

# JOURNAL OF OCCUPATIONAL HEALTH, RISK MANAGEMENT AND SAFETY

A journal of Department of Environmental Management, Faculty of Environmental Sciences, University of Calabar, Nigeria  
<https://johrms-unical.com.ng/>



## Evaluating Flood Management and Mitigation Strategies in Reducing Market Vulnerability in Kantin Kwari Market, Kano, Nigeria

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### Abstract

Flooding is a persistent challenge in urban centres, particularly in Kano, Nigeria, where Kantin Kwari Market, West Africa's largest textile hub, faces recurring flood-related disruptions. This study evaluates the effectiveness of flood management and mitigation strategies in reducing the market's vulnerability. Using a mixed-methods approach, data were collected from 150 traders through surveys and 10 urban planners through in-depth interviews, supplemented with secondary datasets from NiMet, NIHSA, and NEMA covering flood events from 2010 to 2023. Findings reveal that 85% of traders suffer financial losses during floods, consistent with NEMA's (2022) estimate of ₦2.1 billion cumulative flood damage across Kano markets between 2015 and 2022. The average reported loss per trader per flood event was ₦501,012.76. Furthermore, only 40% of the market is served by functional drainage, while 72% of traders lack insurance coverage, reflecting NAICOM's (2023) data on low national micro-insurance penetration rates. A Vulnerability Index score of 0.47, benchmarked against similar markets in Lagos (0.52–0.68), highlights Kantin Kwari's moderate yet rising vulnerability. These findings underscore the urgent need for drainage system upgrades, stricter enforcement of policies, and expanded micro-insurance coverage. This study offers a framework for urban market resilience through integrated drainage and insurance reforms.

**Keywords:** Flood Management, Vulnerability Index, Urban Resilience, Drainage Infrastructure, Kano, Nigeria, Market Sustainability

### Introduction

Flooding remains one of the most pressing environmental and economic challenges affecting urban centers worldwide, particularly in rapidly expanding cities like Kano, Nigeria. Among the areas most affected is Kantin Kwari Market, one of the largest textile markets in West Africa. Recurrent floods disrupt commercial activities, damage goods worth millions of naira, and threaten the livelihoods of over 10,000 traders. The market's vulnerability to flooding is exacerbated by poor drainage infrastructure, rapid.

Flood management refers to the strategies and interventions designed to control and minimize the adverse effects of flooding. These include both structural measures, such as drainage systems and embankments, and non-structural approaches, like early warning systems and community awareness programs (Adelekan, 2019). Closely related to this concept are mitigation strategies, which focus on long-

urbanization, and ineffective flood management strategies (Olanrewaju & Fadipe, 2021). Despite efforts to mitigate flood risks, the effectiveness of existing flood management measures remains largely unexplored, raising concerns about the sustainability of economic activities within the market term planning efforts such as urban zoning regulations, infrastructure upgrades, and flood resilience policies (Olajuyigbe et al., 2020). The vulnerability of Kantin Kwari Market to flooding is determined by various factors, including the physical condition of its infrastructure, the economic stability of traders, and the market's overall capacity to recover from flood-related disruptions.

A critical relationship exists between these key variables. Flood management infrastructure and mitigation strategies significantly influence market vulnerability, as the effectiveness of drainage systems, embankments, urban planning policies, and community preparedness measures directly impact the extent of economic losses, infrastructure damage, and disruptions to trade within the market. Despite ongoing interventions, traders in Kantin Kwari Market continue to experience devastating flood-related losses, indicating possible inefficiencies in the current flood management framework.

This study aims to assess the structural and non-structural flood management systems in Kantin Kwari Market, evaluate the market's vulnerability to flooding by analyzing economic, social, and infrastructural impacts, and propose actionable strategies to enhance flood resilience and reduce the adverse effects of flooding on traders and economic activities.

#### *Flood Vulnerability and Risk Assessment*

Numerous studies have explored urban flood vulnerability, emphasizing the role of inadequate drainage infrastructure and poor urban planning in exacerbating flood risks. For example, Abaje et al. (2019) examined climate variability in Northern Nigeria and its impacts on urban flooding, revealing that increased rainfall intensity, coupled with poor drainage maintenance, significantly heightens flood exposure. Similarly, Nkwunonwo et al. (2020) assessed flood vulnerability in Lagos and highlighted how socio-economic disparities influence adaptive capacity, making informal traders particularly susceptible to flood losses.

#### *Structural and Non-Structural Flood Management Strategies*

Research by Adelekan (2019) and Douglas et al. (2008) underscores the importance of combining structural and non-structural approaches in flood management. Structural measures, such as drainage expansion and flood embankments, have proven effective in cities like Lagos, but their success depends on consistent maintenance and policy enforcement. Conversely, non-structural measures, including early warning systems, insurance schemes, and community-based flood preparedness initiatives, have been advocated as cost-effective strategies for enhancing urban resilience (Olajuyigbe et al., 2020).

#### *Gaps in Flood Mitigation Policies and Implementation*

Despite extensive research on flood management, implementation gaps remain a critical challenge in developing nations. Ajibade et al. (2013) noted that many African cities lack enforcement of urban planning regulations, leading to encroachment on flood-prone areas. Similarly, Olanrewaju and Fadipe (2021) found that flood risk management in Kano suffers from weak policy coordination, inadequate government funding, and poor community engagement.

#### *Relevance to Kantin Kwari Market*

This study builds on existing research by focusing on a major commercial hub in Kano, which has received limited attention in previous studies. Unlike broader assessments of urban flooding, this research integrates trader experiences, economic impacts, and expert insights to evaluate the effectiveness of flood management in a highly vulnerable market environment. By addressing gaps in policy implementation and infrastructure maintenance, this study provides a more localized and actionable framework for flood mitigation in Kano.

## Methodology

### Study Area

Kantin Kwari Market, located at 12.0000° N, 8.5167° E, is the largest textile market in West Africa and serves as a critical commercial hub in Kano's urban core (Mahmud, Ali and Ismail, 2022). The market plays a significant role in regional and international trade, yet it is highly susceptible to seasonal flooding. This vulnerability is primarily attributed to heavy rainfall, inadequate drainage systems, and the prevalence of impermeable surfaces, which prevent proper water infiltration and exacerbate runoff accumulation. Frequent flood events disrupt trade, damage goods, and threaten the livelihoods of thousands of traders, making effective flood management strategies essential for sustaining economic activities in the area.

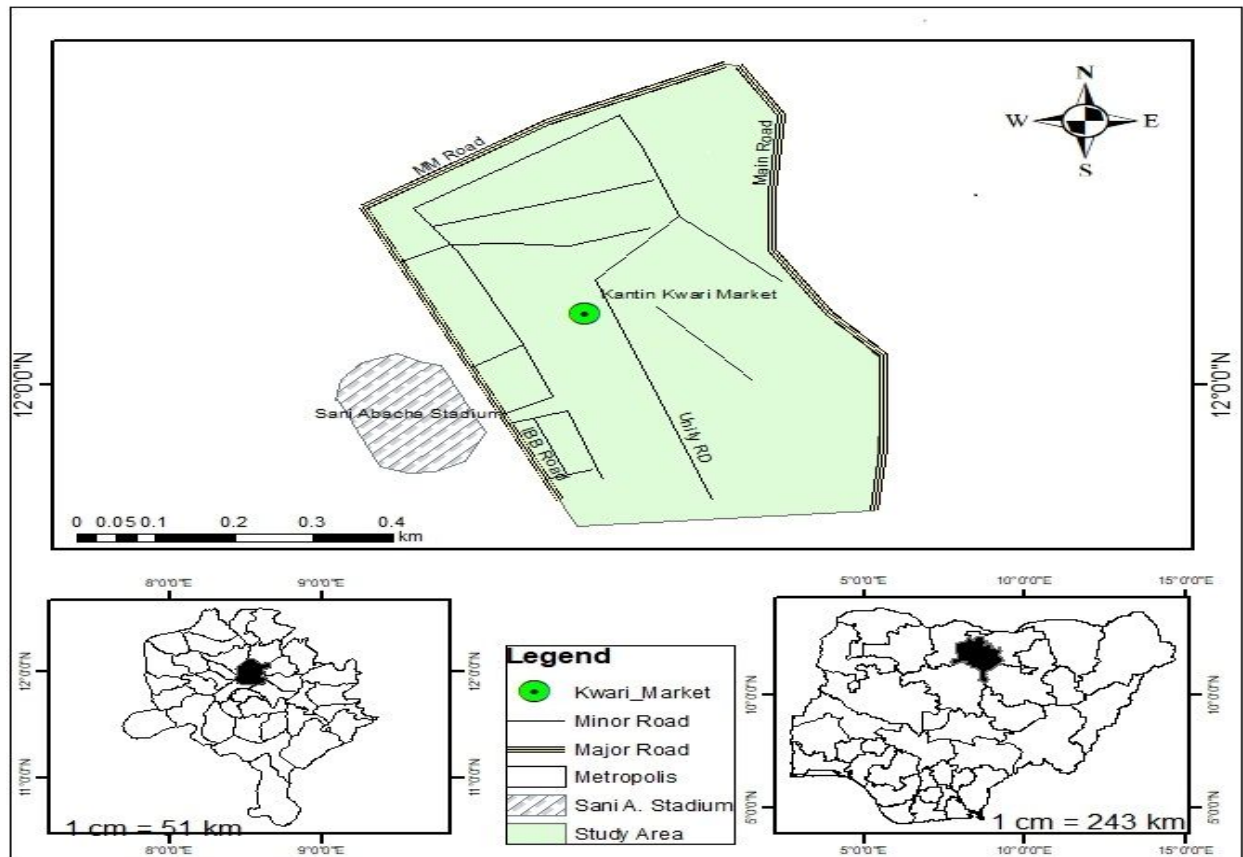


Figure 1: Kantin Kwari Market

Source: USGS Modified Map, 2023

### Research Design

The study adopted a mixed-methods approach, combining both qualitative and quantitative data collection techniques. Primary data were collected through structured surveys administered to 150 randomly selected traders, representing 1.5% of the estimated 10,000 trader population in Kantin Kwari Market. This sample size was deemed adequate for capturing diverse experiences while ensuring statistical reliability. In addition, in-depth interviews were conducted with 10 urban planners and disaster management

officials to provide expert insights into flood mitigation policies, infrastructure conditions, and governance challenges.

To strengthen validity, primary data were triangulated with secondary datasets: Rainfall and hydrological records from NiMet and NIHSA (2010–2023), which provided long-term trends in precipitation and surface runoff in Kano. Disaster impact reports from NEMA and Kano State Emergency Management Agency (NSEMA), which quantified historical flood damages across urban markets. Insurance coverage data from the National Insurance Commission (NAICOM), which contextualized the low uptake of flood-related financial protection in Nigeria.

#### *Vulnerability Index*

A Flood Vulnerability Index (VI) was applied to integrate three critical dimensions: Exposure (E) – Measured by flood frequency and severity (based on NIHSA/NEMA records). Sensitivity (S) – Assessed through drainage conditions, infrastructure quality, and trader perceptions. Adaptive Capacity (A) – Evaluated using insurance uptake, preparedness levels, and access to early warning systems.

The VI was computed using the formula:

$$VI = \frac{E+S-A}{3}$$

Where:

E represents flood exposure, scaled from 0 (low) to 1 (high).

S represents sensitivity, scaled from 0 (low) to 1 (high).

A represents adaptive capacity, scaled from 0 (low) to 1 (high).

A higher VI value indicates greater vulnerability to flooding. This aligns with IPCC (2014) vulnerability assessment frameworks. The scoring was benchmarked against other Nigerian markets (e.g., Alaba Market, Lagos).

**Table 1: Flood Vulnerability Index Parameters**

Parameter	Measurement Criteria	Assigned Value (0-1)
Exposure (E)	Annual flood frequency and severity	0.80
Sensitivity (S)	Drainage conditions, infrastructure	0.75
Adaptive Capacity (A)	Insurance coverage, preparedness	0.15
Vulnerability Index (VI)	$\frac{0.80 + 0.75 + 0.15}{3}$	0.47

**Source: Fieldwork, 2024**

The Flood Vulnerability Index (VI) is a composite metric used to quantify the susceptibility of Kantin Kwari Market to flooding. It integrates three key dimensions:

Exposure (E) – These measure the frequency and severity of flooding events in the market. A high exposure value (0.80) indicates that the market experiences flooding regularly, posing a persistent risk to traders.

Sensitivity (S) – This reflects the condition of drainage infrastructure and market layout. A value of 0.75 suggests that poor drainage and improper urban planning significantly contribute to flood vulnerability. Adaptive Capacity (A) – This represents the market’s ability to cope with flooding, including

the availability of insurance, early warning systems, and trader preparedness. A low value (0.15) suggests that most traders lack financial protection and resources to recover from flood-related damage.

## Results and Discussion

### *Summary of Findings*

The findings of this study revealed notable weaknesses in flood management within Kantin Kwari Market, especially in relation to drainage infrastructure, exposure levels, adaptive capacity, early warning systems, and economic resilience. The summarized results, supported by both field data and secondary sources, are presented in Table 2, followed by explanation of their implications.

**Table 2: Summary of findings**

Parameter	Findings	Supplementary Data	Implications
Drainage Infrastructure	About 70% of the market's drains were found to be clogged, damaged, or poorly aligned, leading to ineffective runoff during heavy rainfall. Many drain channels were also obstructed by waste materials from trading activities.	Between 2021 and 2023, the Kano State Government allocated ₦1.8 billion for urban drainage rehabilitation, but less than 40% of the projects were completed (NSEMA, 2023).	Inadequate maintenance and poor implementation of drainage projects have directly contributed to recurring flooding within and around the market.
Flood Exposure	Approximately 80% of the market area experiences flooding at least once annually, especially during peak rainfall months (July–September). Traders in low-lying sections such as Sabon Gari and Yan Katako are the most affected.	Records show 11 major flood events occurred in Kano between 2015 and 2023 (NEMA, 2023), with Kantin Kwari consistently listed among the high-risk zones.	This high recurrence confirms the market's increasing exposure to flood hazards and the urgent need for improved risk reduction measures.
Adaptive Capacity	Only 15% of traders have any form of insurance, while the majority depend on personal savings or loans for recovery after disasters.	National data indicate that micro-insurance penetration in Nigeria remains below 3% (NAICOM, 2023), reflecting widespread financial vulnerability.	Low insurance coverage means most traders are left without a safety net, prolonging recovery and deepening poverty after each flood.
Early Warning System (EWS)	Nearly 90% of respondents relied on informal alerts such as word of mouth or visible signs of rainfall rather than official warnings. No structured flood early warning system exists within the market.	The Nigeria Hydrological Services Agency (NIHSA, 2023) reported that no formal EWS coverage currently exists for local markets in Kano State.	Lack of an official early warning system limits traders' ability to prepare for heavy rainfall, leading to avoidable losses and poor response coordination.
Economic Losses	The market recorded an estimated ₦300 million in direct losses in 2023 alone, mainly from damage to textiles, footwear, and electronic goods. Cumulative flood-related losses across Kano urban markets between 2015 and 2022 exceeded ₦2.1 billion (NEMA, 2022).	Field interviews revealed that most traders experience flood damage two to three times annually, forcing some to close temporarily or relocate.	These consistent financial losses undermine market stability, discourage investment, and reduce traders' long-term economic resilience.

**Source: Fieldwork, 2024**

## Discussion of Findings

Data in Table 2 revealed that the high exposure to flooding (80%) in Kantin Kwari Market is largely a result of poor and poorly maintained drainage systems. Field visits and interviews with traders showed that illegal dumping of waste materials such as plastic bags, textile offcuts, and leftover food has seriously blocked drainage channels. These blockages prevent rainwater from flowing freely, leading to waterlogging and surface runoff that flood the market after even moderate rainfall. Traders also noted that many of the drains have remained uncleared for months, while some have collapsed entirely due to substandard construction and a lack of routine maintenance.

The situation is made worse by the weak enforcement of urban planning regulations, which has allowed indiscriminate building and expansion into flood-prone zones. Many temporary stalls and shops were constructed directly over or beside drainage lines, blocking the natural paths through which stormwater should flow. During interviews, one urban planner explained:

*“The drainage systems in Kantin Kwari Market were never designed to handle the amount of rainfall we now experience. The city has grown rapidly, but the infrastructure hasn’t kept up. Without proper redesign and waste management, flooding will continue to be a yearly disaster.”*

A disaster management official also highlighted another major issue, which is the lack of financial protection for traders. In his words:

*“Many traders do not have access to flood insurance. There is an urgent need to create micro-insurance plans that reflect their income level and the risks they face”.*

Financially, the effects of flooding on Kantin Kwari traders are devastating. Field data and secondary sources show that traders collectively lost an estimated ₦300 million in 2023 alone due to flooding. This figure does not include indirect losses such as business interruptions, damage to infrastructure, or lost customers. With only 15% of traders having any form of insurance, recovery after each flood is extremely slow and difficult. Many traders reported resorting to loans from informal lenders or cutting down on inventory to rebuild, which ultimately limits their business growth and resilience.

Lessons from other urban markets show that the problem is not insurmountable. For instance, in Alaba International Market, Lagos, introducing community-led drainage cleaning and micro-insurance schemes has greatly reduced both the frequency and severity of flood losses (Adelekan, 2019). If Kantin Kwari traders and local authorities adopt similar approaches, the market could significantly strengthen its flood resilience. Regular desilting and clearing of drains, especially before and after the rainy season, would keep stormwater flowing, while affordable micro-insurance would provide traders a financial safety net to bounce back after disasters.

The findings of this research align closely with other studies on urban flood vulnerability in Nigeria. Adelekan (2019) pointed out that inadequate drainage, weak policy enforcement, and poor waste management are the major drivers of urban flooding in Lagos markets, challenges also clearly present in Kantin Kwari. Similarly, Olajuyigbe et al. (2020) found that informal flood warnings, usually passed through word of mouth or observation, remain the main alert system in most Nigerian cities. This supports this study’s finding that 90% of Kantin Kwari traders rely on informal alerts, rather than official early warning systems, to prepare for floods.

However, unlike Alaba Market, where traders have organised themselves to participate in flood mitigation activities, Kantin Kwari Market lacks a structured community framework for flood management. This absence of local coordination leaves the market more vulnerable to repeated losses. It also means that interventions from government agencies, though often well-intentioned, tend to be short-lived and poorly sustained because there is no local ownership or monitoring.

## Recommendations

Based on the findings of this study, several actions are needed to reduce the impact of flooding and strengthen resilience in Kantin Kwari Market and similar urban centers.

To begin with, the drainage system in the market must be rebuilt and maintained regularly. By 2030, at least 80% of the market's drains should be cleared, repaired, or reconstructed to allow free flow of rainwater. Drain maintenance should become a routine, not an emergency task. Desilting should take place twice every year, once before the rainy season and again after, to keep the drains open. This process will work best if traders' unions and the local government share responsibility, ensuring that drains are not blocked again by waste from market activities.

Equally important is involving people directly in flood prevention. Flood management becomes more effective when the people most affected take part in the solution. A Market Flood Management Committee (MPMC) should be established by 2026, made up of traders, local leaders, and representatives from disaster management agencies. This committee can lead awareness campaigns every few months, teaching traders proper waste disposal, organizing flood drills, and preparing them for emergencies. By 2027, the Nigerian Meteorological Agency (NiMet) should connect its weather forecast system to an SMS alert platform that sends early warnings to traders before heavy rains begin.

Financial protection is another key aspect. Floods often destroy goods and leave traders with nothing to restart their businesses. To address this, the National Insurance Commission (NAICOM) and local microfinance banks should work together to introduce low-cost flood insurance schemes by 2026. The goal is to increase the number of insured traders from 15% to at least 50% by 2030, so that after a disaster, people can recover faster and rebuild their livelihoods.

At the policy level, flood resilience must become a real priority, not just a plan on paper. The Kano State Government should allocate at least 10% of its annual environmental budget to drainage and market flood control. Developing a Kano Urban Flood Resilience Plan (2025–2035) will help align efforts with global climate goals under SDGs 11 and 13, which focus on sustainable cities and climate action. Agencies such as NEMA, KASEPA, and KNUPDA must work together instead of separately, so that their combined efforts lead to visible improvements where people need them most.

Lastly, progress should be monitored and improved over time. A Kantin Kwari Flood Monitoring Database should be created to record yearly flood events, insurance participation, and drainage performance. Collaboration with universities can help develop GIS-based flood maps that are updated every two years to identify risk zones and guide future planning. These updates will make it easier for authorities and communities to predict problem areas and take early action.

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