Original Research Article

Nigerian Journal of Biotechnology and Life Sciences
ISSN: 2814-0281
Vol. 3 No 2 (2026) p. 25 - 33
http://www.njbls.fud.edu.ng/

Assessing Community Risk Perception and Knowledge of Early Warning System during Flood

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https://doi.org/10.67601/njbls.v3i2.15

Article into
Date received
07/06/2026
Date accepted
28/06/2026
Available online
04/09/2026

Keywords
Community risk, Perception, Knowledge, Flood, Early warning

Abstract

This study assesses community risk perception, knowledge, and the effectiveness of early warning systems (EWS) during floods in Gasma, a rural community in Karasuwa LGA, Yobe State, Nigeria. Despite technological advancements in flood forecasting, a persistent disconnect between warning generation and community action leads to avoidable casualties. Using a stratified random sampling approach, data were collected from 200 riverine respondents via surveys, interviews, and structured questionnaires. Descriptive statistics were employed for analysis. Results reveal that while 48% perceive moderate flood risk, 35% view it as high or very high. Although 75% claim to understand EWS terms, 20% understand very little or not at all. National government agencies (48%) and local leaders (23%) are the most trusted information sources. Critically, direct observation of rising water (38%) outweighs official warnings (28%) in evacuation decisions. Key barriers to acting on warnings include fear of looting (33%), lack of safe evacuation sites (25%), and past warning inaccuracies (23%). The study concludes that advanced forecasting alone is insufficient; a reactive institutional culture and reliance on personal verification undermine EWS effectiveness. Bridging the warning-action gap requires community engagement, trust-building, precise impact-based messaging, and co-creation of actionable plans to transform passive recipients into active, prepared participants.

Introduction

Despite advancements in flood forecasting technologies and the institutional promotion of people centered EWS, a critical disconnect often persists between the generation of early warnings and the reduction of flood disaster impacts on vulnerable communities (Emerton et al., 2016). This gap manifests in warning messages not being understood, believed, or acted upon, leading to avoidable casualties and losses (Emerton et al., 2016). The problem is compounded by a lack of integrated assessment that simultaneously evaluates the technical performance of EWS, the sociocultural dynamics

of warning communication, and the operational readiness of community response plans. Without a holistic understanding of these interlinked factors, interventions remain siloed, and the full potential of EWS for flood mitigation remains unrealized (Emerton et al., 2016).

The integration of remote sensing data, high-resolution numerical weather prediction (NWP), ensemble forecasting, and machine learning algorithms has improved the accuracy and lead time of flood forecasts (Emerton et al., 2016). For instance, satellite-based rainfall estimates and digital elevation models have enhanced flood modelling in data-scarce regions (Alfieri et al., 2018). However, literature consistently identifies a disproportionate focus on this technological component at the expense of the human elements. As Cools et al. (2016) argue, many systems remain "supply-driven," designed by experts without sufficient integration of local needs and contexts. This often results in warnings that are too generic, too technical, or lacking in actionable guidance, thereby failing to trigger appropriate behavioural responses (Haer et al., 2020).

The efficacy of a warning is socially constructed. A warning is only effective if it is believed, understood, and acted upon (Lindell, 2018). Research on protective action decision models, such as the extended Protective Action Decision Model (PADM), highlights the sequential cognitive processes individuals undertake from hearing the warning, to understanding it, perceiving personal risk, deciding on protective actions, and finally, implementing them (Lindell, 2018). Individuals often rely on "mental shortcuts" or heuristics based on personal experience. For example, the availability leads people to judge risk based on the ease of recalling past flood events, which can result in underestimation if a severe flood has not occurred recently (Wachinger et al., 2013).

Regarding source credibility and trust, perhaps the most critical factor is the community's trust in the warning source. Trust is multifaceted, encompassing perceptions of competence, objectivity, fairness, and consistency. Research by Morss et al. (2016) demonstrates that warnings from distrusted authorities are likely to be discounted or ignored, regardless of their technical accuracy. Trust is often higher in local institutions and community leaders than in distant government agencies (Bubeck et al., 2017).

Due to social and economic vulnerabilities, the capacity to respond is unevenly distributed. Factors such as gender, age, disability, poverty, and land tenure create structural barriers to action (Sánchez et al., 2020; Sena et al., 2021). For instance, women may have restricted mobility or access to information; the elderly or disabled may lack physical assistance to evacuate; and impoverished households may prioritize securing livelihoods over immediate evacuation (Sánchez et al., 2020; Sena et al., 2021). This highlights that a "one-size-fits-all" warning message is inherently exclusionary.

Methodology

Gasma is a rural community in Karasuwa Local Government Area (LGA), situated in northeastern Yobe State, Nigeria. Its geographical coordinates lie between latitudes 12°52'0"N and 12°56'0"N and longitudes 10°55'0"E and 10°56'30"E. The terrain consists of a flat, low-relief plain with an average elevation of roughly 350 meters, a maximum depth of 6 meters, and a mean pH of 6.5. The region experiences temperatures ranging from 26 to 40 °C, with an average annual rainfall of 600 mm (Yobe State Ministry of Environment, 2022).

The study employed a stratified random sampling approach. Data collection involved a survey, interviews, and a structured questionnaire. The sample size was calculated using the Taro Yamane formula: $n = \frac{N}{1} + N(e)^2$ where n = sample size, N = population, and e = margin of error (Chanuan, Kajohnsak, and Nittaya, 2021). A total of 200 respondents living near the river were selected through stratified random sampling to assess the institutional early warning system. Key variables examined included the most reliable institutional warning source (e.g., Disaster Management Authority), perceived data sources for warnings (e.g.,

satellite imagery), primary communication channels (e.g., mass media, mosque announcements), perceived inter-institutional coordination before and during floods, and warning timeliness (e.g., issued more than three days in advance).

The data collected were analyzed using descriptive statistics, presented as frequencies, percentages, tables, figures, and charts. All results were expressed in frequencies and percentages to clearly illustrate the distribution of variables and observed trends.

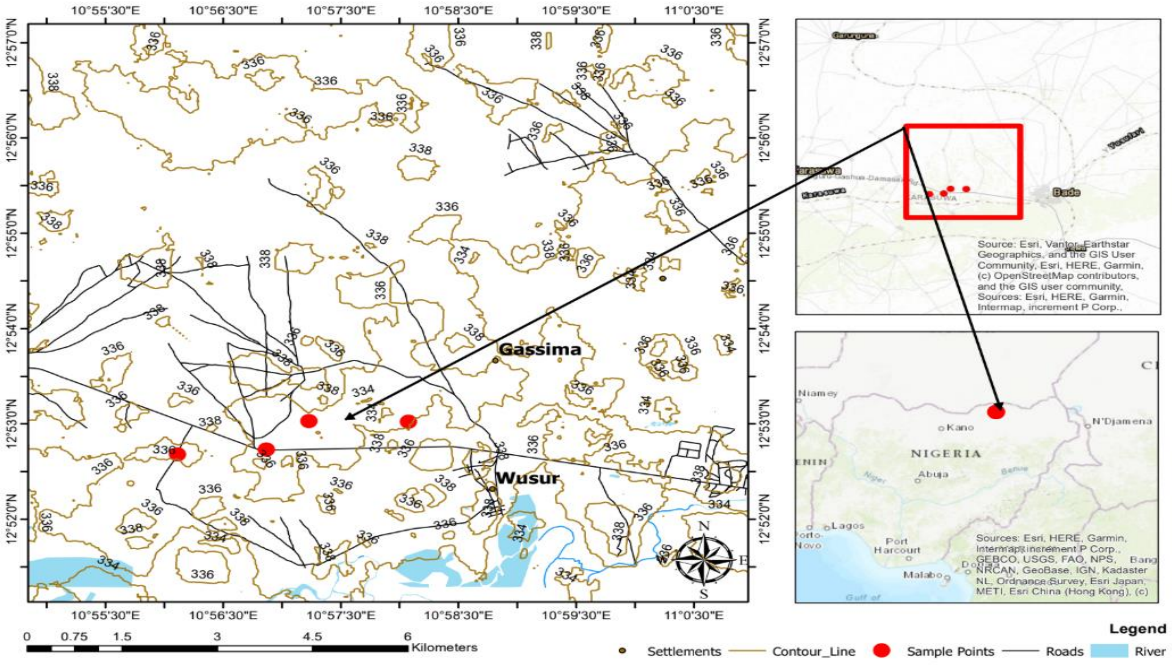

Figure 1: Gasma study area at 12⁰ 52'0"N & 12⁰ 56'0"N and 10⁰ 55'0"E & 10⁰ 56'30"E.

Results and Discussion

The survey outcomes offer insights from the study area on community risk, perception and knowledge of early warning system, emphasizing the origins, transmission methods, and perceived dependability of flood alerts based on respondents' views. The findings are displayed using frequency counts and percentages to give a quantitative summary of community perspectives.

Demographics

The demographic characteristics indicate a largely mature and married respondent population. The most common age groups were 31–40 years (28%) and 41–50 years (25%), showing that most participants are in their active working and family-raising stages. This aligns with marital status data, where the vast majority 170 individuals (85%) were married. Younger adults aged 20–30 years made up 15% of the sample, while older individuals between 61 and 70 years accounted for 13%, ensuring a diverse range of viewpoints across generations (Table 1).

Regarding sociocultural and educational background, the Bade ethnic group formed the largest portion, with 87 respondents (44%), followed by Kanuri (49, or 25%), Hausa (36, or 18%), and Fulani (28, or 14%). In terms of education, the community shows high literacy levels; nearly two-thirds (125 respondents, or 63%) had completed tertiary education. This substantial formal education level indicates a strong capacity to interpret complex warning messages and interact with institutional communication systems (Table 1).

From an economic standpoint, the community relies heavily on agriculture. Crop farming is the primary livelihood, engaging 120 respondents (60%). Other nature-dependent activities include fish farming (37 respondents, 19%) and livestock

rearing (28 respondents, 14%). A smaller proportion (15 respondents, 8%) depends on trade. This significant reliance on climate-sensitive economic activities highlights the vital need for prompt and effective flood early warning systems to ensure the community's economic stability and overall welfare.

Table 1: Demographic information of respondents from the study area

Distributions	Freq.	Percent (%)
Age Distribution		
20 - 30	30	15
31 - 40	55	28
41 - 50	50	25
51 - 60	40	20
61 - 70	25	13
Total	200	100
Marital Status		
Single	30	15
Married	170	85
Total	200	100
Level of Education		
Non-formal education	25	13
Primary education	20	10
Secondary education	30	15
Tertiary education	125	63
Total	200	100
Tribe		
Bade	87	44
Fulani	28	14
Hausa	36	18
Kanuri	49	25
Total	200	100
Respondent's livelihood activities		
Crop farming	120	60
Fish farming	37	19
Livestock farming	28	14
Trading	15	8
Total	200	100

Community Risk, Perception and Knowledge of Flood from the Study Area

Perceived risk of major respondents on flood from the survey was that the community faces a moderate risk of a major flood, with (48%, 95) selecting this option. A combined 35% perceived the risk as either high (23%, 45) or very high (13%, 25). Conversely, 18% viewed the risk as low (13%, 25) or no risk at all (5%, 10) Table 2.

Table 2: The risk of major flood occurring in the community

Risk of flood occurrence	Freq.	Percent (%)
Very high risk	25	13
High risk	45	23
Moderate risk	95	48
Low risk	25	13
No risk at all	10	5
Total	200	100

Understanding of warning terms, significant portion of the community demonstrates a good understanding of flood warnings. While (43%, 85) stated they understand completely, another (33%, 65) said they understand partially. However, a combined 20% reported understanding very little (13%, 25) or not at all (8%, 15). Further (5%, 10) had never received a warning Table 3.

Table 3: Understanding the meaning of the early warning system terms

Understanding meaning EWS	Freq.	Percent (%)
Understand completely	85	43
Understand partially	65	33
Understand very little	25	13
Do not understand at all	15	8
I have never received a warning	10	5
Total	200	100

The most trusted source of information is national government agencies were the most trusted source of flood information reported (48%, 95). Local municipal or village council leaders were the next most trusted as reported (23%, 45), followed by community-based organizations or volunteers (18%, 35). Family/neighbors and international media/NGOs were the least trusted, each at (8%, 15) Table 4.

Table 4: Source of flood information you personally trust the most

Trust in source of flood information	Freq.	Percentage (%)
National government agencies	95	48
Local municipal or village council leaders	45	23
Community-based organizations or volunteers	35	18
Family, neighbors, and friends	15	8
International media or NGOs	15	7.5
Total	200	100

The most influential factor in the decision to evacuate was direct observation, with (38%, 75) of respondents stating they would wait to see the floodwater rising with my own eyes. This was followed by the official warning message from authorities (28%, 55). Advice from family/neighbors (18%, 35) and past experience (13%, 25) were also significant factors, while having a safe place to go was cited by only (5%, 10) Table 5.

Table 5: Important factor you consider when deciding whether or not to evacuate

Factor when vacating home	Freq.	Percentage (%)
The official warning message from authorities	55	28
Seeing the floodwater rising with my own eyes	75	38
Advice from family members or neighbors	35	18
Past experience with similar warnings	25	13
Having a safe place to go and a way to transport	10	5
Total	200	100

The primary reason people might ignore a flood warning was fear of looting or leaving property unattended, reported (33%, 65). Other major barriers included a lack of a safe place to evacuate to reported (25%, 50) and that warnings have been wrong in the past (23%, 45). Warnings providing unclear information (15%, 30) and difficulty moving vulnerable dependents (5%, 10) were also noted Table 6.

Table 6: Main reason people in the community might ignore a flood warning

Reason why people ignore EWS	Freq.	Percentage (%)
Fear of looting or leaving property unattended	65	33
Warnings have been wrong in the past	45	23
Lack of a safe place to evacuate to	50	25
Warning did not provide clear information	30	15
Difficulty moving elderly, children, or livestock	10	5
Total	200	100

The demographic profile highlights a community marked by both contrasting assets and vulnerabilities. Adults in the 31–50 year age bracket constitute 53% of the population, offering substantial physical capacity for disaster preparedness. In contrast, older adults (13%) face limited mobility and lack access to recovery resources (National Institutes of Health, 2021). With 85% of respondents married, most households contain two adults who can support each other during evacuations, placing the community in a low-risk category regarding relationship status vulnerabilities (National Institutes of Health, 2021). Nevertheless, household size influences the uptake of home-based mitigation measures (Shah et al., 2024).

The ethnic distribution Bade (44%) Kanuri (25%) Hausa (18%) and Fulani (14%) underscore the necessity for culturally tailored early warnings that accommodate diverse knowledge systems. Indigenous knowledge constitutes a valid way of understanding that must be acknowledged as a

foundational element (Risk informed Early Action Partnership, 2025). Integrating indigenous knowledge with seasonal forecasting enhances both credibility and acceptance (Prevention Web, 2025). However, language differences continue to obstruct effective communication (National Institutes of Health, 2021).

The high rate of tertiary education (63%) represents a significant asset. Education supports faster post-disaster economic recovery (National Institutes of Health, 2021) and improves comprehension of risk-related information (Shah et al., 2024), opening doors for advanced impact-based warning systems (Meléndez Landaverde et al., 2024). Still, even educated populations lack access to digital services and functional early warning systems (European Commission Knowledge for Policy, 2025).

The agriculture-based economy dominated by crop farming (60%) fish farming (19%) and livestock rearing (14%) explains why floods cause such severe damage. Climate extremes disproportionately affect farming communities; early protection of productive systems must take place before anticipated shocks occur (International Food Policy Research Institute, 2025).

The findings showed that nearly half (48%) of respondents perceive a moderate risk of a major flood, while a combined (35) % view it as high or very high, reflects a community that is aware but not uniformly alarmed. This distribution is consistent with patterns observed in recent research by Kumaresen et al. (2025) who found that while urban residents in Malaysia reported generally high levels of risk perception, this awareness did not always translate uniformly into preparedness.

The fact that 18% perceive the risk as low or non-existent touches on a critical challenge in risk communication. As communication researchers Stephens and Trujillo-Falcón (2025) have noted, people who have not personally experienced flooding often struggle to understand various flood risks. This disconnect can be exacerbated by warning fatigue, where individuals become desensitized to alerts that frequently do not materialize into threats affecting them personally. The data suggests that while the community is largely cognizant of the threat, a persistent minority remains unconvinced, highlighting the need for targeted engagement strategies (Stephens and Trujillo-Falcón, 2025).

The survey indicates that 75% of respondents claim to understand flood warnings completely or partially. However, understanding is not synonymous with effective action. A 2025 report on global early warning systems by Chavdaa (2025) emphasizes that people don't act on what they don't trust, understand, or feel. The finding that 20% understand very little or not at all, and 5% have never received a warning, points to gaps in the communication chain that could have life or death consequences (Chavdaa, 2025).

The results on trusted information sources are particularly significant. The strong preference for national government agencies (48%) and local leaders (23%) underscore the importance of credible, authoritative voices (Gerretsen et al., 2025). This trust is the bedrock of effective warning systems. Research confirms that a message must come from a source perceived as credible to be actionable, a point reinforced by Gerretsen et al. (2025) in their analysis of global warning systems. The lower trust in family/neighbors and international NGOs (8% each) suggests that while interpersonal networks are crucial for spreading urgency, they are not seen as primary sources of official, reliable information in the study context.

Perhaps the most striking result is that direct observation (38%) is the primary factor influencing evacuation, outweighing official warnings 28% (Ha et al., 2025). This behavior waiting to see rising water is a well-documented phenomenon. A 2025 study on evacuation dynamics in Vietnam by Ha et al. (2025) found that households often refuse to evacuate until floodwaters surpass their coping thresholds. This warning action gap is a critical vulnerability. This behavior is rooted in human psychology. People often need to verify the threat personally,

especially if previous warnings have been inaccurate (Stephens and Trujillo-Falcón, 2025). As disaster experts Stephens and Trujillo-Falcón (2025) note, visual warnings and community memories are powerful, but their absence or fading can leave a gap that official alerts struggle to fill. The challenge, as highlighted by Gerretsen et al. (2025), is to make official warnings so credible and precise that they trigger action before visual confirmation is possible.

The data on why people ignore warnings reveals profound barriers. The primary reason fear of looting (33%) is a powerful and practical concern about property loss that directly hinders evacuation motivation, a barrier also identified in the Vietnamese research by Ha et al. (2025). This is closely linked to the second major barrier: lack of a safe place to go (25%). Without a clear, trusted destination, warnings are not actionable.

The fact that 23% cite past inaccuracies in warnings is a critical erosion of trust. As the Chavdaa (2025) report states, warnings are ineffective if they are not trusted, and trust is broken when communities are not involved in designing the systems that affect them. Unclear information (15%) adds another layer, reinforcing the need for warnings with precise location, clear hazard description, and concrete, actionable guidance. The cumulative effect of these barriers, as Kumaresen et al. (2025) would contextualize, creates a population that is aware of the risk but structurally and psychologically unprepared to act upon it.

The survey paints a picture of a community with a foundational awareness of flood risk and a preference for official information channels (Chavdaa, 2025). However, it also exposes a critical fragility, a reliance on personal observation for life or death decisions and significant barriers rooted in fear, mistrust, and a lack of safe options. Bridging this gap, as Chavdaa (2025) and Gerretsen et al. (2025) argue, requires moving beyond one way communication to community engagement that builds trust, clarifies risk with precision, and co-creates actionable plans, transforming passive recipients of warnings into active, prepared participants.

Conclusion

The research confirms that advanced forecasting capabilities alone are insufficient for disaster risk reduction. The community possesses foundational awareness and prefers official information channels, yet a critical fragility persists: residents rely on personal observation for life or death decisions, and substantial barriers rooted in fear, mistrust, and lack of safe options impede timely action. The warning action gap identified in this study represents the single greatest threat to EWS effectiveness, as the most accurate forecast becomes meaningless without a prepared community capable and willing to act upon it.

Furthermore, the study reveals a reactive rather than proactive institutional culture at the community level, where disaster preparedness groups activate primarily during crises rather than maintaining continuous engagement. This undermines the sustainability of preparedness efforts and reduces community resilience.

Acknowledgment

I glorify the exalted name of Almighty Allah (SWT) for his mercy, and protection and my supervisor Dr. Usman Adamu for his invaluable assistance.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The research was conducted independently without any funding or support from organizations that might benefit or be adversely affected by the findings. The corresponding author's institutional affiliation and contact details are provided solely for transparency and scholarly communication purposes.

Author Contributions

Usman Adamu contributed to the study conceptualization, methodology design, data

collection, and statistical analysis. He was also responsible for the interpretation of quantitative results and the preparation of figures and tables. Mohammed Musa Gasma contributed to the literature review, manuscript drafting, writing review and editing, and overall coordination of the write-up. Both authors read and approved the final manuscript and agree to be accountable for all aspects of this work.

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