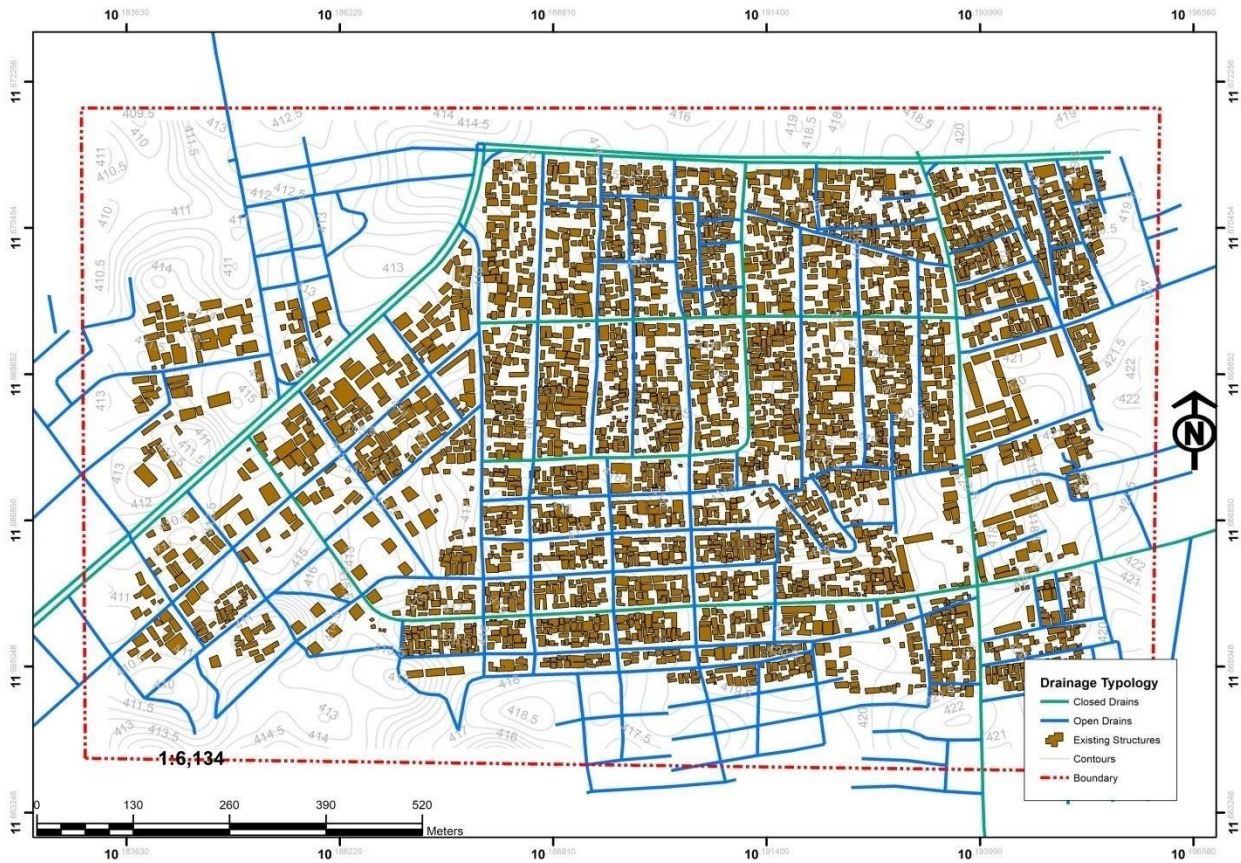


Figure 2: Drainage Typology Map the study area Source: Google Earth Image, 2023.

## SOURCES OF DATA

The methods adopted for this study were exclusively geospatial with majorly secondary datasets. 2023 Satellite imagery: downloaded from United States Geological Survey (USGS) Google Earth platform Rainfall data: Famine Early Warning Systems Network (FEWS NET/ USGS CHIRPS) and UN Climate Research Unit (CRU) LGA boundary and communities: acquired from the Bauchi State Urban Planning and Development Authority. Water bodies Shapefiles and roads: digitized from the satellite imagery and soil data obtained from the Food and Agriculture Organization (FAO) Harmonized World Soil Databases.



## **Primary source**

Primary data generated from households included data on causes of poor drainage system, effects of flood, attitudes and perception of the community members on flood and mitigation measures to be used for flood control in the study area using questionnaire and interview.

## **Secondary sources**

Secondary data involved information on both urban drainage management and flood hazards. Sources from Bauchi State Environmental Protection Agency (BASEPA), National Emergency Management Agency (NEMA) and previous literatures reviewed from Food and Agricultural Organization of the United Nations, Belgium-based Centre for Research on Epidemiology of Disasters (CRED) were used for the study. Other sources included documents from research journals, books and internet documents. Other sources include reports, academic thesis, articles and publications

## **SAMPLING FRAME**

The study area consists of 8,700 households (NPC, 2019) residences in Azare town, Katagum Local Government Area of Bauchi State. The sample size for 8,700 households is 385, using the Krejcia and Morgan (1979) table of sample size determination for population proportion at 0.5 and 95% confidence level. Therefore, a total number of 385 household heads participated in this study. Simple random sampling method was used in selecting the household heads for this study. A total of 25 household heads were selected from each of the 6 most populous wards of the study area (Tatari Ali Quarters, Matsango, Makara Huta, State Low Cost, Gandun Wambai and Chara-Chara wards). Then a total of 16 household heads were also selected from each of the remaining 9 low populous wards of the study area (Kujuru, Tsakuwa, Nasarawa 'B', Nasarawa 'A', Kofar Gabas, Sabuwar Misra, Madangala, Katsalle and Shetima Mustapha Estate).

## **PROCEDURE FOR DATA COLLECTION**

An ethical approval for this study was sought and obtained from the Department of Environmental Management, Bayero University Kano, before the commencement of the study. Informed consent was obtained from all the 385 participants for the purpose of the study after the content of the questionnaire has been fully explained to them. The questionnaire was given to the respondents and procedure for filling the questionnaire was fully explained.

## **RESULTS AND DISCUSSIONS**

Descriptive statistics (which involved use of frequency tables, percentages, charts and graphs) was used to analyze the data collected from the respondents, this involved use of explanatory variables, tables and charts for data presentation using SPSS. However, simple percentage was used to compute, analyzed, and interpreted the data on nature of drainages, effects of flood, attitudes and perception of the community members and mitigation measures employed for flood control in the study area. This was chosen based on the fact that the researcher was convinced to have an optimum outcome from the data gathered which was analyzed, computed, described and interpreted and a concise analysis was also presented.

### **ATTITUDE AND PERCEPTION OF COMMUNITY MEMBERS ON FLOOD**

#### **Lack of Coordination between Departments Facilitates Flood**

Results revealed that attitudinal and operational issues of mismanagement were exacerbated by lack of effective arrangements in sections of monitoring, inspection and proper drainage cleaning in Azare. This tends to be related to lack of resources, manpower and appropriate equipment, what made the situation worse in Azare was separation of departments responsible for solid waste management from that responsible for drainage cleaning and coordination between two different sectors was poor, this led to waste going back to drains after it was being pulled out and left at bank of open drains waiting for those responsible for evacuation, this was explained to me by specialists in Bauchi State Environmental Protection Agency (BASEPA), Bauchi State Ministry of Land and Survey (BSMLS). Absence of coordinating structure to unite and focus the energies of different actors was major contributory factor. The consequences had been interorganizational conflict, inefficient utilization of scarce resources and costly undoing of one agency over another's accomplishments. All these boomerang on community by introducing a number of inconveniences, ill functioning of integrated parts of community system and introduction of diseases. These findings were similarly identified by Amaize (2017) in fifty villages of Delta State whom stated that lack of coordination between responsible departments facilitate floods.

#### **Attitude of Raising Unplanned Structures with Poor Sanitary Sewer System**

The result revealed that the ancient part of the town consist of settlements which comprised hundreds of one-room houses constructed initially from corrugated iron sheets with thatched roofs and rusted iron sheets. Average house size was very small, measuring just about 3 x 3m in plan.

These houses were typically built in blocks of six, eight or ten single rooms on a plot of land with shared walls and a single pitched roof covering all the rooms. Each room had a door, a single small window and was a home to, on average, a family of six members or so. There were no private outdoor spaces. Hence most of the oldest housing structures were dilapidated, decayed and harbored a lot of youths from neighboring villages that hawked kola nuts, cigarettes, mangoes, pushed wheel barrows or carried loads on their bare heads for petty payments in order to earn a living. Most of these houses in the arena had rusted iron sheets with holes as roofs and were built haphazardly not in any way to allow for draining of domestic waste water unless through use of pipe or wall of basement and no proper drainage can be excavated therefore aggravated floods which went a long way in destruction of lives and properties.

The result revealed that about 34.81% of the respondents drain domestic waste water through floor of basement, while 36.36% drain their domestic waste water through wall of basement and only 28.83% of the respondents drain their domestic waste water through ejector pump system. The attitudes of neglecting water stagnation were among the issues that cause accumulation of water in the settlements which had severe consequences on the community. This was similarly identified by Ocheri and Okeke (2017) in Makurdi Town, Benue State whom stated that raising unplanned structures facilitates flood.

<b>Type of sanitary sewer system</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Drains out of house through floor of basement	134	34.81
Drains out of house through wall of basement	140	36.36
Drains out of house through ejector pump system	111	28.83
Total	385	100

Source: Field Survey, 2023

### **Perceived Importance of good Drainage System**

The result revealed that about 26.23% of the respondents believed that drainages were of immense importance in a number of different ways such as prevention of flood and stagnation of water, while 13.25% ascertained that they ensure free flow of liquid waste and also about 13.25% claimed living free of numerous diseases so long as the drainages function as designed while 47.27% cited all the above as benefits of a good drainage system.



On the other hand, poor quality drainage, inadequate coverage, low level of community participation and weak integration of various responsible stakeholders were some of the major challenges of drainage infrastructure in the area that caused blockage which led to foul fermented water from the blocked drainage channels finds its way back into structures. These findings were similarly identified by Amaize (2017) in fifty villages of Delta State whom identified the advantages of proper drainage system.

<b>Community Perception on importance of good drainage system</b>	<b>Frequency</b>	<b>Percentage (%)</b>
prevention of flood and water stagnation	101	26.23
Living free of diseases	51	13.25
Ensuring free flow of storm water	51	13.25
All of the above	182	47.27
Total	385	100

Source: Field Survey, 2023

### **Community Perception on Importance of Drainage Management**

Result confirmed that construction of drainages was more or less a waste if not properly managed. Performance of drainages was not only attributed to how effectively it was constructed but utilization and management also played significant roles according to 74.81% of the respondents who perceived the management as very important. About 23.64% of the respondents' perceived management of drainages as important and only about 1.56% perceived it as not important.

Presence of waste, growing plants and blockages challenged smooth runoff of drainages. These challenges did not only retard flow in drains, but also increased overflow conditions. It was clear that the drainage challenges within Azare were as a result of poor management of the drains themselves. This had succeeded in the creation of weeds and stagnation of water. The community itself believed that adequate and proper participation in drainage operation and management is the only confirmed and sure way of getting desired and required services of the urban drainage system. This result was supported by the findings of Ocheri and Okeke (2017) in Makurdi Town, Benue Stated whom identified the importance of community participation on drainage management.

**Community Perception on importance of Drainage Management**

	<b>Frequency</b>	<b>Percentage</b>
Very important	288	74.8
Important	91	23.64
Not Important	6	1.56
Total	385	100

Source: Field Survey, 2023

**Community Perception on drainage management**

The result confirmed according to 47.01% of the respondents that drainage issues can only be effectively addressed holistically through effective community participation, about 23.90% maintained that it can only be achieved through commitment from the government and municipal authority and only 5.45% claimed that the issues can be addressed by commitment from the individual residents while 23.64% of the respondents confirmed that the drainage issues can only be addressed by adhering to all the mentioned principles and etiquettes. This result in line with the findings of Abba and Rabi (2017) in semi-arid zone of northeastern Nigeria, who also identified methods of solving drainage problems for flood control.

**Community Perception on drainage management**

	<b>Frequency</b>	<b>Percentage (%)</b>
Through effective community participation	181	47.01
Through resident’s commitment at individual level	21	5.45
Through commitment from municipal/government authority	92	23.9
All of the above	91	23.64
Total	385	100

Source: Field Survey, 2023

## Perceived Benefits of Community Participation in Drainage Construction

Result revealed the strong community belief that participation in the area of providing adequate drainage system was of immense importance in a number of way as 25.45% of the respondents ascertained that this facilitates responsible use of the drainage system, while 20.52% claimed that it helps in development of a sense of ownership, about 28.31% maintained that it assists in satisfactory management of the drainage system and 25.72% claimed that it aids in achieving all the above criteria.

Concerning the drainage infrastructure provision in Azare urban area, the major issues associated with it were poor coordination and integration towards its betterment among the stakeholders. Moreover, community participation was among the lowest attention drainage system received in the town. This was as 77% of the respondents proved that there was no community participation in one way or the other for drainage provision. This therefore means that government was the only body responsible solely for the provision of this service with a very little or no efforts on the part of the community. This result was similarly identified and corroborated by the findings of Tucci (2016) in developing countries as advantages of proper drainage system for flood control.

<b>Benefit of community participation for drainage management</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Facilitation of the responsible use of the drainage system	98	25.45
Development of sense of ownership	79	20.52
Satisfactory maintenance of the drainage system	109	28.31
All of the above	99	25.72
Total	385	100

Source: Field Survey, 2023

## CONCLUSION

The study has established that the role of local communities in sustainable urban drainage for flood mitigation in Azare, Bauchi State, Nigeria, is critical to addressing the city's growing flood challenges. As urban expansion and infrastructure development continue, effective management depends not only on technical solutions but also on community engagement and participation. The findings indicate that when local communities are actively involved in urban planning, drainage maintenance, and environmental management, flood risk is significantly reduced. Community awareness and proactive participation in drainage system upkeep, waste disposal practices, and flood

preparedness enhance the effectiveness of flood mitigation measures. Moreover, local knowledge and experiences of residents offer valuable insights that can inform more resilient infrastructure and adaptive urban planning strategies. Public outreach, education, and community-led initiatives can strengthen the local response to flood risks, fostering a sense of ownership and shared responsibility for sustainable urban drainage. The study recommends the need to Encourage and support local flood preparedness groups that can participate in flood risk assessments, disaster drills, and emergency response planning. These groups can serve as vital communication channels between the government and residents, ensuring faster response during flood events and reinforcing community resilience.

## References

- Abba, S. and Rabi, T. (2017). Peoples' Perception of Environmental Degradation in the SemiArid Zone of North Eastern Nigeria. *Journal of Environment and Earth Science* [www.iiste.org](http://www.iiste.org) ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online).5, (11): 32-33 2017.
- Abaje, I.B. and Giwa, P.N. (2018). Urban Flooding in Environmental Safety: Urbanization, Resources Exploitation and Environmental Stability, Association of Nigerian Geographer book of proceedings of the 4th annual conference held in the department of Geography, University of Abuja, 15th-19th October, 2017. Kaduna, Joyce publishers.
- Adedeji.B, H. Bashir, O., Bongwa A, and Oladesu, O. (2018). Floods of Fury in Nigerian Cities. *Journal of Sustainable Development*. 5(7):. 69-79.
- Adeleye, A. and Rustum, R. (2019). Flooding and Influence of Urban Planning. *Journal Urban Design and Planning (ICE)*. 164(3):. 175-187.
- Amaize, E. (2017). "Flood Displaces 50 Villagers in Delta State", in Vanguard: Towards a Better Life for the People. Lagos: Vanguard Media Limited. Monday, July, 4. 9.
- Asoegwu, R. N. 2019. Enforcing Environmental Laws and Regulations: Levels of Responsibilities. *Journal of Environmental Management and Safety*, (9): 26-31.
- Ahern, M., Few, R., Matthies, F and Kovats, S. (2019). Floods, Health and Climate Change: A Strategic Review". Working Paper (63):. 23-25. Tyndall Centre for Climate Change Research.
- Belete, D.A., 2019. Road and Urban Water Drainage Network Integration in Addis Ababa: Addis Katema Sub-city. *Journal of Engineering and Technology Research*. 3(7):. 217-225.
- Douglas, I., Alam, K., Maghenda, M., McDonnell, Y., McLean, L., and Campbell, J. (2018). Unjust waters: Climate Change, Flooding and the Urban Poor in Africa. *Environment and Urbanization*, 20(1):. 33-35
- Dahuwa, D., Dalhatu, S. A., & Ahmed, H. (2024). Analysis of Lineaments Pattern over Azare and Its Adjoining Area using Aeromagnetic Data. *Journal of Systematic, Evaluation and Diversity Engineering*.
- Geldof, G. D. and Starhre, P. 2016. On the road to a new storm water planning approach: from Model A to Model B (Water practice and Technology). 1(1):. 2-5. IWA Publishing.
- Ibrahim, M., Huo, A., Ullah, W., Ullah, S., Ahmad, A., & Zhong, F. (2024). Flood vulnerability assessment in the flood prone area of Khyber Pakhtunkhwa, Pakistan. *Frontiers in Environmental Science*, 12, 1303976.
- Banerjee, S. G. and Morella, E. 2017. Africa's Water

- and Sanitation Infrastructure: Access, Affordability and Alternatives. The International Bank for Reconstruction and Development/World Bank, Washington, D. C. U.S.A.
- Krejcie R. V., and Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychology Measurement*, 2 (30), 607-610.
- Ladan, S. I. (2017). An Analysis of Urban flood in Katsina Metropolis, Katsina State. In *Urbanization, Resource Exploitation and Environmental Stability in Nigeria* AGN Joyce publishers, Kaduna.
- Ladan, S. I. (2007). An Analysis of Urban flood in Katsina Metropolis, Katsina State. In *Urbanization, Resource Exploitation and Environmental Stability in Nigeria* AGN Joyce publishers, Kaduna.
- Nantayi Farida & Luwemba Musa, 'A Panoramic View of the Flood Problem in Eastern Uganda: Lessons from Pakistan and India', Vol. 2 No. 1 (2022)  
<https://journals.iuiu.ac.ug/index.php/ijjss/article/view/175/151>
- Satterthwaite, D., Saleemul, H., Mark, P., Reid, H. and Romero, P. (2017). "Adapting to Climate Change in Urban Areas: The Possibilities and Constraints in Low- and Middle-income nations" Human Settlements Discussion Paper Series.
- Ocheri. M. and Okeke, E. (2017). Social Impact and People's Perception of Flooding in Makurdi Town Benue state Nigeria. *Perspectives from West Africa*: published by Sunny Publications 3. (8): 30-42.
- Olajuyigbe, A. E. Rotowa, O.O. and Durojaye, E. F. (2018). An Assessment of Flood Hazards in Nigeria: The case of Mile 12 Lagos. *Mediterranean J. of Social Sciences* 3 (2): 367-375.
- Olusegun, A. T. (2023). Challenges and Potential Solutions to Pluvial Flood Risk in Urban Tropical African Communities a Case Study Using Ijebu-Ode in South West Nigeria (*Doctoral dissertation, The University of Liverpool (United Kingdom)*).
- Tucci, C. E. M. (2016). Urban Drainage Issues in developing countries, in: *Urban Drainage in Humid Tropics*, C. E. M. Tucci (ed.), *Urban Drainage in Specific Climates*, C. Maksimovic (ch. Ed.), UNESCO Technology Documents in Hydrology, 1 (40); 23-40.
- Senan, C. P., Ajin, R. S., Danumah, J. H., Costache, R., Arabameri, A., Rajaneesh, A., ... & Kuriakose, S. L. (2023). Flood vulnerability of a few areas in the foothills of the Western Ghats: a comparison of AHP and F-AHP models. *Stochastic Environmental Research and Risk Assessment*, 37(2), 527-556..
- Sowmya, C. (2024). Recent developments and inventive approaches in vertical farming. *Frontiers in Sustainable Food Systems*, 8, 1400787

Suleiman, L. (2021). Blue green infrastructure, from niche to mainstream: Challenges and opportunities for planning in Stockholm. *Technological Forecasting and Social Change*, 166, 120528.

Sule, R.O. (2017). Urban Development Planning Framework: Nigerian Experiment. Thumbprint International Company, Calabar