Cross-sectoral Collaboration for Flood Management in Nong Khai, Thailand

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Abstract

This article aimed to theoretically diagnose institutional bottlenecks and develop an Integrated Flood Collaborative Management Framework for Nong Khai Province, utilizing the Collaborative Governance Regime (CGR) lens. The study focused on the 2024 flood event, which shared characteristics with historical floods in 2008 and 2011 but was intensified by operational dynamics of transboundary water infrastructure in the Greater Mekong Subregion (GMS). A qualitative research design was applied, combining systematic literature review, documentary analysis, focus group discussions, and in-depth interviews with 26 key informants from government agencies, the private sector, and civil society. Content analysis was used to synthesize findings and identify gaps in existing disaster management systems. The results indicated that while national frameworks like the Thai government's 20-Year National Strategy (2018–2037) emphasize sustainable development, a critical gap remains in the operationalization of these strategies at the local level. The analysis of the 2024 response revealed specific coordination failures between state and non-state actors, resulting in insufficient shelter provision and inadequate support for vulnerable groups. Consequently, the study proposes an integrated framework that proposes concrete governance mechanisms to institutionalize collaboration, addressing the specific challenges of cross-sectoral coordination to support resilient flood management in high-risk border areas.

Keywords: Flood risk management, Climate change impacts; Community resilience, Mekong River Basin, Nong Khai Province, Thailand

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Introduction

Thailand has faced increasingly severe floods in recent years, largely as a result of climate change impacting water management systems, particularly in major river basins such as the Mekong. These floods have caused widespread economic, environmental, and social damage. Effective flood management in this context requires cooperation among the government, private sector, and civil society, with clear strategies for prevention, mitigation, and recovery (Promchote et al., 2016; Petpongpan et al., 2021).

In 2024, Nong Khai Province, situated along the Mekong River and sharing a border with Laos, experienced significant flooding impacts. The Mekong River overflowed, inundating six districts, 33 sub-districts, and 175 villages, impacting over 8,000 households, damaging more than 57,000 rai of farmland, and causing significant livestock losses (Nong Khai Provincial Department of Disaster Prevention and Mitigation, 2024). This situation was aggravated by abnormal rainfall due to climate change and water releases from upstream dams, which increased the complexity of flood management (Petpongpan et al., 2021). Recent climate data indicates a shift in precipitation patterns, with the 2024 event sharing characteristics with the historical floods of 2008 and 2011, yet intensified by the operational dynamics of transboundary water infrastructure in the Greater Mekong Subregion (GMS).

Current disaster response in the area remains insufficiently integrated, with gaps in shelter provision and early warning systems, resulting in vulnerable groups, such as young children, the elderly, and bedridden patients, being inadequately supported. The Thai government's 20-Year National Strategy (2018–2037) focuses on secure, prosperous, and sustainable development, emphasizing environmental improvement and disaster preparedness. However, a critical gap remains in the operationalization of these strategies at the local level (Office of the National Economic and Social Development Council, 2018; Promchote et al., 2016; Limthongsakul et al., 2017).

Therefore, this study aims to achieve three specific objectives: (1) to theoretically diagnose the institutional bottlenecks hindering cross-sectoral collaboration using the Collaborative Governance Regime (CGR) framework; (2) to analyze the operational dynamics of the 2024 response, identifying where and why coordination failed between state and non-state actors; and (3) to develop an Integrated Flood Collaborative Management Framework that proposes concrete governance mechanisms to institutionalize collaboration.

Given that this study focuses on the 2024 flood event in Nong Khai. Its findings are limited by the cross-sectional nature of the data collected immediately post-disaster. Furthermore, accessing real-time decision-making processes of upstream transboundary actors (e.g., dam operators in China

and Laos) was outside the scope of this field research, presenting a limitation in fully mapping the GMS hydro-political dynamics.

Literature Review

To achieve the study's objectives, this paper reviewed 1) theoretical frameworks; 2) hydrological and institutional landscapes of Nong Khai Province; 3) disaster risk reduction and GMS stakeholders; and 4) related research.

2.1 Theoretical Frameworks

Management concepts relevant to organizational and societal resilience encompass disaster management, risk and crisis management, collaborative governance, and community-based management. Disaster management is divided into pre-disaster preparedness, including planning and public awareness, and post-disaster response, recovery, and mitigation to reduce future vulnerabilities, with effectiveness being enhanced by multisectoral collaboration and advanced technologies (Alexander, 2018; Bullock et al., 2020; Coppola, 2015). Risk and crisis management focus on the identification, assessment, and control of risks across all operational domains, emphasizing methods for prevention, mitigation, transfer, or acceptance of risks, along with structured crisis response and post-event learning (Crouhy et al., 2014). Collaborative governance emphasizes citizen-focused, horizontally integrated coordination among stakeholders to improve public service quality, resource efficiency, and agile decision-making, requiring cultural changes within the public sector to promote cross-agency cooperation and performance (Karavekphan, 2016). To understand the mechanisms of cooperation, this study adopts the Collaborative Governance Regime (CGR) framework by Emerson, Nabatchi, and Balogh (2012). CGR defines collaboration as a system nested within a broader environment, consisting of principled engagement, shared motivation, and capacity for joint action. This is complemented by Ansell and Gash's (2008) contingency theory, which emphasizes that successful collaboration depends on starting conditions (e.g. power asymmetries, trust levels) and facilitative leadership. These theories explain that without a structured regime to manage interdependence, stakeholders revert to silos, increasing transaction costs and reducing response effectiveness. Community-based management (CBM) centres local participation, leadership, and decision-making, leveraging social capital to foster collective action and sustainable resource management, while also promoting equitable access and integrating economic, social, and environmental concerns for long-term development (Putnam, 2000; Arnstein, 1969; Berkes, 2009; Adger, 2001; Brundtland Commission, 1987).

2.2 Hydrological and Institutional Landscapes of Nong Khai Province

Nong Khai Province is located in the upper border area of northeastern Thailand, sharing a natural boundary with the Lao People's Democratic Republic along the Mekong River. Owing to its strategic location, Nong Khai serves as a vital gateway for trade between ASEAN countries and southern China. The province features a mix of highlands and fertile river plains influenced by the Mekong, making it highly suitable for agriculture, especially rice and organic crops. Nong Khai is a regional center for economy, border trade, tourism, and international relations, and its economy is further supported by important infrastructure such as the Thai-Lao Friendship Bridge. Culturally, Nong Khai boasts diverse tourism attractions and a rich, multicultural heritage. Despite its potential, the province also faces several challenges, including drought, water resource management, and insufficient infrastructure that may hinder future development. Sustainable growth thus requires integrated efforts from government, private, and civil society sectors (Nong Khai Provincial Office, 2024).

Regarding water resources, specifically, Nong Khai faces a dual threat: local climate change and transboundary water management. Hydrologically, the Mekong River's flow regime has been altered by upstream dams, which disrupt the natural flood pulse and sediment load essential for the riverine ecosystem (Baird, Thorne, & Gaja-Svasti, 2025). Historically, the 2008 and 2011 floods demonstrated similar patterns of backwater effects, yet the 2024 event was exacerbated by increased rainfall volatility associated with La Niña conditions (Wang, et al, 2024). Consequently, the province, situated in the Mekong River basin, is vulnerable to various forms of flooding, including river overflows, flash floods, and stagnant water. Key contributing factors include intense rainfall from tropical storms and the effects of climate change. Major flood events over the past six years, such as those caused by tropical storms Son-Tinh (2018) and Noru (2023), have led to widespread inundation of households and agricultural areas, infrastructure damage, and significant economic loss. Some years, such as 2020 and 2021, saw reduced or no major flood damage, reflecting improvements in flood prevention systems. However, recurrent floods still cause considerable social and economic impacts, including property loss, displacement, and disruption to livelihoods in the province (Nong Khai Provincial Department of Disaster Prevention and Mitigation, 2024).

Furthermore, institutionally, flood management is fragmented. While the Disaster Prevention and Mitigation Act 2007 designates the Provincial Governor as the single command, in practice, authority is diluted among central agencies like the Royal Irrigation Department (RID) and the Department of Disaster Prevention and Mitigation (DDPM). This creates a governance gap where local administrative organizations (LAOs) bear the responsibility but lack the authority to manage transboundary flows (Singchai & Subnawin, 2024).

2.3 Disaster Risk Reduction and GMS Stakeholders

The Sendai Framework for Disaster Risk Reduction (2015–2030) has served as the principal international policy for disaster risk reduction, aiming to minimize loss of life, economic disruptions, and environmental damage worldwide. It priorities understanding disaster risk, strengthening disaster governance, investing in resilience, particularly in infrastructure, and improving preparedness and response capacities. The framework encourages inclusivity, multi-sectoral collaboration, and the integration of disaster risk management into sustainable development policies, with progress gauged by reducing mortality and economic losses and improving risk management systems (UNDRR, 2015).

In alignment with the Sendai Framework, Thailand has implemented the Disaster Prevention and Mitigation Act B.E. 2550 (2007) to establish a comprehensive, coordinated disaster management system. This Act covers prevention, mitigation, and recovery, mandating collaboration among central, provincial, and local authorities, with the Department of Disaster Prevention and Mitigation (DDPM) as the central coordinating agency. Disaster management schemes focus on preparedness, emergency communications, evacuation, relief distribution, and rapid recovery, with the Prime Minister empowered to take special actions during severe disasters (Disaster Prevention and Mitigation Act, 2007).

Additionally, the National Disaster Prevention and Mitigation Plan B.E. 2564-2570 (2021–2027) has provided a strategic framework for addressing the increasing complexity of natural disasters and climate change. It integrates international principles and national philosophies to build a resilient Thai society, with strategies focusing on risk reduction, management innovation, international co-operation, systematic emergency response, and sustainable, community-based recovery (National Disaster Prevention and Mitigation Committee, 2021).

At the provincial level, the 2024 Nong Khai Provincial Flood Response Plan aims to enhance coordinated flood preparedness, emergency operations, and recovery, while assigning clear roles among agencies and prioritizing infrastructure, relief, and public awareness to strengthen local resilience (Nong Khai Provincial Disaster Prevention and Mitigation Command, 2024). Reflecting the Sendai Framework's priority on strengthening disaster governance, management in the Nong Khai context involves not just domestic actors but also Greater Mekong Subregion (GMS) stakeholders, including the Mekong River Commission (MRC), which provides critical early warning data, and the Lancang-Mekong Cooperation (LMC) mechanism. Effective DRR in this border province requires integrating these regional data streams into local decision-making.

2.4 Related Research

Thailand, being situated along major rivers, such as the Chao Phraya and Mekong, is highly susceptible to flooding, particularly in communities located near waterways. Previous studies have identified various factors influencing flood disaster management, emphasizing the significance of community characteristics, social vulnerability, previous disaster experiences, and the utilization of

social capital (Ayuwat et al., 2017; Wongwatthanaphong, 2022). Key findings highlight that effective disaster management is closely linked to community preparedness, leadership roles, knowledge sharing, and strong coordination between local agencies and national authorities (Somrotrat, 2014; Chansrithada, 2021; Saengkla et al., 2021). Community-based disaster management approaches have proven successful when there is robust leadership, active participation, and resource mobilisation, although challenges often arise due to insufficient budgets, inadequate equipment, complex bureaucratic processes, and limited decision-making power at the local level (Khatasombun & Phra Suthirattanapandit, 2020; Nooprakob, 2022). Studies further demonstrate that building community resilience through knowledge, self-reliance, and shared social values enhances disaster response and recovery (Laipaporn, 2019; Ruenkitrak & Pattaranukrom, 2018).

Technological integration, particularly through early warning systems, geographic information systems (GIS), and digital communication tools, has also emerged as a critical element in all phases of disaster management, from preparedness and response to recovery (Akkarapongpaiboon et al., 2020). Regular training and technological literacy for both disaster management personnel and community members are emphasized as vital for increasing adaptive capacity and timely intervention. Furthermore, long-term planning, inter-agency collaboration, and legal and policy reforms remain necessary to address increasing disaster risks, especially those driven by climate change (Sinhasema, 2011; Bhusri, 2019). Research also shows that while public motivation and participation levels are generally high and significantly correlated, expanding community involvement in planning and decision-making processes is necessary for more sustainable disaster management outcomes (Vivatthanawanich & Yenyuak, 2024; Yongpanich & Ngernklay, 2022).

Overall, the literature suggests that disaster management in Thailand benefits from holistic and inclusive approaches that integrate community empowerment, technological advancements, effective inter-agency networks, and continuous capacity building at all institutional levels. Policy recommendations include empowering local governments and communities, investing in technology and training, strengthening early warning systems, and fostering multi-sectoral collaboration to ensure efficient and equitable disaster response and recovery.

Research Method

The study employed a qualitative research design, utilizing both systematic literature review and content analysis approaches. The design integrated documentary research with empirical fieldwork to comprehensively examine and synthesize current disaster management practices, with a specific focus on flood risk management in Nong Khai Province, Thailand.

3.1 Research Process

The research process commenced with the systematic collection and review of relevant literature, encompassing academic theories on integrated administration, disaster management frameworks, provincial flood data for Nong Khai, and official regulations and guidelines. Requests for operational methods and outcomes were formally submitted to the relevant governmental agencies within Nong Khai Province. The subsequent step involved synthesizing documentary research concerning flood disaster events, their underlying causes, management processes, and challenges faced across stakeholders, which served to inform the development of focus group discussion guidelines for primary data collection. Following this, focus group discussions were conducted with two principal groups: representatives from government agencies, with the aim of identifying operational workflows, lessons learned, and recommendations for system improvement; and representatives from the private sector and civil society, including flood-affected community members, to elicit experiences on collaboration, warning communications, impacts, and system development. Data derived from both document analysis and focus groups were subsequently examined, summarized, and utilized to formulate evidence-based recommendations for integrated flood disaster management. To bolster data validity, follow-up in-depth interviews were undertaken with additional stakeholders. The findings and recommendations were disseminated to relevant stakeholders and discussed for policy application in Nong Khai and other regions.

3.2 Data Collection

Data collection was executed in two primary phases: (1) secondary data were compiled through a rigorous review of academic literature, national and provincial policies, legal instruments, official guidelines, and disaster management plans pertinent to flood response; and (2) primary data were gathered via focus group discussions. The focus groups were facilitated using semi-structured guides meticulously tailored for distinct stakeholder groups (government, private sector, and civil society). Open-ended questions provided scope for the exploration of experiences, perceptions, and suggestions relating to disaster preparedness and response.

3.3 Key Informants for Focus Group

A purposive sampling strategy was adopted to select 26 key informants, representing three core stakeholder groups in Nong Khai Province. They comprised representatives from (1) the government sector, which was constituted of 12 individuals including administrators, heads of governmental departments, and operational staff possessing a minimum of four years of local experience and direct involvement in flood management; (2) the private sector, which was constituted of 5 local business owners or executives actively engaged in community disaster support; and (3) civil society, which was constituted of 9 participants encompassing

community leaders, representatives from religious organizations, foundations, social clubs, and ordinary residents with disaster experience or community engagement.

3.4 Instrument

The primary research instruments consisted of semi-structured focus group discussion guides and unstructured in-depth interview forms. Focus group guides for government incorporated sections on management mechanisms, lessons learned, system improvement recommendations, and practitioner competence. Guides for the private and civil sector incorporated questions on system awareness, flood impacts, collaboration, improvement proposals, and the knowledge and abilities of practitioners.

3.5 Data Analysis

Data analysis was carried out using deductive content analysis, mapping stakeholder responses against the CGR dimensions of 'shared motivation' and 'capacity for joint action' to diagnose specific governance failures. Coded data from documents and focus groups were systematically categorized in accordance with the research objectives. Thematic connections were established to generate propositions, which were subsequently analyzed descriptively. Triangulation was achieved through the triangulation of researchers, and data sources (different informant groups, times, and locations). Interpretation was conducted by comparing data against theoretical frameworks, and findings were synthesized and discussed in alignment with the research objectives to derive conclusions and recommendations.

3.6 Research Ethics

The research protocol and materials were submitted to and received approval from the Khon Kaen University Human Research Ethics Committee, in compliance with the Belmont Report and Good Clinical Practice (GCP) in Social and Behavioral Research standards (approval number: HE673545, December 20, 2024).

Findings and Discussion

The findings are synthesized into four themes, interpreted through the theoretical lenses of CGR and contingency theory.

4.1 The Failure of Principled Engagement

Severe floods in Nong Khai between August and October 2024 caused extensive damage to homes and agriculture, particularly in low-lying villages. Vulnerable populations including the bedridden, young children, and the elderly—were disproportionately affected, and livelihoods were disrupted. Emergency shelters, such as the four located in Mueang Nong Khai district, were unevenly

distributed and poorly publicized, leaving many residents unaware of or reluctant to use them. Cash aid (5,000–9,000 baht per household, depending on flood duration) was distributed via official channels, but delays, insufficient amounts, and cumbersome documentation have hindered access. In some cases, households lost eligibility when floodwaters destroyed records. Long-term recovery, including housing repairs, livelihood support, and flood-proof infrastructure, remained inadequate. Pre-disaster preparedness was undermined by outdated or incomplete data (water levels, population counts), uneven resource allocation (pumps, sandbags, shelters), and ad-hoc planning across agencies.

Focus group discussions have reinforced these findings. Stakeholders reported that real-time hydrological data from small tributaries were not integrated, and upstream data from Laos were unavailable. The official reliance on raw hydrological data (e.g. water-gauge levels posted on social media) without actionable interpretation created an information asymmetry, representing a failure of 'principled engagement' (Emerson et al., 2012). Unlike the 'shared meaning' required for effective CGR, residents were left confused by technical jargon, forcing them to rely on informal news channels. This disconnect resulted in delayed announcements and repeated false alarms in September that fostered fatalism, leaving communities underprepared when the flood finally hit. These observations are consistent with prior research indicating that effective risk communication requires clear, actionable information tailored to local channels (Prathumchai & Bhula-or, 2020).

4.2 Coordination and Multi-Agency Challenges

Coordination during the floods was severely fragmented. Although a provincial Incident Command Center (ICS) was nominally established under the governor's leadership, it lacked clear authority and integration. In terms of Ansell and Gash's (2008) contingency theory, the 'starting conditions' were marked by high power asymmetry and a history of bureaucratic compartmentalization. Agencies protected their own resources (silos), increasing the transaction costs of collaboration. The lack of facilitative leadership meant that no single actor could bridge the gap between the RID's water management logic and the DDPM's relief logic. Consequently, agencies maintained separate datasets and protocols, resulting in duplicated aid near government centers while remote households were neglected.

These findings reflect broader disaster-management research, which highlights that multi-agency responses often fail without unified command and shared data (Kapucu & Garayev, 2011). The ICS is designed to overcome such challenges by enforcing unity of command and standardized roles. Strong ICS adoption is recommended to integrate, for examples, police, firefighters, military, NGOs, and local government under a single lead during emergencies (Bradley-Smith et al., 2024). The systemic challenges in the province mirror wider governance issues in Thailand, where fragmented responsibilities across irrigation, municipal planning, and disaster relief lead to duplication or neglect of critical tasks (Singchai & Subnawin, 2024). By contrast, high-performing disaster-prone regions typically implement unified command structures and multi-stakeholder coordination councils (Mishra & Dahal, 2024).

4.3 Community Engagement and Volunteer Management

Community and volunteer engagement were critical but underutilized. Private-sector and NGO volunteers mobilized rapidly, such as the YEC business networks that organized food and donations. However, they were not integrated into the ICS. This exclusion represents a wasted capacity for joint action (Emerson et al., 2012). The state viewed volunteers as subjects to be commanded rather than partners in a governance regime, leading to duplicated efforts and safety risks. Lacking registration, credentialing, or relevant training, some untrained community volunteers even impeded operations or faced health risks in the field.

Research indicates that structured volunteer programs, including formal training and certification, improve community disaster capacity by aligning skills with defined roles (Iizuka & Aldrich, 2022; Laokhompruttajarn & Laokhompruttajarn, 2023). The Sendai Framework also emphasizes cross-sector collaboration, in which government, private sector, civil society, and citizens share responsibility for disaster management (UNDRR, 2015). Integrating community volunteers into a formal Incident Command System (ICS) would enhance effectiveness while minimizing operational risks.

4.4 Communication and Early Warning Systems

Effective communication emerged as a critical dimension of flood management. In Nong Khai, official warnings were limited to raw water-gauge data posted on Facebook or government websites, with little instruction on actions or evacuation routes. Effective risk communication requires a shift from ‘dissemination’ to ‘engagement.’ Residents reported confusion and uncertainty about appropriate responses. Participants recommended plain-language alerts, multi-channel dissemination (community radio, SMS, LINE, loudspeakers), and the appointment of local “flood ambassadors”—trusted neighbors who interpret warnings for vulnerable populations. Linking local observation with technology, such as district weather officials sending daily updates via LINE to villagers, enabled real-time alerts and increased trust. These findings align with prior research emphasizing clarity, consistency, and accessibility in risk communication (Traiyut et al., 2024; Tripathi, 2018).

Based on stakeholder input, the study has proposed a provincial Disaster Management Platform that integrates GMS data (from MRC) with local community inputs to strengthen preparedness, response, and recovery. Key components include: (1) centralized data systems integrating real-time hydrological monitoring and census-based community registers; (2) multi-channel alert systems to disseminate warnings clearly and quickly; (3) formal Incident Command System (ICS) with centralized command and delegated field teams to coordinate relief and resource allocation; and (4) community micro-grant funds for pre-purchasing equipment such as pumps and medical supplies. Evidence from Thai community-based flood projects support this approach, demonstrating that well-defined local committees with assigned roles improve early warning, evacuation, and relief outcomes (Tripathi, 2018). The current study also observed informal community initiatives in Nong Khai, suggesting that formalizing and supporting these networks would enhance resilience. Integrating grassroots knowledge, volunteer efforts, and state and corporate

resources is essential to effective flood management (Mishra & Dahal, 2024; Prapasavat & Laohavichien, 2023). Policy recommendations include maintaining updated datasets, investing in infrastructure (shelters, communication, pumping capacity), empowering a unified Incident Command Center, and extending recovery beyond cash aid with simplified procedures (Singchai & Subnawin, 2024).

In summary, the root challenge in Nong Khai's flood management is lack of integration, systematic planning, and clear institutional roles, rather than a lack of stakeholder willingness. Implementing the proposed platform, unified ICS, multi-channel warning systems, and standardized volunteer programs would establish a more resilient, whole-of-society approach, enabling both effective response and active community participation when floods occur. As a result, an integrated framework for the roles and responsibilities of the community, government, and volunteers in flood management is proposed below.

Table 1: Integrated Flood Collaborative Management Framework

Phase	Theoretical Objectives	Governance Mechanism	Collaborative Actions
Pre-Disaster	Shared Motivation	Provincial Resilience Council	- **Joint Risk Mapping:** Co-production of risk maps integrating technical data (MRC/RID) with local wisdom. - **Volunteer Credentialing:** Registering and training civil society organizations (CSOs) to integrate them into the formal ICS structure.
During-Disaster	Capacity for Joint Action	Unified Incident Command System (ICS)	- **Common Operating Picture (COP):** Real-time data fusion via a shared digital dashboard. - **Zoned Response:** Assigning specific NGOs/private sector to geographic zones to prevent aid duplication.
Post-Disaster	Adaptation	Joint Recovery Committee	- **After-Action Reviews (AAR):** No-fault debriefings to update the system context for the next cycle. - **Participatory Recovery:** Ensuring infrastructure is built based on community needs.

Conclusion and Strategic Recommendations

The 2024 floods revealed that Nong Khai's vulnerability is institutional as much as it is hydrological. Applying the CGR framework reveals that the primary barrier is not a lack of resources, but a lack of regime—a stable system of rules and norms that binds independent actors together. Therefore, the research recommends the followings.

(1) Institutionalize the partnership: move beyond ad-hoc cooperation by formalizing the role of the private sector and civil society in the Provincial Disaster Plan.

(2) Enhance GMS data integration: the province must actively integrate upstream data from the Mekong River Commission into its local warning systems to account for transboundary risks.

(3) Invest in Facilitative Leadership: Training for local administrators should focus not just on technical skills, but on the 'soft skills' of negotiation and conflict resolution required to manage cross-sectoral networks.

Limitation and Recommendations for Future Research

The study faced two key limitations. Firstly, the researcher was heavily reliant upon the cooperation of participants and representatives, which occasionally resulted in delays in communication and incomplete coordination. These challenges may have curtailed the depth and completeness of the data that was gathered. Secondly, the data collection was confined to a short and fixed timeframe, which constrained the ability to capture long-term developments or changes in disaster-related knowledge and preparedness.

As a result, the study offers three recommendations. Firstly, agencies responsible for disaster management ought to strengthen knowledge-building programmers and establish clearer information channels to enhance community preparedness and reduce vulnerability. Secondly, similar studies should be conducted across multiple institutions or provincial areas to enable comparative analysis and improve the generalizability of the findings. Thirdly, future research should incorporate longitudinal data collection to examine how awareness, preparedness, and community engagement develop over time.

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