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Flood Vulnerability Assessment Around the River Kaduna Catchment Area of Kaduna South Local Government Area, Kaduna State, Nigeria

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***Abstract*—Flooding remains one of the most destructive and recurrent environmental hazards confronting urban communities in Nigeria. This study undertook a comprehensive flood vulnerability assessment around the River Kaduna catchment area of Kaduna South Local Government Area (LGA), Kaduna State, Nigeria. A mixed-methods design was adopted, integrating geospatial analysis in ArcMap 10.8.2 using Multi-Criteria Evaluation (MCE) with elevation, slope, Topographic Wetness Index (TWI), and proximity to the River Kaduna as flood conditioning factors, alongside structured questionnaires administered to 390 respondents across all 13 wards. A Socio-Economic Vulnerability Index (SEVI) was computed from eight indicators and analysed using IBM SPSS Statistics. Findings revealed that 21.71% of the study area (10.03 km²) falls within the most vulnerable category and a further 29.57% (13.66 km²) within the more vulnerable category, meaning over 51% of Kaduna South LGA is exposed to high-to-moderate flood risk. An estimated 14,669 buildings and over 73,000 people are situated within the highest-risk zones. Makera (SEVI = 0.474) and Tudun Wada South (SEVI = 0.460) recorded the greatest socio-economic vulnerability. Notably, 31% of respondents had not yet recovered from a previous significant flood, and 60.8% were unaware of any government or community flood mitigation measures. The study concludes that flood vulnerability in Kaduna South is a structural problem rooted in the convergence of physical geography, governance deficits, and socio-economic inequality. It recommends integrated interventions spanning floodplain regulation, drainage rehabilitation, GIS-informed spatial planning, community-based early warning systems, and targeted social protection for the most vulnerable wards.**

***Index Terms*—flood vulnerability; GIS; socio-economic vulnerability index; Kaduna South; Nigeria; multi-criteria evaluation; urban flooding**

I. INTRODUCTION

Flooding constitutes one of the most severe and recurring natural hazards globally, displacing millions, destroying livelihoods, and undermining decades of socioeconomic progress, particularly in developing nations where adaptive capacity remains limited (Shrestha, Datta, and Nakamura, 2022; Ali, Khan, and Hussain, 2023). In sub-Saharan Africa, rapid urbanisation, climate change, and inadequate infrastructure have dramatically intensified flood risk, with Nigeria emerging as one of the most flood-prone nations on the continent (Douglas et al., 2022; Adelekan, Olajide, and Ajayi, 2023).

Nigeria has experienced catastrophic floods in recent decades. The 2012 floods affected 32 states, displaced more than 7 million people, and caused economic losses estimated at approximately USD 16.9 billion (World Bank, 2014). The 2022 floods, described as the worst in a decade, affected all 36 states and the Federal Capital Territory, displaced over 2.4 million people, claimed more than 600 lives, destroyed over 200,000 homes, and generated losses exceeding USD 9.12 billion (World Bank and Federal Government of Nigeria, 2022; Ogar, 2023). Between 2011 and 2020, Nigeria recorded 1,187 flood-related deaths, representing approximately 15% of Africa's total, with property damage estimated at USD 904.5 million (Centre for Research on Epidemiology of Disaster, 2021).

Within Kaduna State, the River Kaduna catchment has emerged as a recurrent epicentre of flood disasters.

Kaduna South Local Government Area (LGA), situated along the southern bank of the River Kaduna, faces heightened vulnerability due to dense population, rapid and unplanned urbanisation, industrial activities, fragile riparian ecosystems, and deficient drainage infrastructure (Oladipo, Suleiman, and Musa, 2021; Usman and Okoye, 2022; Ahmad et al., 2025). Recent spatial analyses have estimated that 86.9% of Kaduna South LGA falls within highly vulnerable flood zones (Tukur, Ikusemoran, and Ezra, 2020), yet no comprehensive, integrated vulnerability assessment had been conducted at the community level to simultaneously address causes, spatial distribution, socio-economic dimensions, and resilience strategies.

This study addresses that gap by undertaking a multi-dimensional flood vulnerability assessment for Kaduna South LGA. It is guided by four research objectives: (i) to identify the causes of flooding in the River Kaduna catchment area; (ii) to map flood-prone areas using GIS; (iii) to quantify the socio-economic vulnerability of communities; and (iv) to propose preventive and resilience strategies for reducing flood vulnerability. The study contributes a validated, ward-level flood vulnerability framework and a replicable integrated assessment model applicable to comparable Nigerian urban settings.

II. STUDY AREA

Kaduna South Local Government Area is located in the southern portion of Kaduna metropolis, bounded to the north by the River Kaduna. It encompasses an area of approximately 46.2 km² and comprises 13 administrative wards: Makera (LGA headquarters), Barnawa, Kakuri-Gwari, Kakuri-Hausa, Television, Tudun Wada North, Tudun Wada South, Tudun Wada West, Tudun Nupawa, Sabon Gari North, Sabon Gari South, Unguwan Sanusi, and Badiko. The LGA lies between latitudes 10°25′30″N and 10°32′15″N and longitudes 7°23′15″E and 7°27′45″E (Study Area Map, 2026). The current estimated population is 730,012 (KDBS, 2025).

The terrain is predominantly flat to gently undulating, with elevations ranging from 584 m to 644 m above mean sea level. The area experiences a tropical continental climate characterised by a distinct wet season from April to October with annual rainfall of 1,000–1,500 mm, and a dry season from November to March. Recent climatological studies document a persistent rise in rainfall intensity and variability across Kaduna State (Musa, Adeyeri and Ochege, 2022; Ahmad et al., 2025). The LGA functions as an industrial and commercial centre in northern Nigeria, hosting textile, food processing, and light manufacturing industries. A significant proportion of communities are situated in informal settlements on low-lying floodplains, rendering them acutely susceptible to riverine and pluvial flooding.

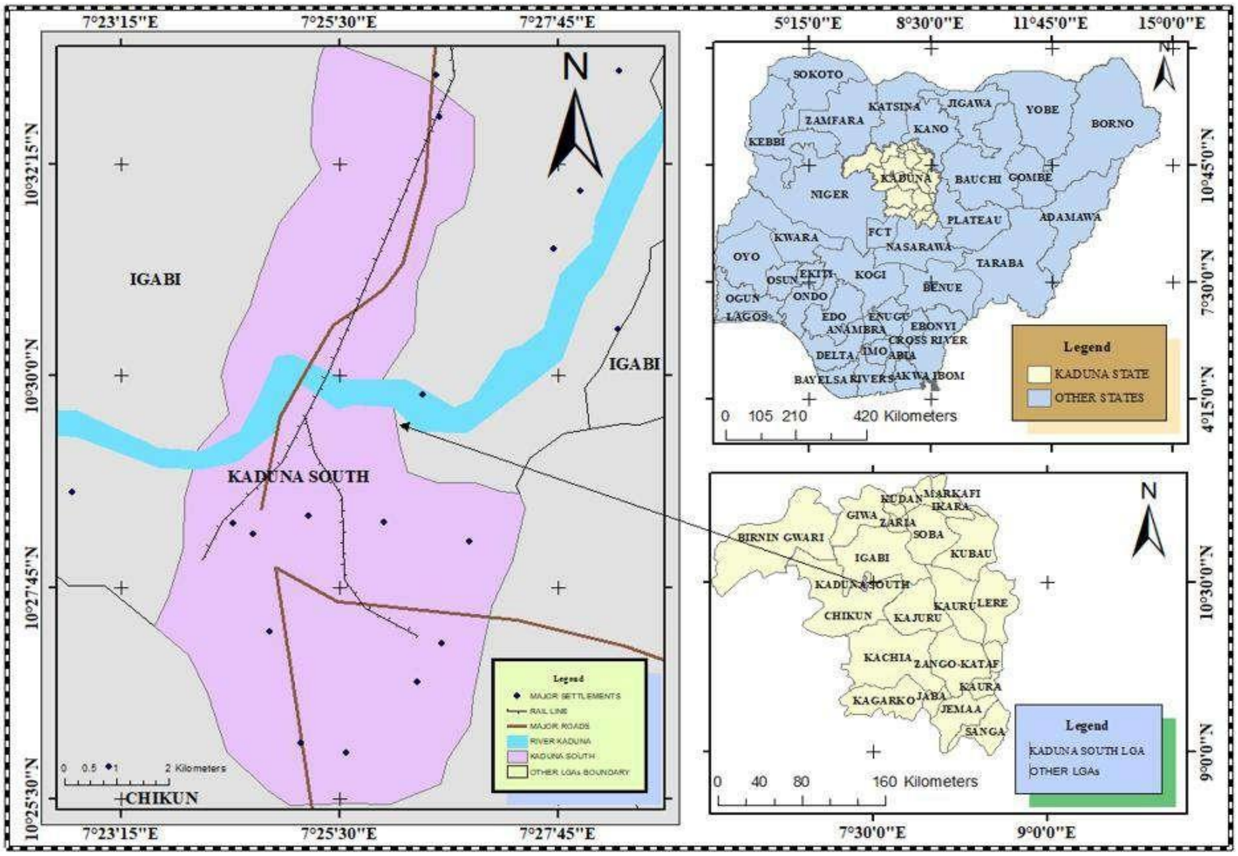

Figure 1: Map of the Study Area — [Kaduna South LGA showing the 13 wards, River Kaduna, and administrative boundaries. Source: Modified from GIS/NDA, 2026]

III. MATERIALS AND METHODS

3.1 Research Design

A mixed-methods research design was adopted, integrating quantitative geospatial analysis with socio-economic data collection. This approach is consistent with contemporary flood vulnerability assessment literature which emphasises the need for multidisciplinary frameworks encompassing hydrology, geomorphology, socio-economic assessment, and spatial analysis (Nasiri, Mohd, and Mohammad, 2016; Rehman et al., 2019).

3.2 Geospatial Data and Analysis

Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) data were acquired from NASA Earth Data (https://search.asf.alaska.edu/) at 30-metre spatial resolution. High-resolution satellite imagery was obtained from Quick-OSM for building footprint extraction. Study area boundaries were extracted from the Grid3 Nigeria dataset. All spatial datasets are summarised in Table 1.

Table 1. Datasets used in the study and their sources.

Dataset	Type	Source	Year
Study Area Boundary	Polygon (vector)	Grid3 Nigeria	2026
SRTM Digital Elevation Model	Raster (.tiff)	NASA Earth Data	2026
High-Resolution Satellite Imagery	Raster (.tiff, 30 m)	Quick-OSM	2026
Building Footprint	Polygon (vector)	Extracted from imagery	2026
Reference Points/Settlements	Point (vector)	Field Survey (GPS)	2026

Source: Author's Research, 2026.

Spatial analysis was performed in ArcMap 10.8.2 using Multi-Criteria Evaluation (MCE). Four flood conditioning factors were processed: (i) elevation derived from the SRTM DEM; (ii) slope gradient derived from the DEM; (iii) Topographic Wetness Index (TWI), calculated as TWI = ln $\left(\frac{A}{\tan\beta}\right)$, where A is the upslope contributing area per unit contour length and β is the slope angle; and (iv) Euclidean distance from the River Kaduna and its tributaries. Each factor was reclassified into four vulnerability categories (most, more, less, and least vulnerable) based on the classification scheme in Table 2, and integrated through weighted overlay to produce a composite flood vulnerability index map.

Table 2. Factor scaling for flood vulnerability classification.

Factor	Most Vulnerable	More Vulnerable	Less Vulnerable	Least Vulnerable
Elevation	584–603 m	604–623 m	624–643 m	> 644 m
Slope	0°–10°	11°–20°	21°–30°	> 30°
TWI	> 40	30–40	20–30	< 20
Distance from River	0–500 m	500–1,500 m	1,500–2,500 m	> 2,500 m

Source: GIS/RS Analysis, 2026.

3.3 Socio-Economic Data Collection

A stratified random sampling technique was employed. Communities were stratified into high, moderate, and low flood risk zones based on preliminary GIS overlay analysis. Sample size was determined using Yamane's (1967) formula for finite populations ($n = \frac{N}{[1 + N(e)^2]}$), yielding a required sample of 400 respondents from a population of 730,012 (KDBS, 2025). A total of 390 questionnaires were successfully retrieved (response rate: 97.5%). To ensure balanced representation, 30 questionnaires were administered in each of the 13 wards.

The structured questionnaire captured flood experience, structural housing characteristics, socio-economic characteristics (income, occupation, education), preparedness, coping strategies, and access to early warning systems and financial support.

3.4 Socio-Economic Vulnerability Index (SEVI)

A Socio-Economic Vulnerability Index (SEVI) was computed from eight indicators: (1) educational level; (2) average monthly income; (3) livelihood dependence on the River Kaduna; (4) percentage of income spent on basic needs; (5) access to flood insurance or financial aid; (6) access to early warning systems; (7) flood preparedness actions; and (8) time to recovery from past flood events. All variables were re-coded where necessary (so that higher values represent greater vulnerability), normalised using min–max scaling, and averaged to obtain SEVI scores ranging from 0 (lowest vulnerability) to 1 (highest vulnerability). Data were analysed using IBM SPSS Statistics v.27.

IV. RESULTS

4.1 Causes of Flooding in the River Kaduna Catchment

Field observations and questionnaire responses identified a convergence of natural and anthropogenic factors as the primary drivers of flooding in Kaduna South LGA. Physical and topographic causes include: (i) low-lying terrain and gentle slope gradients (0°–10°), which promote slow surface runoff, water stagnation, and prolonged inundation; (ii) high Topographic Wetness Index values exceeding 40 along the River Kaduna corridor, indicating strong soil moisture accumulation; (iii) proximity of densely settled communities to the river channel; and (iv) increasing rainfall variability and intensity, with recent climatological analyses documenting a significant upward shift in annual rainfall across Kaduna State (Musa, Adeyeri and Ochege, 2022; Ahmad et al., 2025; Ako et al., 2025).

Anthropogenic causes were prominent across all 13 wards and include: (i) indiscriminate disposal of solid waste into drainage channels, identified as the most consistently observed cause during field reconnaissance; (ii) unplanned urban expansion and encroachment into the River Kaduna floodplain; (iii) inadequate and poorly maintained drainage infrastructure; (iv) degradation of riparian buffer zones and wetland encroachment; (v) deforestation and land-use change increasing impervious surface cover; and (vi) uncoordinated upstream dam releases. The combined effect of these drivers is consistent with findings from Usman and Okoye (2022), Wuyep et al. (2024), and Ibrahim et al. (2024).

Plate 1: Flooded GSSS, Richifa Street T/Wada South
Adapted from: Kaduna State Teachers' Forum (21/09/2025)

Plate 2: Flooded Farmland in Kabala T/Wada West

Plate 3: Inundated Buildings along Bye Pass, Kaduna

Plate 4: Dilapidated Fences in GSS, Richifa T/Wada

Plate 5: Waste disposal into drainage channels in Tudun/Nupawa

Plate 6: Waste disposal into drainage channels in Bashama, Tudun Wada South

PLATES 2–6: Field photographs documenting flood conditions and anthropogenic pressures, including inundated school buildings, flooded farmlands, and waste-blocked drainage channels across Kaduna South wards.
Source: Author fieldwork, 2026

4.2 GIS-Based Flood Vulnerability Assessment
The elevation map (Figure 2) reveals that the lowest elevations (584–603 m) are concentrated along the River Kaduna corridor, particularly in northern Makera and Barnawa, and in southern Sabon Gari West and Tudun Wada South. These areas exhibit limited natural drainage gradients, promoting water accumulation during rainfall.

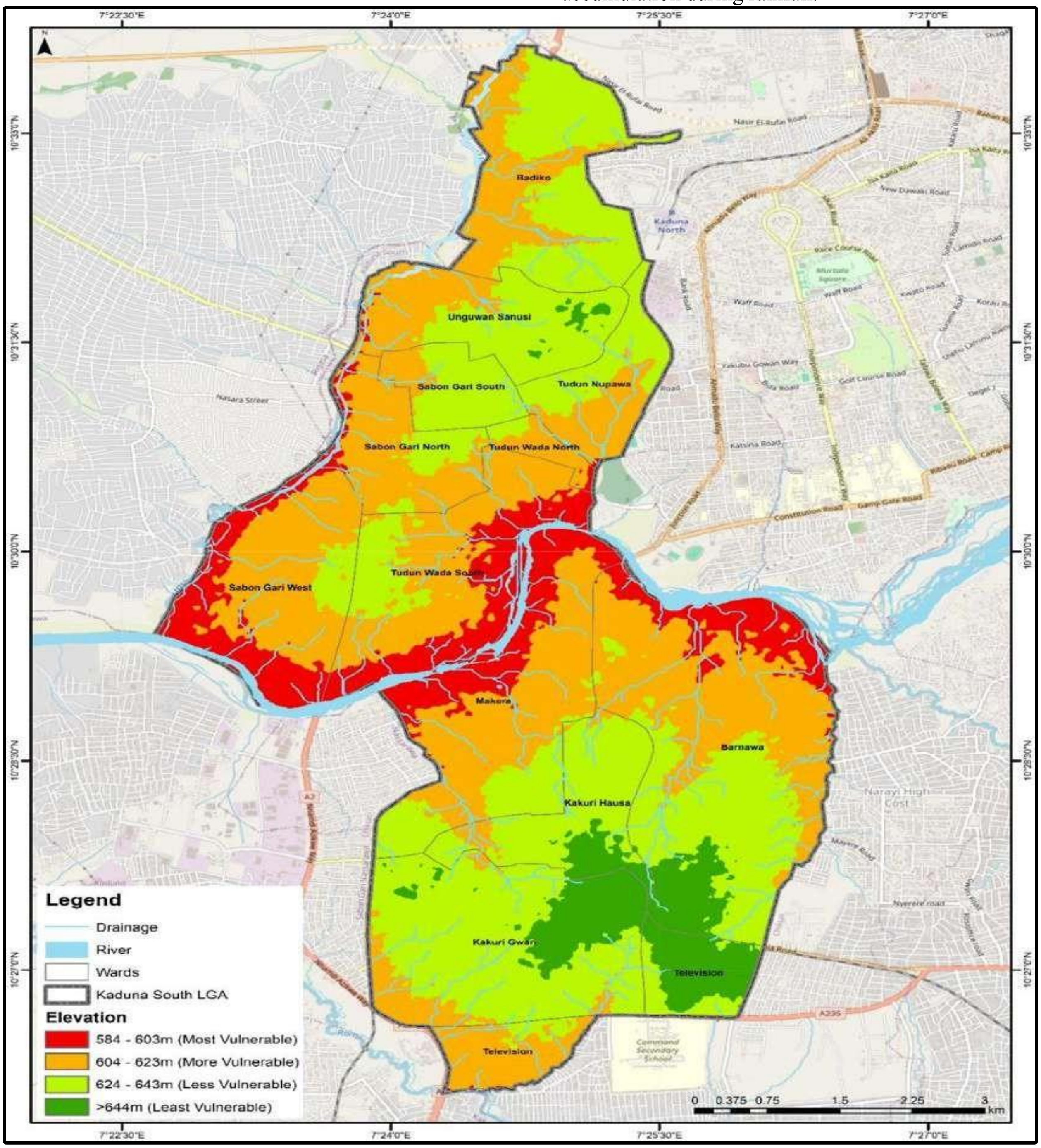

Figure 2: Elevation Map of Kaduna South LGA derived from SRTM DEM (2026).
Source: SRTM DEM, 2026

The slope map (Figure 3) confirms that large portions of the LGA fall within 0°–10° gradients, particularly along the riverbank corridor. Steeper slopes (11°–30°) characterised the southeastern wards including Kakuri Hausa, Kakuri Gwari, and Television.

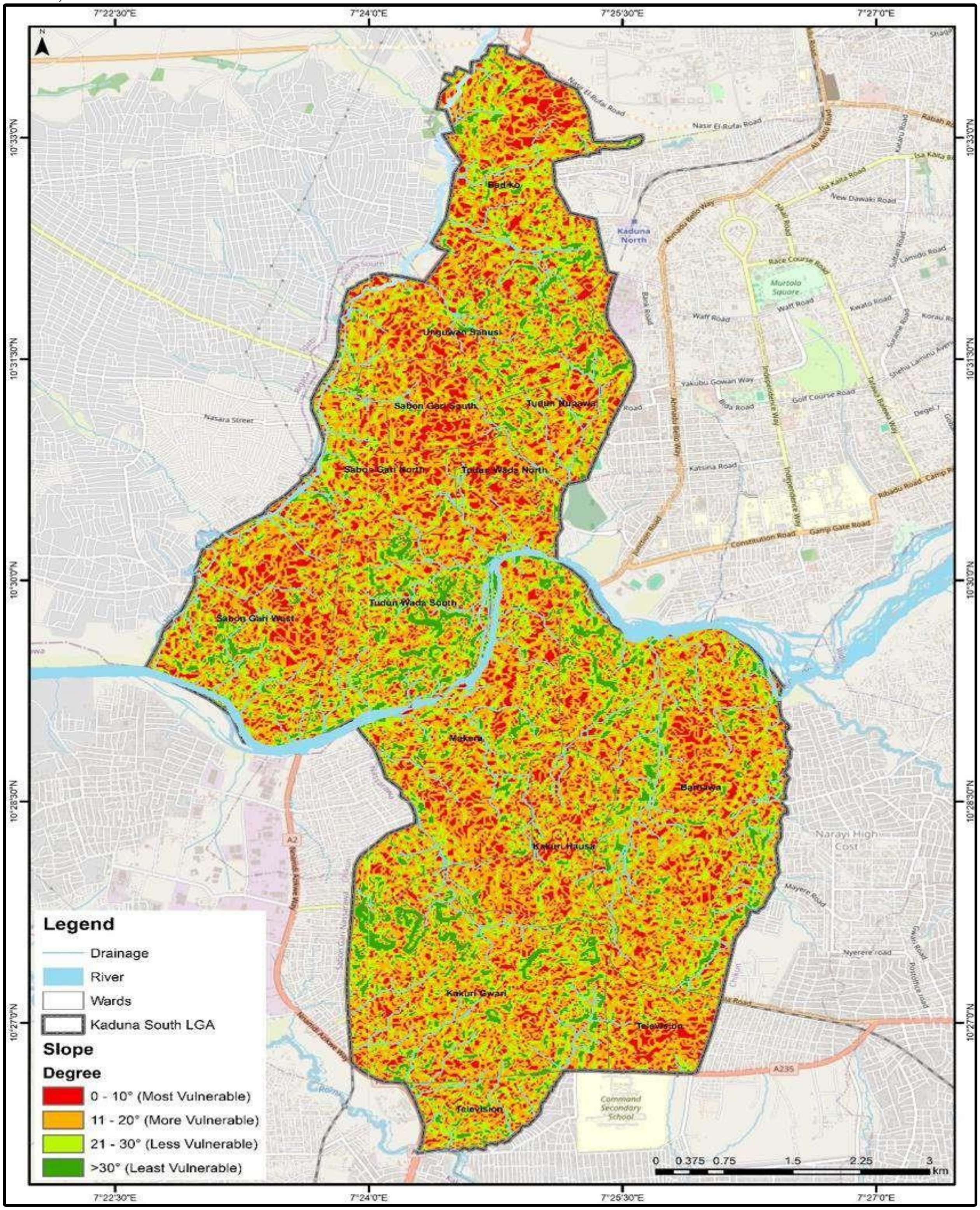

Figure 3: Slope Map of Kaduna South LGA.
Source: SRTM DEM, 2026

The TWI analysis (Figure 4) shows that values exceeding 40 are concentrated along the River Kaduna corridor and drainage convergence zones, corresponding spatially with the communities most frequently cited by respondents as flood-prone. These high-TWI zones indicate strong soil moisture accumulation, elevated surface runoff, and high pluvial and riverine flooding susceptibility.

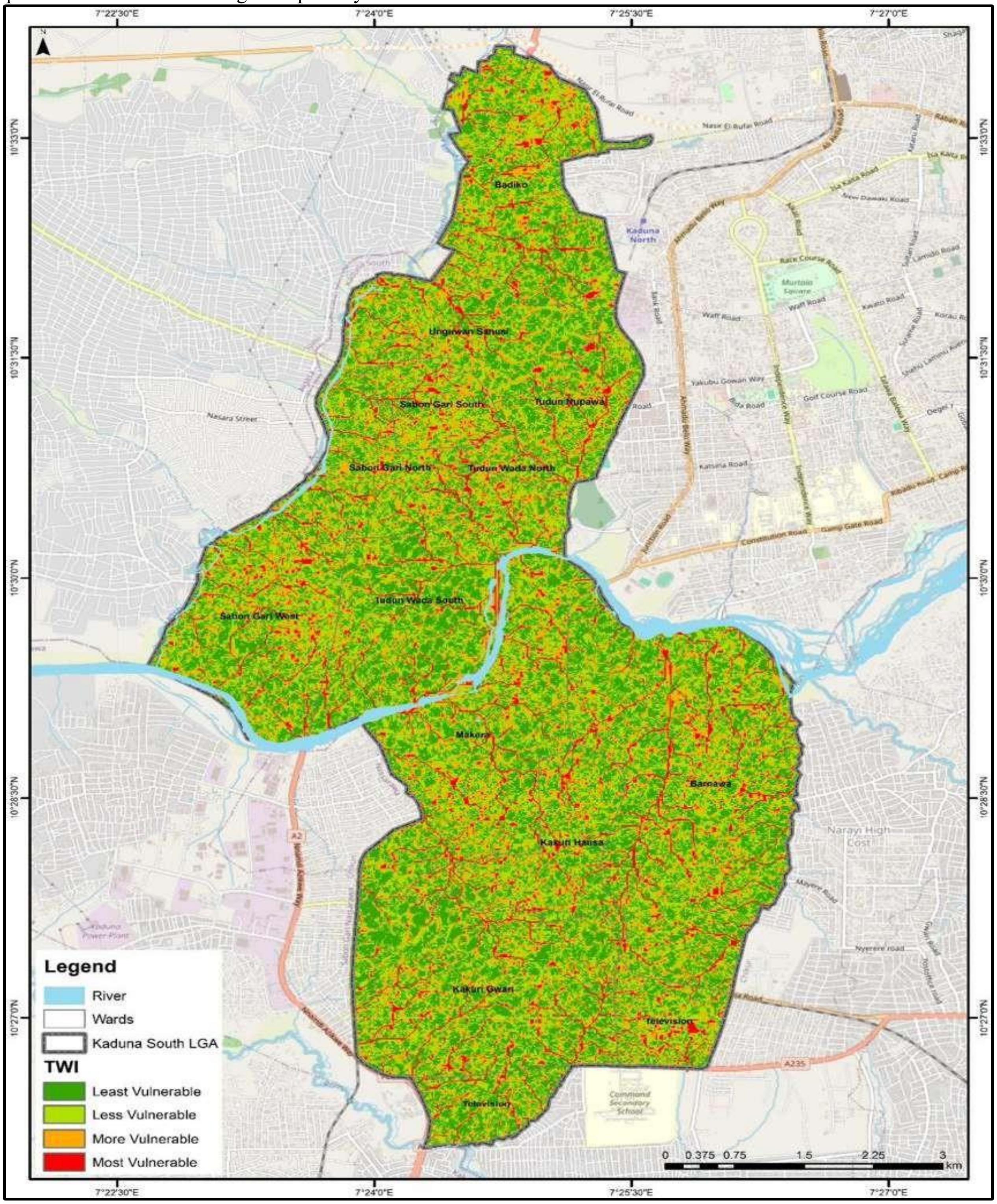

Figure 4: Topographic Wetness Index (TWI) Map of Kaduna South LGA.
Source: SRTM DEM, 2026

The proximity to waterbody analysis (Figure 5) shows that communities within 0–500 m of the river face the highest direct riverine flood exposure, with the maximum distance across the LGA reaching approximately 2,500 m.

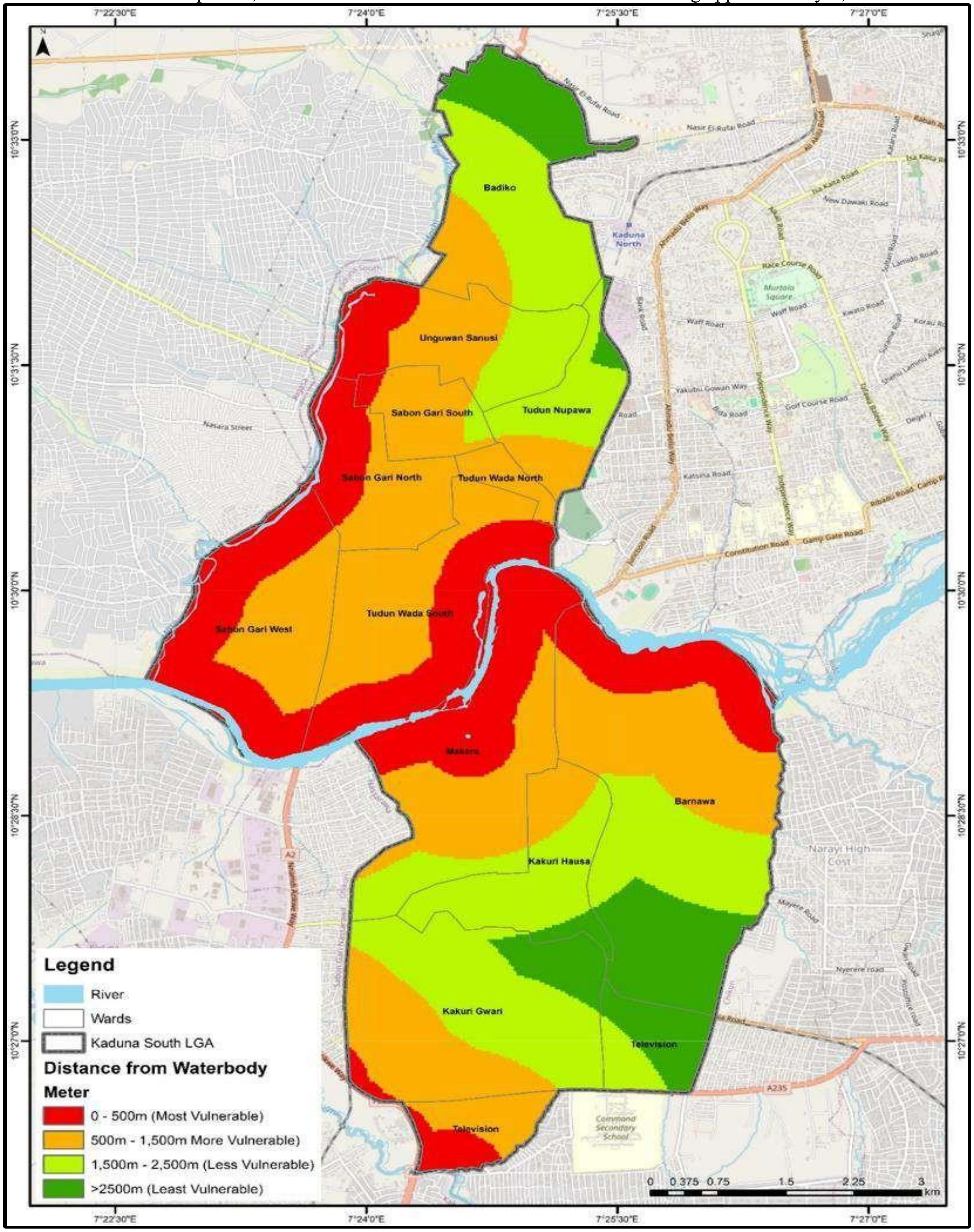

Figure 5: Proximity to Waterbody Map of Kaduna South LGA.
Source: GIS/RS Analysis, 2026

The composite MCE-based flood vulnerability map (Figure 6) reveals a clear spatial gradient of risk across the LGA. The most vulnerable zones are concentrated in Makera, Tudun Wada South, Sabon Gari West, and parts of Sabon Gari North. Least vulnerable areas are concentrated in Kakuri Hausa, Kakuri Gwari, and Television, characterised by higher elevations and steeper slopes. Table 3 presents the areal extent of each vulnerability category.

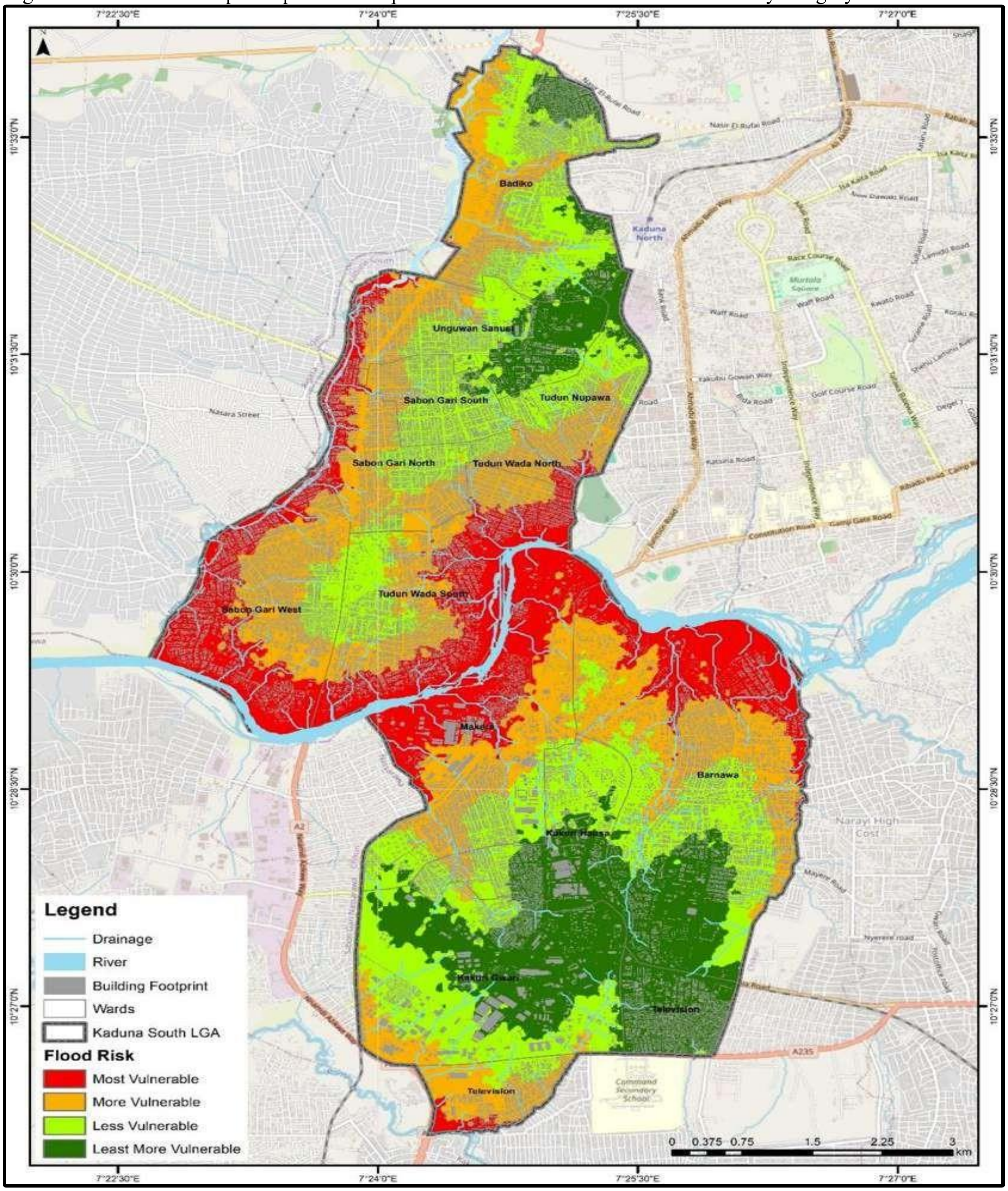

Figure 6: Flood Vulnerability Map of Kaduna South LGA showing the spatial distribution of the four vulnerability categories.
Source: GIS/RS Analysis, 2026

Table 3. Areal extent and proportional distribution of flood vulnerability categories in Kaduna South LGA.

Flood Vulnerability Category	Area (km^2)	Percentage (%)
Most Vulnerable	10.03	21.71
More Vulnerable	13.66	29.57
Less Vulnerable	13.75	29.76
Least Vulnerable	8.76	18.96
Total	46.20	100.00

Source: GIS/RS Analysis, 2026.

The most and more vulnerable categories together account for 51.28% of the total LGA area, confirming that flood risk is widespread and not confined to the immediate riverbank. The spatial distribution of existing buildings across vulnerability categories, overlaid with estimated household and population figures (Table 4), demonstrates the scale of human exposure.

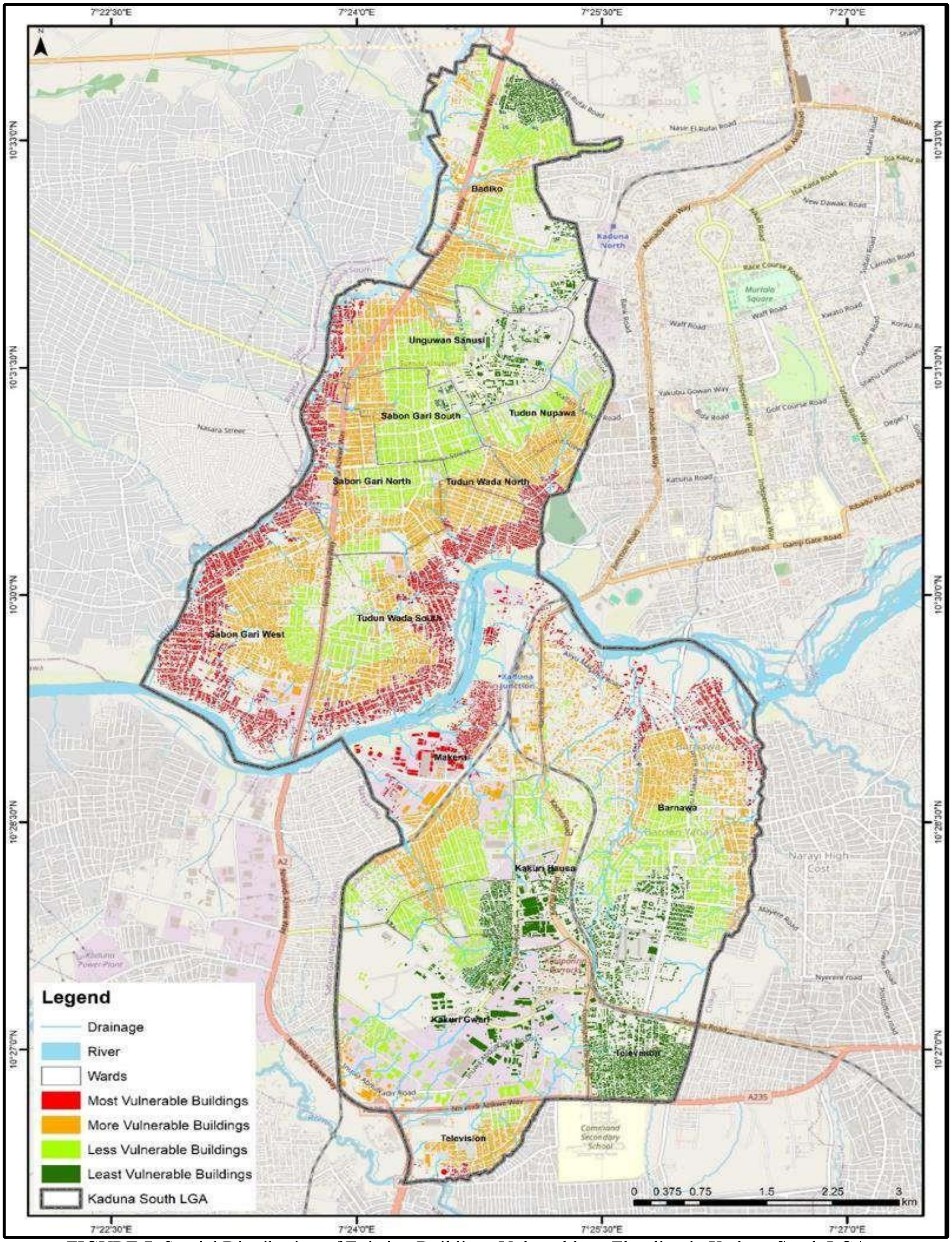

FIGURE 7: Spatial Distribution of Existing Buildings Vulnerable to Flooding in Kaduna South LGA.
Source: GIS/RS Analysis, 2026

Table 4. Existing buildings and estimated population by flood vulnerability category.

Vulnerability Category	Buildings	Estimated Households	Estimated Population
Most Vulnerable	14,669	14,669	73,345
More Vulnerable	29,943	29,943	149,715
Less Vulnerable	25,150	25,150	125,750
Least Vulnerable	11,181	11,181	55,905
Total	80,943	80,943	404,715

Estimated at 5 persons per household, consistent with UN-Habitat and World Bank planning benchmarks for developing countries. Source: GIS/RS Analysis and IBM SPSS v.27, 2026.

4.3 Demographic and Socio-Economic Characteristics

Table 5 presents the socio-demographic characteristics of the 390 respondents. The sample was predominantly male (61.5%), with the largest age cohort between 36 and 50 years (41.8%). Educational attainment was relatively high, with 65.1% holding tertiary qualifications, though 15.4% reported no formal education. Livelihood dependence on the River Kaduna was significant, with 48.7% of respondents dependent on river-based activities such as fishing, irrigation, and riverbank trading. Access to early warning systems was reported by 64.1% of respondents, indicating a notable gap of 35.9% without access.

Table 5. Demographic characteristics of respondents in Kaduna South LGA (n = 390).

Variable	Category	Frequency	Percentage (%)
Sex	Male	240	61.5
	Female	150	38.5
Age (Years)	18–25	118	30.3
	26–35	82	21.0
	36–50	163	41.8
	Over 50	27	6.9
Level of Education	Secondary	76	19.5
	Tertiary	254	65.1
	No Formal Education	60	15.4
Livelihood Dependence on River Kaduna	Yes	190	48.7
	No	200	51.3
Access to Early Warning Systems	Yes	250	64.1
	No	140	35.9
Income Spent on Basic Needs	Less than 50%	84	21.5
	50–75%	164	42.1
	Over 75%	142	36.4
Flood Recovery Time	Less than 1 month	135	34.6
	1–6 months	101	25.9
	Over 6 months	33	8.5
	Not yet recovered	121	31.0
Primary Preparedness Action	Temporary relocation	233	59.7
	Raised properties	72	18.5
	Reinforced structures	70	17.9
	Saved money	15	3.8
Perception of Flood Mitigation Measures	Somewhat effective	153	39.2
	Not aware of measures	237	60.8

Source: Field Survey, 2026; analysed using IBM SPSS v.27.

Income data revealed that 78.5% of respondents who disclosed their income spent more than half of their income on basic needs, leaving minimal financial buffers for flood recovery. The recovery data are particularly alarming: 31.0% of respondents had not yet recovered from a previous significant flood event at the time of survey. Temporary relocation was the dominant preparedness strategy (59.7%), reflecting largely reactive rather than proactive adaptation. Critically, 60.8% of respondents were unaware of any government or community flood mitigation measures, indicating a serious failure of institutional communication and outreach.

Table 6. Descriptive statistics of socio-economic vulnerability indicators (n = 390).

Indicator	Mean	Std. Deviation	Range
Level of Education	2.96	0.590	2
Livelihood Dependence on River Kaduna	1.51	0.500	1.00
Average Monthly Income	4.38	1.721	5.00
Income Spent on Basic Needs (%)	2.15	0.748	2.00
Actions Taken to Prepare for Floods	3.05	1.232	3.00
Access to Flood Insurance or Financial Aid	1.90	0.297	1.00
Time of Recovery from Flood Events	2.36	1.244	3.00
Effectiveness of Flood Mitigation Measures	3.22	0.978	2.00

Source: IBM SPSS v.27, 2026.

4.4 Ward-Level Socio-Economic Vulnerability Index (SEVI)

Table 7 presents SEVI scores for all 13 wards. Scores range from 0.372 (Kakuri Gwari, lowest vulnerability) to 0.474 (Makera, highest vulnerability). Makera and Tudun Wada South record the highest SEVI values, reflecting a concentration of river-livelihood dependence, limited income, poor preparedness, and protracted recovery. The clustering of high SEVI scores in wards that also feature the highest physical flood exposure (Makera, Tudun Wada South, Sabon Gari North) creates a compounding vulnerability landscape demanding priority policy attention.

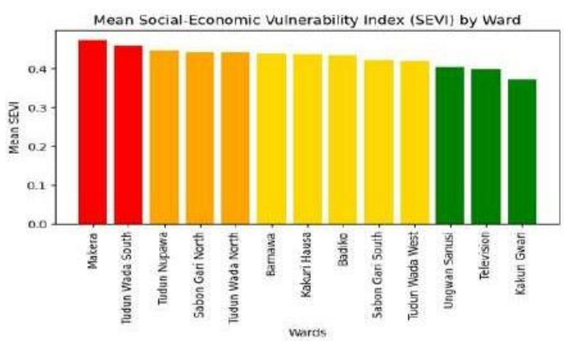

Figure 8: Mean Socio-Economic Vulnerability Index (SEVI) by Ward in Kaduna South LGA, displayed as a choropleth map. Red = Very High; Orange = High; Gold = Moderate; Green = Low. Source: GIS Analysis, 2026

Table 7. Summary of Socio-Economic Vulnerability Index (SEVI) by ward, Kaduna South LGA.

Rank	Ward	Mean SEVI	Interpretation
1	Makera	0.474	Very High
2	Tudun Wada South	0.460	Very High
3	Tudun Nupawa	0.446	High
4	Sabon Gari North	0.443	High
5	Tudun Wada North	0.442	High
6	Barnawa	0.439	Moderate – High
7	Kakuri Hausa	0.438	Moderate – High
8	Badiko	0.434	Moderate
9	Sabon Gari South	0.422	Moderate
10	Tudun Wada West	0.418	Moderate
11	Ungwan Sanusi	0.403	Low–Moderate
12	Television	0.398	Low
13	Kakuri Gwari	0.372	Lowest

Source: IBM SPSS v.27, 2026.

V. DISCUSSION

The findings of this study reveal that flood vulnerability in Kaduna South LGA is extensive, structurally embedded, and driven by the convergence of physical susceptibility and socio-economic deprivation. The MCE-based vulnerability mapping demonstrates that over 51% of the LGA falls within high-to-moderate risk zones, corroborating and extending the earlier findings of Tukur et al. (2020), who estimated that 86.9% of Kaduna South falls into highly vulnerable zones using a GIS–AHP approach. The slight divergence likely reflects differences in the factor sets and classification thresholds employed, underscoring the importance of transparent methodological reporting in flood vulnerability studies.

The identification of waste-blocked drainage channels as the most consistently observed anthropogenic cause of flooding aligns with national assessments by Eze and Chukwuma (2023) and Umar (2023), who identified poor solid waste management and drainage deficits as central drivers of urban flooding across Nigeria. The finding that 14,669 buildings and over

73,000 people are situated within the most vulnerable zones is particularly significant, as it documents an acute and quantifiable human exposure that has not previously been reported at this spatial resolution for Kaduna South.

The SEVI analysis adds a critical socio-economic dimension to the physical vulnerability picture. The co-location of the highest physical flood exposure and the highest socio-economic vulnerability in Makera and Tudun Wada South creates a compounding risk environment that mirrors patterns documented in comparable African urban settings (Ndimele et al., 2024; Okunola, Salihu, and Bello, 2022). The finding that 31% of respondents had not yet recovered from a previous flood, and that 60.8% were unaware of any institutional mitigation measures, reflects a profound governance gap that transcends physical risk management and demands urgent institutional reform. The dominance of temporary relocation as the primary coping strategy, adopted by nearly 60% of respondents, is consistent with findings from other Nigerian flood-affected cities (Chinwendu et al., 2017; Nwankwo and Edeh, 2022) and underscores the reactive, household-level character of existing adaptive responses. The absence of proactive structural or institutional preparedness among the majority of respondents confirms that current flood management in Kaduna South is inadequate and insufficiently anchored in the realities of affected communities.

These findings collectively demonstrate that effective and lasting flood risk reduction in Kaduna South will require a fundamental shift from reactive emergency response to proactive, community-engaged, and spatially grounded risk management — a shift supported by the integrated framework and spatial evidence produced by this study.

VI. RECOMMENDATIONS

Based on the empirical findings of this study, the following evidence-based recommendations are directed at the Kaduna State Government, Kaduna South LGA Administration, NEMA, KASUPDA, community leaders, and relevant agencies:

6.1 Addressing the Causes of Flooding

- Rehabilitate and expand urban drainage infrastructure across all 13 wards, with priority investment in Makera, Tudun Wada South, Sabon Gari West, and Barnawa. New drainage should be sized for climate-adjusted design storms and maintained through formal schedules.
- Enforce solid waste management regulations through the Kaduna State Solid Waste Management Authority; establish designated waste collection points in flood-prone wards and conduct regular channel-clearing exercises.
- Demarcate and enforce minimum riparian buffer zones along the River Kaduna corridor; prohibit further construction within these zones and initiate afforestation and vegetation restoration programmes.
- Develop and enforce strict land-use regulations prohibiting new construction within the delineated most and more vulnerable flood zones, formally adopting the GIS vulnerability map produced in this study as a development control reference.

6.2 Strengthening GIS-Based Flood Risk Mapping and Early Warning

- Institutionalise the flood vulnerability map produced by this study within the disaster risk management plans and land-use frameworks of the Kaduna State Government and Kaduna South LGA.
- Establish a real-time hydrological monitoring network along the River Kaduna, feeding into a community-accessible early warning system disseminated through radio, SMS, community notice boards, and ward-level emergency coordinators.
- Update the flood vulnerability assessment every five years, or following major flood events, using the latest satellite imagery, updated DEMs, and current demographic data, in partnership with KADGIS.

6.3 Reducing Socio-Economic Vulnerability

- Design and implement targeted livelihood diversification programmes for the highest SEVI-scoring wards, including vocational skills training, microenterprise support, and agricultural extension services for river-dependent households.
- Establish a dedicated flood recovery and resilience fund providing rapid-disbursement grants and low-

interest loans for flood-affected households, prioritising the most vulnerable and poorest.
- Conduct sustained, multilingual flood risk education campaigns in all 13 wards to address the 60.8% awareness gap identified in this study.

6.4 Preventive and Resilience Strategies
- Develop a comprehensive, integrated Kaduna South Flood Risk Management Plan anchored in the GIS mapping and SEVI analysis of this research, developed through a participatory process involving ward councils, community leaders, and civil society.
- Establish an inter-agency flood risk coordination committee for Kaduna South to align activities of NEMA, KADSEMA, KEPA, NIHSA, and KASUPDA, with community representation from the most vulnerable wards.
- Align flood risk investments with Nigeria's National Adaptation Plan (NAP), the Sendai Framework for Disaster Risk Reduction (2015–2030), and the United Nations SDGs 11 and 13.

VII. CONCLUSION

This study has produced the first comprehensive, ward-level flood vulnerability assessment for Kaduna South LGA, integrating GIS-based geospatial analysis with socio-economic data from 390 respondents. The findings confirm that flood vulnerability in Kaduna South is extensive, affecting over 51% of the LGA's land area and over 400,000 people, and is driven by the compounding interaction of physical susceptibility, rapid urbanisation, governance deficits, and socio-economic deprivation. The spatial concentration of vulnerability in Makera, Tudun Wada South, and Sabon Gari West — where high physical flood exposure coincides with high SEVI scores — demands urgent, targeted policy intervention.

The validated ward-level flood vulnerability framework and SEVI methodology developed in this study provide a replicable, decision-oriented model applicable to comparable Nigerian urban settings. The study makes an unambiguous case for sustained, equitable, and evidence-based investment in flood risk management in Kaduna South, grounded in local knowledge, driven by spatial evidence, and designed to leave no community behind.

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