

# Sokoto Journal of Geographical Studies (SJGS)



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# **Sokoto Journal of Geographical Studies (SJGS)**

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**Department of Geography, Sokoto State University, Sokoto  
P.M.B. 2134, Along Birnin Kebbi Road, Sokoto State-Nigeria**

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All correspondence shall be addressed to:

Secretary Editorial Board,  
Sokoto Journal of Geographical Studies  
Department of Geography  
Faculty of Social and Management Sciences  
Sokoto State University, Sokoto  
P.M.B 2134, Along Birnin Kebbi Road, Sokoto State-Nigeria

Tel: 080-6950-1786 (Secretary Editorial Board)

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## ASSESSING THE IMPACTS OF EXTREME HYDROLOGICAL EVENTS AND FLOOD VULNERABILITY IN LOKOGOMA COMMUNITY, ABUJA, NIGERIA

Abubakar SADIQ<sup>1</sup> & Mohammad Abdul-Rahman Muslim<sup>2</sup>

<sup>1</sup>Geography Department, Federal University of Technology, Minna

<sup>2</sup>Department of Urban and Regional Planning, Federal Polytechnic Bida



Corresponding Author's Email: [sadiq.abubakar@futminna.edu.ng](mailto:sadiq.abubakar@futminna.edu.ng)

### Abstract

*This study evaluates the impact of extreme hydrological events, particularly flooding, on the Lokogoma community in Abuja, Nigeria. With rapid urbanisation and the accompanying destruction of natural vegetation and expansion of impervious surfaces, the area has become increasingly susceptible to surface runoff and recurrent flooding. The study adopts a mixed-method approach comprising field observations, community surveys, and interviews with residents and local authorities to assess both the causes and consequences of flooding events, and analysed the data with an Excel-based hazard identification working tool developed by the Institute for Housing and Urban Development Studies (IHS). Findings revealed that flood is the most devastating hazard, with an exposure index of 63.33% and a hazard impact index of 77.5%. The second most impactful hazard is drought, with an exposure index of 40%, and a hazard impact index of 42.5%, while the overall exposure index for extreme hydrological hazards in Lokogoma is 32.67%. Physical capital, particularly infrastructure, has the highest vulnerability index of 77.08%. The socio-economic impacts are widespread, including the destruction of residential buildings, loss of personal property, disruption of livelihoods, and power outages resulting from damaged installations, and was estimated at over ₦1,000,000 per household. Furthermore, the study highlights the psychological toll on residents, who experience stress, trauma, and displacement during flood events. The study recommends collaborative efforts between Lokogoma residents and local authorities to develop and implement a comprehensive flood management plan. This should include constructing new drainage systems, maintaining existing infrastructure, and promoting flood-resilient building practices to enhance the community's adaptive capacity.*

**Keywords:** Adaptive Capacity, Exposure Index, Extreme Hydrological Event and Flood Vulnerability.

### Introduction

Extreme hydrological events are rare or severe disturbances that occur in the hydrologic cycle, often caused by climatic or geologic factors such as intense rainfall, tectonic activity or prolonged heat waves. These disturbances are often associated with excesses or deficiencies in water, leading to floods, storm surges, tsunamis, or drought. Each of these types of events can potentially impact water quality and also cause severe disaster (Konapala, Mishra, Wada, & Vörösmarty, 2020). The Intergovernmental Panel on Climate Change (IPCC, 2021) highlighted that global warming is contributing to the increased frequency and intensity of these events, especially floods and droughts, as they pose growing risks to human and environmental systems. The continuous warming of the atmosphere by greenhouse gases over the 21st century has made scientists conclude that extreme precipitation, extreme heat, and drought are likely to increase in both intensity and frequency in many regions of the world (IPCC, 2014).

Climate change is intensifying extreme hydrologic events globally, with the frequency and severity of floods and droughts rising significantly. Observations from NASA's GRACE satellite mission indicate that hydrologic extremes have more than doubled between 2002 and 2023

(NASA, 2023). This is supported by climate model projections (e.g., CMIP6), which predict up to a fivefold increase in the frequency of very wet years in tropical regions by the late 21st century under Representative Concentration Pathways (RCP8.5) “business-as-usual” scenarios (Cai et al., 2021). The underlying mechanism is largely thermodynamic, as the atmosphere holds approximately 7% more water vapour per 1°C of warming, intensifying precipitation extremes (Myhre et al., 2019).

In West Africa, especially Nigeria, long-term trends show increasing rainfall intensity and variability. For instance, Oguntunde et al. (2020) documented statistically significant increases in RX5day, PRCPTOT, and heavy rainfall days across Nigeria from 1970 to 2013. More recent simulations using CORDEX-Africa data project increases of up to 24% in 5-day rainfall maxima in southern Nigeria under RCP8.5 (Owolabi et al., 2022). In the Federal Capital Territory (FCT), Abuja, a climate risk assessment (1983–2010) identified a 33.5% decadal rainfall variability, while river discharge modelling shows a projected increase of up to 3,652 m<sup>3</sup>/s in peak wet season flows near Abuja under future scenarios (Abdulkadir & Garba, 2023).

Flooding is widely recognized as one of the most frequent and destructive environmental hazards in Nigeria, both in terms of spatial coverage and socioeconomic impact. According to the Nigerian Meteorological Agency (NiMet) and the National Emergency Management Agency (NEMA), floods affect over 80% of Nigerian states annually, with flash floods and riverine flooding being the most common types (NEMA, 2022). The devastating 2012 nationwide floods displaced over 2.1 million people, damaged 597,476 houses, and caused an estimated ₦2.6 trillion (US\$17 billion) in economic losses, making it one of the most catastrophic flood events in West African history (Adelekan, 2016). More recently, the 2022 floods affected 33 out of Nigeria’s 36 states, displacing over 1.4 million people and resulting in over 600 deaths (UN OCHA, 2022).

Similarly, involuntary human mobility is often driven by water-related environmental hazards like floods and droughts. In the past decade, over 100 million internal displacements worldwide have been caused by floods, accounting for almost half of all weather-related displacements (IOM, 2023). According to the United Nations Convention to Combat Desertification (UNCCD, 2022), drought accounts for 15% of all natural disasters but has a significant effect on human existence, as approximately 650,000 deaths were recorded from 1970–2019. In 2022, about 160 million children were vulnerable to severe and extended periods of drought, while 2.3 billion people faced water stress globally. If necessary, actions are not stepped up, by 2050, droughts may affect over three-quarters of the world population.

Urban areas such as Lagos, Ibadan, Port Harcourt, and Abuja are particularly vulnerable due to rapid urbanisation, poor drainage infrastructure, and increasing rainfall intensity linked to climate change (Olowoporoku, 2020). These patterns consistently reinforce flooding as a recurrent and intensifying hazard in Nigeria's environmental risk landscape. These projections underscore the urgent need for improved urban resilience. Settlements like Lokogoma, situated in low-lying parts of Abuja, face heightened flood risk. Adaptive strategies must prioritize upgraded drainage systems, hydrological monitoring, and integration of climate models into spatial planning to mitigate climate-induced hydrologic extremes.

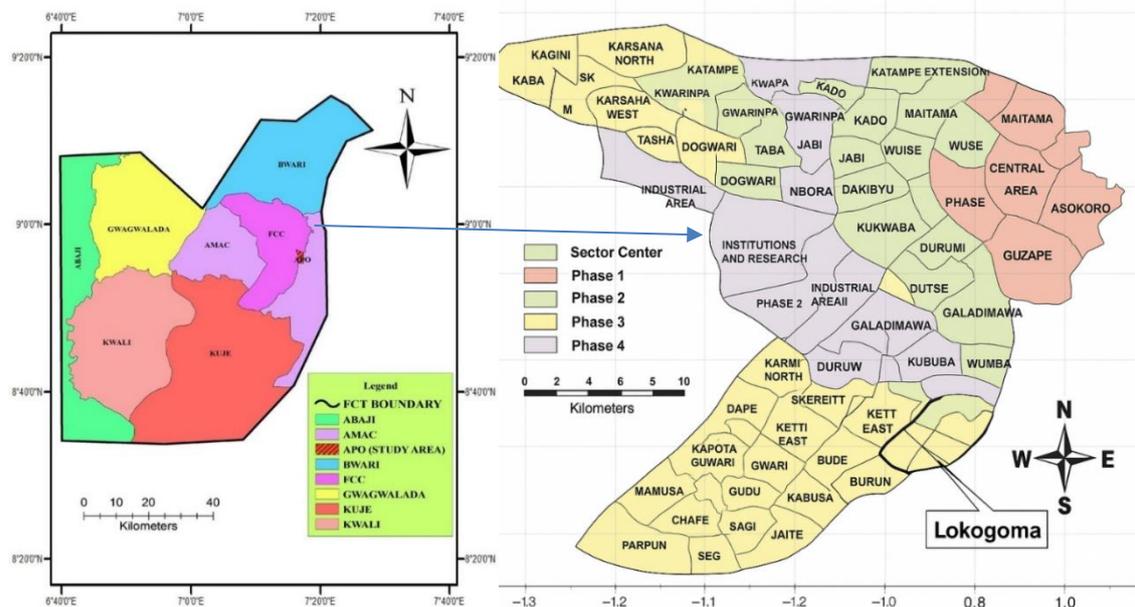
Abuja is a well-planned city with a comprehensive master plan that strategically incorporates measures to address natural occurrences like drought, heat waves, landslides, and flooding, ensuring proactive disaster management. In planning city areas, certain areas were identified as flood plains and natural watercourses on which development of any kind is prohibited. Also prohibited are constructions of any kind on designated water and sewer lines. These prohibitions are for very obvious reasons. Construction in these areas can lead to property damage and loss of lives. That is the case of the Lokogoma district in Abuja, where people have

lost their lives and properties worth hundreds of dollars over the last couple of years due to floods in the area. Also, the rivers Kabusa and Wamba have their natural courses running through the Lokogoma community, with illegal structures blocking natural waterways and floodplains, which has further aggravated extreme hydrologic problems in the community. However, immediate remedial measures need to be taken to prevent future occurrences. It is against this background that this research work aims to assess the impact of hydrological extremes in the Lokogoma community, Abuja, Nigeria.

**Materials and Methods**

**The Study Area**

The study area, Lokogoma, is a fast-growing suburban community located in Abuja, Nigeria. It is located within latitude 8.99100N and 9.00000N and longitude 7.47150E and 7.48200E at an elevation of 234 metres above sea level, in the southern part of the Abuja Municipal Area Council (AMAC), along the Lokogoma – Kafe road. Lokogoma has become a notable residential area due to its proximity to the central business district (which is about 25-30 minutes’ drive) and its relatively affordable housing when compared to those in the city centre. The district is bordered to the north by Apo and Gudu districts, to the south, it extend toward Dakwo and Galadimawa. Lokogoma has undergone a lot of development in recent years and this has significantly increased the population in the area. A number of gated houses and new estates like Crown Estate, ACO Estate and SunnyVale Estate, have sprung up along the Lokogoma expressway (Blog NaijaSpider, 2021).



**Figure 1: Locational Map of Lokogoma in F.C.T.**

Lokogoma is prone to seasonal flooding especially during the rainy season. This has been exacerbated by poor drainage network and rapid urban development. The Federal Capital Territory Administration (FCTA) have tried to ensure that people do not build on the floodplain by demolishing several structures in 2019 following a fatal flooding incident, as these structures are deemed to be obstructing water flow and contributing to the flooding problem (Premium Times, 2019). Despite this effort, more residential buildings are still being erected in Lokogoma community, necessitating the need to evaluate the impact of water extreme events in the community.

## Sampling and Data Collection

Quantitative and qualitative research techniques were adopted for the study, specifically, the sequential explanatory mixed method for deeper understanding of the environmental condition of the study area. Particularly, field survey and checklist were employed to identify patterns, hazard frequency, severity and determine spatial exposure, while, field observation, informal interview, and a detailed semi-structured questionnaire were administered to the residents of the Lokogoma community to collect data related to extreme hydrological events, understand community perceptions on hazards occurrence and barriers to resilience.

The estimated population of Lokogoma community ranges between 68,000 and 102,000 residents. According to the National Bureau of Statistics (NBS) and National Population Commission (NPC), AMAC is projected to be approximately 1.7 million population as at 2022, and Lokogoma is believed to constitute around 4% to 6% of AMAC's population, given its high density of gated estates, and its strategic position within the fast-developing Kabusa Ward (NBS, 2022; NPC, 2022). A purposive sampling method was employed in selecting the respondents. Though extreme hydrological events affect a significant percentage of the populace in the community, a total of 100 questionnaires were administered to residents in five estates identified as high-risk zone for urban flooding based on drainage infrastructure characteristics and 88 questionnaires were retrieved, while 20 stakeholders like the traditional/community leader, local council representative (for emergency services and urban planning), NGOs, youth leader, women leader, estates chairmen, head of government healthcare facility in the community, and head of security in the community were interviewed. Each of these stakeholders has distinct roles and responsibilities to ensure effective disaster management in the community.

The questionnaire was designed to solicit information for identifying the most common hazard in the study area, examine the exposure index and adaptive capacity of the community to the hazard, develop a hazard problem tree for solution identification, and proffer solutions to the problems.

## Data Analysis

The data collected was analysed using an Excel-based hazard identification working tool developed by the Institute of Housing and Urban Development Studies (IHS), Erasmus University Rotterdam, and presented with the aid of descriptive statistics. While IHS offers several urban management and climate resilience toolkits (e.g., CDS, CLIMATE Prio, CAST 2.0), published applications of their Excel-based hazard identification working tool appear limited in peer-reviewed literature. Further inquiry with IHS practitioners may reveal field implementation. For more information on IHS's operational frameworks, see their Tool and Toolkits paper (IHS, 2025).

In completing the hazard identification and exposure index table (Table 1), a field survey was conducted to enquire from the selected community representative on the most common hazards and their potential effects on the sector (i.e., environment). These were filled in columns 1 and 2, respectively. The specific impacts to be considered in this research are economic impact, frequency (annual probability), duration of the hazards, loss of life, spatial extension (Km<sup>3</sup>), and infrastructure (reconstruction cost). For each of these impact columns, a value between 1 and 5 according to the proposed scale: 1 (lowest) and 5 (highest) to indicate the level of exposure to this hazard. The scale for each of the impacts is classified as follows:

**Economic impact** (₦ per household): 1 ≤ ₦225,000; 2 ≤ ₦450,000; 3 ≤ ₦675,000; 4 < ₦900,000; 5 more than ₦1,000,000.

**Frequency** (year probability): 1 = some years; 2 = 1 in 3 years; 3 = 2 in 3 years; 4 = one per annum; 5 = 2 per annum.

**Duration** (days/year):  $1 \leq 5$ ;  $2 \leq 10$ ;  $3 \leq 15$ ;  $4 < 25$ ; 5 more than 25.

**Loss of life** (# persons/year):  $1 \leq 50$ ;  $2 \leq 500$ ;  $3 \leq 1,000$ ;  $4 < 3,000$ ; 5 more than 10,000.

**Spatial extension** (km<sup>2</sup>):  $1 \leq 10$ ;  $2 \leq 50$ ;  $3 \leq 100$ ;  $4 < 150$ ; 5 more than 150.

**Infrastructure** (₦ reconstruction costs):  $1 \leq \text{₦} 1,500,000$ ;  $2 \leq \text{₦} 5,000,000$ ;  $3 \leq \text{₦} 10,000,000$ ;  $4 < \text{₦} 15,000,000$ ; 5 more than ₦ 30,000,000.

The exposure index for each hazard is calculated as follows: for each impact evaluated, the scores assigned to the impacts are added, and the sum obtained is divided by 30 (which is the maximum possible sum value) and multiplied by 100. The City Exposure Index is equal to the average of the indices for each hazard, and this value (index) must be copied into the exposure index box of the sensitivity, adaptive capacity, and vulnerability table (table 2).

Similarly, in calculating the sensitivity, adaptive capacity, and vulnerability index of the selected hazards, 4 capitals and their proposed elements were used; these are: - Physical Capital: These include all types of infrastructure (buildings, bridges, electrical installations, roads, drinking water, sewage, etc.). Productive Capital: These categories include all kinds of services or organisations connected with various commercial, industrial, and public sectors, etc., affected by the hazards. Environmental Capital: This is associated with the quality of water, air, soil, the groundwater table, biota (ecosystem), etc. Social Capital: These include the different social groups and social interactions affected by the hazards. Four (4) elements or indicators that are connected with each capital were proposed, and the sensitivity and vulnerability index of all the indicators will be calculated.

The sensitivity index is calculated by assigning a value between 1 and 5 for each of the selected indicators of the capital according to the proposed scale of 1 (lowest) and 5 (highest). To determine the level of sensitivity of the hazard, we sum the value of the sensitivity index of each indicator of the same capital (horizontal) and divide the sum obtained by 25 (which is the maximum sum value possible) and multiply it by 100. The total hazard impact index of each hazard, which is the severity and potential effects of the hazard on the community, infrastructure, and ecosystem, is calculated as the average of the hazard impact indexes of each capital for the hazard studied. Also, the calculation of the sensitivity index of each capital for all hazards is the average of the sensitivities of the indicators of each capital, while the vulnerability equals the sensitivity index plus the exposure index minus the adaptive capacity. The Excel programme is designed to automatically calculate the sensitivity index, hazard impact index, vulnerability index, and weighted score and give the adaptive capacity of the analysed capital once the value for the indicators of each hazard is imputed.

## Results and Discussion

Identification of most common hazards and the exposure index of the community to the hazard.

Exposure index (EI) in this study refers to the metric used in quantifying the degree to which people, assets, or ecosystems are exposed to environmental hazards to help stakeholders prioritize mitigation efforts. The results from the questionnaire and the group discussions were processed to complete the hazard identification and exposure index table (Table 1). From the table, the major hazards experienced in Lokogoma community range from drought, landslides, rain storms, floods, and extreme heat. Drought, which basically leads to water scarcity, reduced soil fertility and food insecurity, usually has an average annual economic impact of about ₦300,000 for each household, according to the stakeholders.

**Table 1: Hazard Identification and Exposure Index**

Lokogoma, Abuja	Sector: Environment (Water extreme events)							
Hazards: 5 common hazards identified	Description of the potential effects of the hazards in the chosen sector	Economic Impact (PER YEAR)	Frequency	Duration	Losses of lives	Spatial Extension (Km)	Infrastructures important for the chosen sector(s)	Exposure Index
Drought	Water scarcity, reduced soil fertility and food insecurity, water rationing (quality/quantity), prevalence of water borne diseases, disrupt businesses depending on water.	3	1	5	1	3	2	40.00
Landslides (mudslides)	Infrastructure destruction & blockages, pollute streams and water bodies with excess sediments	1	1	1	1	1	1	16.67
Rain Storm	Infrastructure destruction, soil erosion, high runoff. Loss of crop and livestock.	2	1	1	1	1	2	20.00
Floods	Destruction of infrastructure, Soil erosion, disruption of treatment of water, wastewater, poor drinking water, outbreak of diseases e.g cholera, typhoid,	4	5	5	1	3	5	63.33
Extreme Heat	High temperatures, cooling systems leading to CO2 emission, crop water stress, reduced food production, heat related illnesses.	2	2	1	1	1	2	23.33
<b>City Exposure Index</b>								<b>32.67</b>

Source: Authors Survey, 2023

They explained that during this period, areas with access to public water supply usually experience water rationing, while the majority of residents depend on water vendors, whose water is often not suitable for consumption, leading to the prevalence of waterborne diseases; hence the value "3" was assigned in the economic impact column of the hazard identification and exposure index table.

Similarly, the frequency of drought in the study area was rated "1," indicating that severe drought only occurred in some years. Also, the residents revealed that the duration of the severe drought period is usually more than 25 days in a year; hence the value "5" was assigned to duration in the hazard identification and exposure index table. In addition, no death has been recorded as a direct impact of the severe drought event in the Lokogoma community, but few death cases (less than 50 persons a year) have been witnessed in the community from waterborne diseases. This can be associated with some of the consequences of severe drought events; hence the value "1" was recorded in the losses of lives column.

The spatial extension of the drought hazard extends beyond the study area, but since the research is focused on the Lokogoma community, hence the value "3" was assigned in the table, indicating 100 km<sup>2</sup>. Also, the important infrastructure or services impacted by drought hazards in the study area are the public water supply services and the health facilities. Usually during drought periods, water supply to the residential houses is often not adequate; this has sometimes led to the vandalisation of the reticulation network in the community by scavengers.

Also, the residents of the Lokogoma community often depend on water vendors for their water supply during drought (prolonged dry season), and the quality of water from water vendors cannot be guaranteed, so they sometimes develop water-related illnesses, thereby stretching the health facilities in the area. According to some of the respondents, the cost of replacing these reticulation lines and medical services is about 5 million per annum, hence the value "2" in the infrastructure column on the hazard identification and exposure index table. The Lokogoma community Exposure Index (EI) to drought is 40%, and it is the second-ranked potential hazard to which the people are vulnerable in the area.

Flood is the hazard with the most devastating effect in the study area, as the exposure index, which indicates the degree of exposure of people, infrastructure, or assets to flood hazards, was calculated as 63.33%. Also, the economic cost of flood disaster in the Lokogoma community, Abuja, varies depending on location and coping capacity, as explained by the community leader. He concluded that infrastructures, including residents close to the natural courses of the Kabusa and Wamba rivers, are the most affected. The socio-economic impact of the flood was estimated at over ₦1,000,000 per household, as the residents complained that it doesn't only affect infrastructures (see plate A and B) but also leads to soil erosion, crops destruction (see plate C and D, showing the impacts of flood in Lokogoma community), and water supply by polluting surface and ground water sources, waste displacement, and disease outbreaks such as cholera and typhoid.

Similarly, the frequency of occurrence is high, as the residents explained that it is possible to experience two (2) flood events in one rainy season. The aggregate number of days in a year (i.e., duration) of a flood event exceeds 25 days in most cases, but there is no reported loss of life as a direct consequence of the flood event. Infrastructure (housing and roads) is the worst affected by the perennial flood in Lokogoma, and the annual cost of reconstructing this infrastructure is estimated at about ₦30,000,000. The exposure index for extreme heat is calculated as 23.33%, and rainstorms have an exposure index of 20.00%, respectively. The overall Exposure Index (EI) for the Lokogoma community on water extreme hazards is 32.67%.

**Plate A: Bridge Collapse in Lokogoma****B: Flooded Office Building in Lokogoma****(c) Residential Building Affected by Flood****(d) Farmland Destroyed by Flood in Lokogoma**

### **Identified Hazards and Most Vulnerable Capital (Sectors) in the Study Area**

This section of the study identified hazards and the most vulnerable capital (sectors) in the study area showing the sensitivity, adaptive capacity and vulnerability index in Table 2 below. The sensitivity, adaptive capacity and vulnerability of the different hazards were examined based on their impacted on the various capitals (sectors). The capitals are physical (all types of infrastructure (buildings, bridges, electrical installations, roads, drinking water, sewage, etc.), productive sector (all kinds of services / organizations connected with various commercial, industrial, public sectors, etc.), environmental (quality of water, air, soil, water table, biota, ecosystem, etc.), and social capital (effects on social interaction, health, income, accessibility, different social groups etc.). Also, four (4) critical elements that are most negatively impacted by the hazards in the various capital were selected for the assessment. The respondents were asked to rate from 1-5 (1 being having the lowest impact and 5 being highest impact) the impacts of these hazards on the individual element. This is to enable the identification of the most vulnerable capital (sector) and the most impacted element in the capital for problem solving. These rating was computed and entered into the excel-based hazard vulnerability table.

Table 2: Sensitivity, Adaptive Capacity and Vulnerability Index Table

Types of capitals	Flooding	Drought	Heat Waves	Landslide	Rain storm	Sensitivity index	Exposure index	Adaptive capacity	Vulnerability
<b>Physical</b>	<b>90</b>	<b>55</b>	<b>20</b>	<b>45</b>	<b>50</b>	<b>52</b>	<b>32.67</b>	<b>7.59</b>	<b>77.08</b>
Destruction of housing and transportation infrastructure	5	4	1	3	2	60	32.67	7.59	85.08
Food Distribution network	3	1	1	3	3	44	32.67	7.59	69.08
Water supply and sanitation	5	5	1	1	2	56	32.67	7.59	81.08
Power supply	5	1	1	2	3	48	32.67	7.59	73.08
<b>Productive sector</b>	<b>65</b>	<b>30</b>	<b>25</b>	<b>25</b>	<b>30</b>	<b>35</b>	<b>32.67</b>	<b>7.59</b>	<b>60.08</b>
Food processing industries	4	1	1	1	2	36	32.67	7.59	61.08
Food production output	3	2	1	1	1	32	32.67	7.59	57.08
Construction projects	3	2	2	2	2	44	32.67	7.59	69.08
Recreational activities	3	1	1	1	1	28	32.67	7.59	53.08
<b>Environmental</b>	<b>80</b>	<b>60</b>	<b>30</b>	<b>30</b>	<b>40</b>	<b>42</b>	<b>32.67</b>	<b>7.59</b>	<b>67.08</b>
Quality of water	5	1	1	2	3	48	32.67	7.59	73.08
Soil nutrient content	4	3	2	1	2	48	32.67	7.59	73.08
Air pollution	2	1	2	1	1	28	32.67	7.59	53.08
Increase in disease vectors	5	1	1	2	2	44	32.67	7.59	69.08
<b>Social</b>	<b>75</b>	<b>25</b>	<b>30</b>	<b>45</b>	<b>50</b>	<b>45</b>	<b>32.67</b>	<b>7.59</b>	<b>70.08</b>
Access to basic services	4	1	1	2	3	44	32.67	7.59	69.08
Displacement from dwellings/houses	3	1	1	2	3	40	32.67	7.59	65.08
Loss of income	4	1	2	2	2	44	32.67	7.59	69.08
Psycho-social trauma	4	2	2	3	2	52	32.67	7.59	77.08
<b>Hazard impact index</b>	<b>77.5</b>	<b>42.5</b>	<b>26.25</b>	<b>36.25</b>	<b>42.5</b>				

Source: Authors Survey, 2023

The result (Table 2) shows the hazards and the most vulnerable capital in the study areas. The identified hazards (floods, droughts, extreme heats, etc.) show the degree to which they impact several sectors, such as physical, productive, environmental, and social, in the Lokogoma community, indicating their sensitivity index, exposure index, adaptive capacity, and vulnerability. The result shows that the physical capital is the most susceptible to the impact of all the hazards, with a sensitivity index (SI) of 52% and a vulnerability index (VI) of 77.08%. This reveals that destruction of housing and transportation infrastructure, food distribution networks, water supply and sanitation, and power supply are mostly impacted during disasters.

Identifying the level of sensitivity and vulnerability of a particular community to a given hazard is very important, especially in disaster risk mitigation and management, as vulnerability is a precondition that manifests itself during a disaster. Vulnerability is the degree of weakness or exposure of an element or set of elements to the occurrence of natural or anthropic hazards of a given magnitude (Brilhante, 2021). Similarly, sensitivity is directly proportional to vulnerability; therefore, the higher the sensitivity or exposure, the greater the vulnerability. So, any mitigation strategy (structural or non-structural) on a given hazard will directly reduce its vulnerability and sensitivity to such hazard while increasing the coping or adaptive capacity of the community.

The social capital, with a sensitivity index of 45% and a vulnerability index of 70.8%, is the second most affected sector by the hazards in the study area. This indicates that activities such as access to basic services, displacement from dwellings, loss of income, and psychosocial trauma significantly affect the residents of Lokogoma during any of the hazard events. Though psychosocial trauma is the element that the residents are most vulnerable to, with a vulnerability index of 77.08%. This indicates that the majority of residents of Lokogoma may require targeted intervention, such as counselling or social support, to maintain their mental health.

In addition, the environmental capital had a sensitivity of 42% and a vulnerability index of 67.08%. In this case, two (2) elements are worst impacted in any hazard event. These are the quality of water and soil nutrient content, with a vulnerability index of 73.08%. This confirmed the community head's complaint about the difficulty in sourcing water for domestic use during and after any flood event, as their water supply is mostly affected by the disaster. The productive sector is the least affected by all the hazards assessed, with a sensitivity index of 35% and a vulnerability index of 60.08%. Construction projects are the most affected element within this capital, with a vulnerability index of 69.08%. This suggests that during hazard events like flooding or rainstorms, construction activities experience substantial losses in terms of materials and productivity.

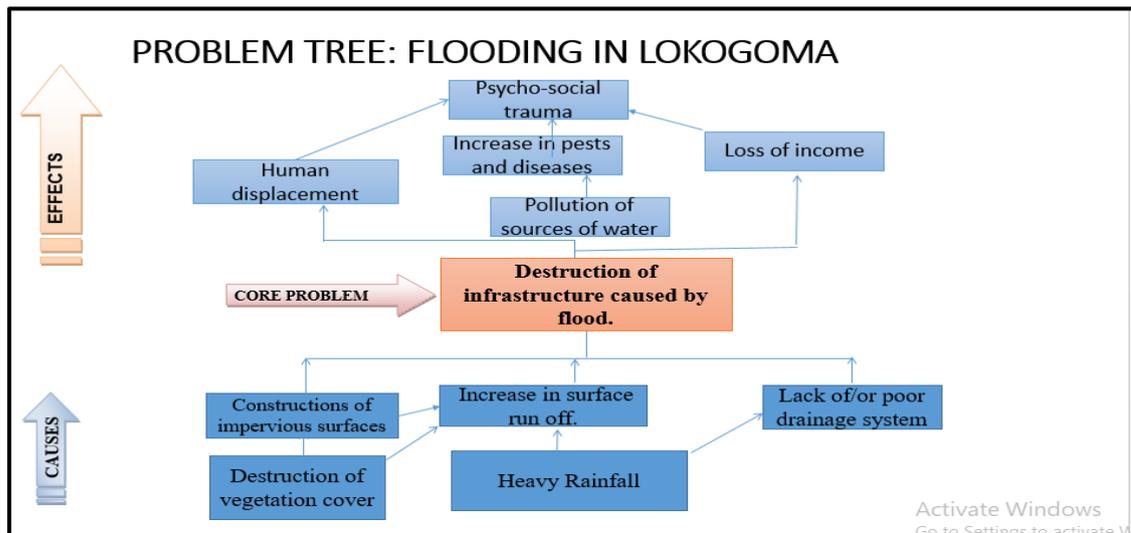
The Hazards Impact Index (HII), which indicates the severity of potential or actual hazards (natural or man-induced) in a given area, population, or system for response prioritisation (Brilhante, 2021), revealed that flooding is the severe hazard being experienced in the Lokogoma community with a hazard impact index of 77.5%, followed by drought and rainstorm with 42.5%, respectively. Landslides and heat waves rarely occur with significant impact in the study area; therefore, their hazard impact indexes are 36.25% and 26.25%, respectively. In summary, this result revealed that flood is the most devastating hazard in the study area with a high potential of causing disaster, and the most impacted element is the destruction of housing and transportation infrastructure, with a vulnerability index of 85.08% in the physical capital. This, therefore, implies that the disaster risk mitigation strategy should prioritise mitigating flood impact on housing and transportation infrastructure.

### **Hazard Problem Tree for Solution Identification**

The hazard problem tree is a visual tool used in disaster risk management to identify the root causes, main problems, and effects of a particular hazard or disaster-related issue (GIZ, 2014). It takes into cognisance the main hazard with the highest potential to impact negatively on society

or the environment that sustains lives and livelihoods (i.e., flood) and the capital with the highest vulnerability index (i.e., physical capital) to identify the problem and proffer practical risk reduction/mitigation strategies. This is achieved by clearly defining the problem, analysing the causes of the problem, and analysing the effects caused by the problem to the area, population, or system in a structural format to give a clear view of the situation.

The main problems caused by flooding in the Lokogoma community in Abuja are the destruction of housing and transportation infrastructure, food distribution networks, water supply and sanitation, and power supply. These problems can be titled as "destruction of infrastructure caused by flood" to be the core problem.



**Figure 1: Hazard Problem Tree for Solution Identification**

The Lokogoma community often experiences heavy rainfall, though, the mean annual rainfall in Abuja ranges from 1,200mm to 1,600mm, depending on elevation and location within the FCT (NIMET, 2021), Lokogoma has recorded a high rainfall intensity of approximately 166.5mm in a single hour (Garba & Abdulraheem, 2022). This level of intensity is classified as extremely heavy rain and can easily trigger flash floods in any area with poor drainage system. Previously, such rainfall intensity does not usually result in a disaster, as no negative impact is recorded on the community or the environment that sustains life and livelihood, as the rainwater usually infiltrates or percolates into the soil and rock layers, replenishing the underground aquifers, due to the availability of high vegetation cover in the environment.

Recently, the situation has deteriorated, as the resident's lament that the flood is now causing serious devastation in their environment. This claim validates the findings from the hazard identification and exposure index table (table 1) and the sensitivity and vulnerability index table (table 2). The hazard problem tree (fig. 1) revealed that the major causes of the flood begin with the destruction of vegetation cover, resulting from urbanisation, and the construction of impervious surfaces, which leads to the increase in surface runoff from rainwater, and due to the poor drainage network system in the community, this has led to the destruction of infrastructures by flood in the community. This is the core problem the community is presently faced with. These findings are consistent with existing literature across urbanising areas in Nigeria and other developing countries, where poorly managed urban growth often leads to heightened flood risk.

Numerous studies affirm that unregulated urban expansion is a primary contributor to increased surface runoff and reduced natural absorption of rainwater. For instance, Adegun (2013) emphasized that the rapid replacement of vegetated land with impervious structures such as roads and buildings significantly alters the hydrological cycle in urban centres, reducing infiltration

and enhancing runoff. This situation is aggravated when urban development lacks corresponding infrastructural upgrades, particularly in drainage capacity. Aderogba (2012) similarly established that the rising frequency of urban flooding in Lagos is attributed to the increase in impervious surfaces and the absence of proactive land-use planning. This phenomenon is mirrored in Lokogoma, where the absence of green spaces and vegetation has not only escalated the volume of surface runoff but has also intensified the risk of flash flooding during extreme rainfall events.

The major effects of this problem, as illustrated by the problem tree, are the pollution of the various sources of domestic water supply. Floods often carry contaminants like heavy metals, pesticides, fertilisers, pathogens, sediments, and untreated liquid waste discharge into water sources and contaminate surface and ground water, causing increased risk of pest and waterborne diseases in the community. Also, the destruction of infrastructure due to the flood has significant socio-economic ramifications. It causes the loss of income to the residents of Lokogoma community, especially when the destruction involves power installations. This usually leads to power outages, making businesses and other commercial ventures either shut down or use other expensive sources of power to run their businesses. The residents reported delays in repairs by the relevant authorities following damage to the power system during floods, often leading to community-led fundraising efforts for necessary repairs. This observation is supported by Nkwunonwo, Whitworth, and Baily (2020), who found that floods in urban Nigeria often disrupt small- and medium-scale enterprises, leading to direct income loss, increased operational costs, and broader economic inequality. Likewise, Olanrewaju et al. (2019) noted that repeated flood damage to power and transport infrastructure in Lagos exacerbates poverty and undermines the economic resilience of affected communities.

Similarly, the destruction of residential buildings, has led to the displacement of people from their dwellings. Residents have suffered significant losses as a result of the perennial flooding, both physically and psychologically, as explained by the community head. The flood has caused residents to lose personal belongings, increased poverty and inequality, and led to stress and trauma within the affected areas. The unaffected areas within the community have also had their own share of the problem, as the displaced residents often move to these areas, causing the place to be overcrowded and creating strain on the available resources. All these effects arising from the destruction of infrastructure, generally contribute to the psycho-social trauma experienced by the residents of the Lokogoma community, a phenomenon echoed in the literature. Adelekan (2010) reported similar findings in coastal Lagos, where households displaced by floods faced not only material loss but also psychosocial distress, including anxiety and post-traumatic stress symptoms. Action-Aid Nigeria (2012) further emphasized the long-term mental health implications of flood-induced displacement and the inadequacy of institutional responses in supporting affected populations.

The results of this study are, therefore, in agreement with a growing body of evidence that shows how unmanaged urbanisation, coupled with weak infrastructural and institutional capacities, heightens vulnerability to flood hazards. The psycho-social trauma, economic dislocation, and infrastructure collapse observed in Lokogoma typify the cascading impacts of extreme hydrological events in rapidly growing urban environments. These insights reinforce the urgent need for integrated environmental planning, proactive flood risk governance, and community-based adaptation strategies in flood-prone Nigerian urban communities.

## **Conclusion and Recommendations**

This study assessed the impact of extreme hydrological events in the Lokogoma community in Abuja, shading light on the community exposure index and vulnerability to the various water extreme hazards. Key findings indicate that flooding is the hazard with the most negative impact on the society or the environment that sustains lives and livelihoods when compared to drought, landslide, rainstorm, and extreme heat. This severe flood occurrence is attributed to

inadequate drainage systems, rapid urbanisation leading to the destruction of vegetation cover, and climate change-induced rainfall variability.

The social and economic impacts include displacement from dwellings, destruction of property, loss of livelihoods, and heightened health risks due to waterborne diseases. These social problems faced by the residents of Lokogoma have affected not only their individual mental and emotional well-being but also disrupted their relationships and social interactions (psychosocial trauma) within the community. Economically, the residents of Lokogoma have suffered significant economic losses due to flood disaster.

Community resilience strategies, though present, remain insufficient due to a lack of infrastructure, funding, and institutional support. These findings underscore the need for multi-stakeholder collaboration to mitigate the risks associated with extreme water events. Immediate recommendations include:

1. Improving the efficiency of the present drainage system and creating a new drainage infrastructural network in the community to ensure efficient draining of urban areas during heavy rainfall to reduce flooding by relevant stakeholders.
2. Promote sustainable urban planning and development practices by incorporating more vegetative cover in the community to encourage rainwater percolation, reduce soil erosion, and increase water retention capacity. Encourage green infrastructure, such as permeable pavement; this can help to reduce the number of impervious surfaces and increase infiltration.
3. Develop retention ponds and reservoirs where possible to store excess water during heavy rainfall events.
4. Empowerment of affected settlements should be made by the relevant authority to enable them to construct resilient buildings.
5. Relevant institutions and authorities should not only provide material relief during and after any flood event; they should also provide psychological support for the victims, as some of them usually undergo psychosocial trauma.

Hydrological extremes, which include floods and droughts, have significant impacts on human societies, economics, and the environment. Floods, in particular, can cause damage to infrastructure, homes, and businesses, as well as lead to loss of life and displacement of people. By addressing these challenges and implementing the above recommendation, Lokogoma will not only reduce its exposure and vulnerability index, it will transition towards a greater resilience and sustainable community in the face of extreme water events.

## References

- Abdulkadir, A. A., & Garba, A. (2023). *Risk assessment of climate variability in the Federal Capital Territory (FCT), Abuja, Nigeria*. ResearchGate.
- ActionAid Nigeria (2012). *Disaster Risk Reduction: A Practitioner's Guide for DRR in Nigeria*. Abuja: ActionAid Nigeria.
- Adegun, O. B. (2013). Green infrastructure in the Nigerian urban context: A case of green open spaces in Lagos. *Journal of Geography and Regional Planning*, 6(2), 56–67.
- Adelekan, I. O. (2010). Vulnerability of poor urban coastal communities to flooding in Lagos, Nigeria. *Environment and urbanisation*, 22(2), 433–450.
- Adelekan, I. O. (2016). Flood risk management in the coastal city of Lagos, Nigeria. *Journal of Flood Risk Management*, 9(3), 255–264.
- Aderogba, K. A. (2012). Qualitative studies of recent floods and sustainable growth and development of cities and towns in Nigeria. *International Journal of Academic Research in Economics and Management Sciences*, 1(3), 1–25.
- Blog NaijaSpider. (2021). *Area Guide and Property Market of Lokogoma, Abuja*. Retrieved June 27, 2024, from hf-lokogoma-abuja/.
- Brilhante, O. (2021). *The Netherlands Refresher Course in South Africa*. IHS (EUR) Rotterdam.
- Cai, W., Lengaigne, M., Borlace, S., et al. (2021). Increasing frequency of extreme La Niña events under greenhouse warming. *Nature Climate Change*, 11, 415–422.
- Garba, H. & Abdulraheem, L. (2022). Modelling and Estimation of the Rainfall Intensity and Flood Management in Efab-Estate, Abuja. *Journal of science & technology research*. 4(3).
- German Agency for International Cooperation (GIZ) (2014). *Risk Analysis-A Basis for Disaster Risk Management*.
- Intergovernmental Panel on Climate Change (IPCC) (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge.
- Intergovernmental Panel on Climate Change (IPCC) (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva, Switzerland: IPCC.
- International organisation for Migration, (2023). *Human mobility and water in the context of climate change, disasters and environmental degradation. Water and its extremes: Shaping development and mobility*.
- Konapala, G., Mishra, A., Wada, Y., & Vörösmarty, C. J. (2020). Water scarcity in a changing world: A review of current understanding and future challenges. *Earth-Science Reviews*, 201, 102585.
- Myhre, G., et al. (2019). Global warming and changes in the water cycle. IPCC Special Report on Climate Change and Land.
- National Bureau of Statistics (NBS). (2022). *Nigeria population estimates by LGA and State, 2022*. Abuja: NBS Publications.
- National Population Commission (NPC). (2022). *2022 Nigeria Population and Housing Projections*. Abuja: NPC Headquarters.
- NASA. (2023). GRACE data reveals rise in intensity of global hydrologic extremes. NASA Earth Observatory.

- NEMA. (2022). *Flood outlook and disaster impact report*. National Emergency Management Agency, Nigeria.
- Nkwunonwo, U. C., Whitworth, M., & Baily, B. (2020). A review of the current status of flood modelling for urban flood risk management in the developing countries. *Scientific African*, 7, e00269.
- Oguntunde, P. G., Lischeid, G., & Dietrich, O. (2020). Observed trends of rainfall extremes over Nigeria (1970–2013). *Atmosphere*, 11(10), 1084.
- Olanrewaju, C. C., Chitakira, M., Olanrewaju, O. A., & Louw, E. (2019). Impacts of flooding on urban low-income communities and small businesses in Lagos, Nigeria. *Sustainability*, 11(24), 6932.
- Olowoporoku, A. O. (2020). Urban flooding and the challenges of climate change adaptation in Nigerian cities: A review. *Journal of Geography, Environment and Earth Science International*, 24(3), 18–31.
- Owolabi, Y. T., Salami, A. W., & Aremu, J. A. (2022). Spatio-temporal analysis of extreme precipitation indices in Anambra–Imo Basin. *Journal of Meteorology and Climate*.
- PremiumTimes (2019). Abuja homeowners lament demolition of houses without compensation after fatal flood.
- United Nations Convention to Combat Desertification (UNCCD) (2022). *Desertification and Drought Day 2022*. UNCCD.
- UN OCHA. (2022). *Nigeria floods: Situation report*. United Nations Office for the Coordination of Humanitarian Affairs.