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Effectiveness of risk analysis and civil–military cooperation in enhancing disaster preparedness in Kelantan-mediating role of communication

Safar Yaacob, Noor Azmi Mohd Zainol, Suzana Ali Hassan @ Ali

Faculty of Management and Defence Studies, UPNM

Correspondence: Safar Yaacob (email: safar@upnm.edu.my)

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Abstract

Disaster preparedness is increasingly becoming a collaborative effort among multiple stakeholders in Malaysia's disaster management system. Nonetheless, states that are vulnerable to flooding, especially Kelantan, which annually experiences extreme monsoon floods, indicates a need for better preparedness measures. Collaboration has been emphasized; however, there remains a lack of empirical research modeling communication as a mediator within this area of study. Specifically, this study examined how disaster risk assessment and civil–military collaboration can improve disaster preparedness; communication was modeled as a mediator. Underpinning the Crunch Theory, the study posits that successful disaster management requires interdependent efforts involving local knowledge, community networks and military capabilities as opposed to reliance upon agency institutions alone. A quantitative methodological approach utilizing a questionnaire survey of 412 participants representing both military personnel and community members in flood-prone areas of Kelantan was used. Military ranks and community districts represented were randomly sampled to provide representative data across both strata. Descriptive statistics were calculated using SPSS version 29.0 and structural equation modeling (SEM) using SmartPLS version 4.1 were used to analyze the data. The results indicate that risk analysis, civil–military cooperation and communication significantly predict disaster preparedness ($p < 0.001$), collectively explaining 41% of the variance ($R^2 = 0.41$). Furthermore, communication functions as a significant mediator, strengthening the influence of both risk analysis and civil–military cooperation on preparedness outcomes. Situational awareness and local knowledge contributed by the community and logistical support, technical expertise and leadership provided by the military are supported by communication that facilitates coordination of these resources. The findings of this study have important policy implications. It fills an identified gap in disaster preparedness research by modeling communication as a mediator and provides additional insights into disaster preparedness from the context of floods in Malaysia. Additionally, the findings of this study can be useful to policymakers at various levels including those of the National Disaster Management Agency (NADMA), the Malaysian Armed Forces and local authorities in developing strategies to strengthen civil-military collaboration, including integrated command structures and community-based early warning systems to develop more resilient communities.

Keywords: Civil–military cooperation, communication, disaster preparedness, Malaysia, risk analysis, structural equation modelling

Introduction

Kelantan is located within the monsoon zone and is exposed to floods annually; therefore, it is a prime example of an area where the effects of flood can be studied. The nation's flood loss in 2024 was approximately RM 933.4 million (Department of Statistics Malaysia [DOSM], 2024). In terms of residential property damage, Kelantan recorded the largest number of damaged homes (RM 139 million) in addition to losses incurred from businesses and public infrastructure (DOSM, 2024). At the national level, the Malaysian government has accepted responsibility to implement all provisions of the Sendai Framework for Disaster Risk Reduction (2015 – 2030) (United Nations Office for Disaster Risk Reduction [UNDRR], 2024). This study will be consistent with priority two of the framework, which will strengthen disaster risk governance to better manage disaster risk through the examination of interaction between institutional and community stakeholders. The federal government has emphasized the need for multi-stakeholder involvement, particularly amongst local government, the private sector and non-government organizations (NGOs) in addition to the development of risk maps and disaster resilient urban planning guidelines (Asian Disaster Reduction Centre, 2024; Malay Mail, 2024).

At the national level, NADMA coordinates national disaster management activities along with several other technical agencies. Regionally, organizations such as ASEAN have provided updates to frameworks through workshops on civil-military coordination. However, a significant gap continues to exist at the operational level in Kelantan. While there are national and regional frameworks for disaster management, empirical studies have shown that coordination efforts fail to meet expectations due to poor communication networks and rigid command structures (Rahman & Fang, 2019). This study identifies communication as the missing element in prior structural models for disaster management in Malaysia that have primarily been focused on either the logistical capability of disaster response organizations or the resilience of communities in isolation. Thus, this study addresses a void in the literature by being the first to empirically model communication as a mediator that links risk analysis to civil-military cooperation. Specifically, this paper aims to fulfil the following goals:

- Examine the impact of risk analysis on improving disaster readiness in Kelantan.
- Assess the effects of civil-military cooperation on disaster readiness in Kelantan.
- Investigate whether communication is an intermediary between risk analysis and civil-military cooperation, to improve disaster readiness in Kelantan.

This study therefore acknowledges that Malaysian disaster governance cannot be based solely on national policy frameworks such as NADMA Directive No. 01. There exists however, a major knowledge gap concerning the extent to which top-down directives are converted into effective ground level readiness through communication. The necessity exists to adopt multi-actor approaches that incorporate both communities and the armed forces. Although there is growing academic interest, this study will be one of the first in Malaysia to provide empirical evidence of whether communication acts as an intermediary linking risk analysis and civil-military cooperation to disaster readiness outcomes. As a result of using Collaborative Disaster Governance principles as the basis of the model, this research provides a new theoretical contribution to disaster governance literature and presents evidence-based recommendations for embedding participatory risk analysis. Research systematic reviews have demonstrated that studies examining disaster risk

assessments in Malaysia remain disjointed with limited integration of multiple stakeholder views and a lack of empirical models demonstrating causal pathways between risk analysis and disaster preparedness outcomes (Ramli et al., 2025). Similarly, whilst civil-military cooperation has been examined in operational and policy terms, continued weaknesses exist in areas of coordination, role definition and communication systems (Nordin et al., 2023; Ma et al., 2024). In addition, most of the extant literature examines either community resilience (Marasco et al., 2022), or military involvement in flood responses (Yaacob et al., 2021; Yatim et al., 2024), separately, without examining the interdependencies of each other's roles. Notably, while communication is universally regarded as key to establishing trust and facilitating coordination, it has very rarely been empirically tested as a mediator of the relationship between risk knowledge and civil-military cooperation to disaster preparedness outcomes. This study fills this void by providing empirical evidence of a structural model integrating risk analysis, civil-military cooperation, and communication, to explain disaster preparedness in Kelantan, Malaysia's ‘ground zero’ for large-scale floods. By positioning communication as a mediator, this research presents a new theoretical contribution to disaster governance literature and provides evidence-based recommendations for embedding participatory risk analysis and structured civil-military collaboration into Malaysia's disaster management framework.

Literature review

Disaster preparedness

Preparation for disasters means preparing prior to a disaster to mitigate damage and facilitate effective emergency response; it involves assessing potential hazards, establishing early warning systems, having ready-made plans and resources available and involving the public at the local, regional and state levels in disaster preparation and response (UNDRR, 2015), which is a priority focus area within the four priority areas outlined by the Sendai Framework for Disaster Risk Reduction. The Malaysian government has made DRR a focus area through Priority 2 and aims to mainstream DRR into national development planning, however, preparedness planning at the district level is still inconsistent. Preparedness will be successful if it combines science-based information regarding the identified risks with participative approaches that engage stakeholders from both the community and institution levels (Khan et al., 2022). Flooding is a regular occurrence in Malaysia and highlights the need for preparation measures. In 2024, floods were reported across the country and resulted in total economic loss of RM933.4 million, with the residential sector bearing the greatest portion of the total loss with RM372.2 million. Losses incurred to residential properties in the state of Kelantan were the largest among all states at RM139.0 million, which further emphasizes the severity of flooding impacts in this state (DOSM, 2025). High vulnerability is not limited to the flooding events experienced in 2024 and reflects a trend of increasing unpredictability and severity of monsoon flooding in Kelantan, resulting from land use changes and climatic factors, thus, there is a necessity for more robust preparedness measures to be implemented at the district level.

Community preparedness

Similarly, research has shown that preparedness based on community efforts for example, evacuation drill programs and public awareness campaigns increases community preparedness and resilience, but community efforts vary greatly from district to district (Fu & Zhang, 2024; Suharini et al., 2020). Similarly, at the institutional level, military organizations including the Malaysian Armed Forces provide valuable assistance including logistical support, transportation and technical assistance to the country's emergency response effort. However, gaps in the ability of the National Security Council (MKN) to coordinate with the community to implement the MKN's directives continues to be a problem which hinders the effectiveness of preparedness (Ma et al., 2024; Nordin et al., 2023).

Institutional and military preparedness

Similar problems exist in the other Southeast Asian countries including Thailand, Indonesia and the Philippines. The Philippines 'zero casualties' policy is an example of the success of strict enforcement of evacuation drills in communities and Indonesia's Desa Tangguh Bencana (Destana) is an example of the importance of local community leaders in disaster mitigation both examples of the type of knowledge that will be important for Malaysia to learn from in order to improve its preparedness to respond to emergencies. Regional experience suggests that Malaysia can further improve its preparedness by learning from its neighbors and developing ways to coordinate responses among multiple stakeholders in a manner like how it does in the region (Samad et al., 2025).

Technology-based preparedness

Additionally, technology is being seen as an essential tool for managing disasters in many parts of the world. Malaysia's *eBencana* platform, developed by the Public Works Department (JKR), provides real-time communication and disaster relief services to the public (Malaysia Government, 2025). While the use of technology has improved the efficiency of emergency response systems, there are still serious limitations. Several recent studies have indicated that mobile apps are frequently adopted poorly by older people and those living in rural areas who may be the hardest hit by floods due to lack of access to digital technologies and unreliable communications in times of disasters (Permana et al., 2025). Moreover, these types of digital platforms are frequently isolated, failing to provide seamless integration into the official civil-military coordination processes.

Disasters occur because of root causes and unsafe conditions (Wisner et al., 2004) as described in the Crunch Theory. In this study's conceptual framework, Risk Analysis identifies the root causes of the risks. Civil-Military Cooperation works to reduce dynamic pressures through coordinated resource mobilizations. Importantly, Communication is the intervention used to address the unsafe conditions through the dissemination of risk information to the community, thus decreasing the impact of the hazard. However, this disconnection contributes to the social and institutional weaknesses that are identified in the Crunch Theory since communication silos inhibit collaboration between the responding agencies and the local communities. Modern communication technologies are frequently studied in community-based studies in Kelantan in isolation from institutional response mechanisms (Shariff & Hamidi, 2019). Therefore, this study

fills a large gap in the literature by studying empirically whether effective communication can close the gap between the technological potential and actual preparedness outcomes as well as bridge the gap between technological and institutional divides to increase preparedness in Malaysia, where this relationship has rarely been modeled.

Hypotheses development and conceptual framework

Disaster risk analysis in Malaysia

Disaster risk analysis is an important part of disaster risk reduction (DRR), and within the Malaysian context, DRR is being implemented through MKN's Directive No. 20 which outlines the requirement for proactively identifying hazards and conducting risk assessments to reduce loss of life and property. Within the east coast states of Malaysia, disaster risk analysis is used to inform localized intervention activities, including the building of flood bunds in Kelantan, and relocating villages located in floodplains. A long-standing gap exists in terms of the application of national DRR policies at the local level.

Quantitatively, the need for effective risk analysis is demonstrated by the Special Report on the Impact of Floods in Malaysia 2024, which identifies inadequate risk mapping at the local level as one of the contributing factors to residential losses of approximately RM139 million in Kelantan alone, which equates to a significant portion of the RM933.4 million in total residential losses across all affected areas (DOSM, 2024). Although NADMA has developed some standardized frameworks for assessing disaster risks, there continue to exist several barriers to incorporating multiple data sources into the assessment process and ensuring that community participation occurs (Nordin et al., 2024). Recent research and literature advocate for conducting multidimensional assessments of vulnerability as a means of addressing the complexity associated with integrating different types of data and achieving full-scale community participation. For example, IDRAF and IDRI have been utilized to assess not only the degree of physical exposure related to disasters, but also socio-economic exposures to disaster-related risks, and as such provide a comprehensive understanding of the nature of disaster-related risks (UNDRR, 2019; Ramli et al., 2024). Wisner et al. (2004) argue that the risk of disaster does not arise solely due to hazards, but rather is generated from the interaction between hazards and vulnerabilities. Examining the intersection of high hazard conditions and extreme levels of vulnerability during the 'Bah Kuning' flood of 2014 serves to illustrate the extreme potential for damage that can result from the intersection of high hazard conditions and extreme levels of vulnerability. In this regard, the risk equation may be conceptualized as follows:

$$\text{Risk} = \frac{(\text{Extreme Monsoon Rainfall} \times \text{Flood Plain Exposure}) \times (\text{Socio-economic Vulnerability})}{\text{Preparedness Capacity}}$$

Risk = The possibility of loss, death and destruction

The hazard for the 2014 disaster was the excessive rainfall; however, the disaster was exacerbated due to the weaknesses in districts such as Kuala Krai and Pasir Mas, where the housing infrastructure was unable to sustain the torrential rains (DOSM, 2024). While local communities have critical knowledge of their situation and location, they are generally without the extensive logistical support needed for the response. The MAF can provide this type of logistical support and therefore, fill a critical capability gap in the risk assessment process. In fact, the MAF’s 8th

Infantry Brigade utilized its heavy equipment, including 7-tonne trucks and combat boats, to access remote areas in Manek Urai during the 2014 disaster. This example illustrates how the capability element of the risk equation will be greatly influenced by military preparedness and readiness (Yaacob et al., 2021). Today, Risk Analysis in Malaysia is operationalized through two distinct processes prior to the occurrence of a disaster – Technical Agency Pre-Disaster Hazard Mapping, which is carried out by agencies, such as JPS and Post-Disaster Damage Assessments conducted by District Offices. However, typically, these types of analyses are limited to individual agencies. Therefore, to prevent these separate technical risk analyses from becoming nothing more than isolated analyses, CIMIC provides an opportunity to link these analyses together and ultimately use them to guide pro-active and not merely reactive deployments.

Hypothesis 1 (H1). Risk analysis significantly influences disaster preparedness.

Civil–military cooperation in disaster management

Humanitarian assistance and disaster relief operations require civil-military cooperation between the military and civilian organizations to provide humanitarian assistance and disaster relief. In Southeast Asia, flooding is an increasingly common event and is therefore a major area of focus for civil-military cooperation. The military can provide many types of support including logistical and technical support to civilian organizations which will be very important to support the flood-affected communities. In Malaysia, the military's contribution to flood relief was using its helicopters and boats with the aid delivery being delivered to isolated communities in Kuala Krai, during the 2014 floods in Kelantan. Civil-military cooperation directly impacts the readiness of a country for a disaster by addressing the capability gaps experienced by civilian organizations during a large-scale disaster. Through the inclusion of military assets into the planning stages of a disaster relief operation, the speed and reach of the disaster relief operation will be greatly improved so that disaster relief plans will be effectively implemented. However, there remain inefficiencies in the operation of civil-military cooperation. Although the military provided a rapid response capacity to the floods, post-flood analysis found that communication problems existed between military and civilian organizations when they utilized different radio frequencies. These problems caused duplication of effort and delayed evacuation from affected areas during the most critical time of the first 48 hours after the start of the flood (Rosmadi et al., 2023; The Star, 2015). Therefore, it is why ASEAN's Technical Working Group on Civil-Military Cooperation (TWG-CIMIC) is advocating for harmonized civil-military cooperative operational standards (NADMA, 2024); therefore, the researcher will test the following hypothesis:

Hypothesis 2 (H2). Civil-military cooperation significantly influence disaster preparedness.

Role of communication in disaster preparedness

Communication is key to a successful disaster response, especially in flood-prone states such as Kelantan where timely dissemination of information can mean life or death. Research shows that having reliable and effective communications between emergency responders and the public can increase confidence and encourage preventive behaviours (Mowbray et al., 2024). In Malaysia, an example of how reliable communication can be demonstrated is using two-way communication between district officers and village heads using informal WhatsApp groups. The importance of

these communication streams can be seen in their ability to report on increasing water levels before official warnings are sent out. As stated in systematic reviews, jurisdictions utilizing two-way communication streams tend to be much more prepared than those without (Khan et al., 2023).

Considering these interpersonal aspects of communication, large scale social media platforms such as Facebook and Twitter have become essential for disseminating early warning messages and encouraging community involvement, especially in rural settings (Gopal et al., 2024; Seneviratne et al., 2024). The speed at which information can be disseminated and the ability to engage peers and educate them about disaster prevention are just some of the benefits of social media platforms. Alongside social networks, newer technologies are changing the face of disaster communication. For example, mobile applications such as *eBencana* in Malaysia and global flood alert models allow users to receive real time notifications and coordinate efforts (Çicek et al., 2023; Nordin et al., 2024). Additionally, governments are implementing direct mobile alert systems to bypass SMS delays and send immediate alerts to at risk areas (MCMC, 2024).

At the cutting edge of technological advancements are IoT networks including flood sensors to create real time hazard data (Leong, 2025). In Malaysia, new technologies such as the Mobile Integrated Radio and Internet Communication System (Prime), which utilizes satellite, cellular and drone technology to keep communication lines open even if regular network access fails (The Star, 2025). Together these represent a continuum of communication capabilities ranging from simple messaging to sophisticated communication systems demonstrating that communication represents a link between the scientific knowledge of risk and actualized preparedness measures.

Hypothesis 3 (H3). Communications significantly influence disaster preparedness.

Communication as a mediator in disaster preparedness

Effective disaster management depends heavily on communication. The use of timely, accurate and transparent communication channels will allow for efficient transfer of risk related information to communities and responding agencies. If there is inadequate communication, then it creates additional vulnerabilities and makes it difficult to have a coordinated response to disasters (Sabri et al., 2025; Sulaiman et al., 2019). In terms of empirical evidence, communication systems used in Malaysian flood management such as the Government Integrated Radio Network (GIRN) and early warning systems are underutilized due to problems associated with interoperability and accessibility at the local levels (Azmi et al., 2025). It is important to understand the role of communication as it enables not only the exchange of technical knowledge about risks but also helps build trust among the military, civilian authorities and communities that results in increased collective capacities for response.

In terms of theory, communication serves as a mediating variable that connects risk analysis to outcomes regarding preparedness. This mediating function is supported by two theoretical frameworks. The first is the Social Amplification of Risk Framework (SARF), which suggests that communication channels serve as amplification stations that may either amplify or dampen public perceptions of risk depending on the way information is processed (Kasperson et al., 1988). Additionally, the Risk Information Seeking and Processing (RISP) Model suggests that an individual's preparedness behaviours are directly affected by the adequacy of information provided via these communication channels. Using a metaphor to illustrate this theoretical connection: risk analysis provides the blueprint and civil-military cooperation provides the

construction crew and without proper communication, the crew does not have the instruction manual to follow the plan. Thus, without effective communication, scientific risk data cannot be efficiently converted into action. Communication, therefore, plays an important role in Malaysia in translating the scientific findings of risk analysis into actions by providing the glue that connects analytical science with operational practices (Hinata et al., 2024; Abid et al., 2024).

Three key points emerge from the literature. First, Malaysia has established a formal structure for disaster risk management, however the application of risk analysis at the local level is limited. Second, civil-military cooperation continues to increase, yet operational and institutional barriers remain. Lastly, communication is identified as a critical component in converting risk knowledge into preparedness actions. These gaps form the basis for this research, which analyzes the interaction of risk analysis, civil-military cooperation and communication in shaping disaster preparedness in Kelantan. Based on the literature, the following hypotheses were formulated:

Hypothesis 4a (H4a). Communication significantly mediates the relationship between risk analysis and disaster preparedness.

Hypothesis 4b (H4b). Communication significantly mediates the relationship between Civil-Military Cooperation and Disaster Preparedness.

Building on previous research, this study will develop a conceptual model combining elements of disaster risk assessment, civil-military cooperation and communications to create an integrated approach to disaster preparedness. The role of disaster risk assessment is widely accepted as a critical component of disaster risk reduction. This process provides the essential knowledge base required for informed decision making and the development of early preparedness activities (Weichselgartner & Pigeon, 2015; Hermans et al., 2022). In Malaysia, by accurately identifying and assessing risks in a timely manner, both military personnel and local populations can better identify their vulnerabilities, assign resources and design appropriate responses to disasters. It is therefore hypothesized that disaster risk assessment will have a significant impact on disaster preparedness.

Civil-military cooperation is also recognized as a key factor in determining the success of disaster management efforts in countries like Malaysia that are at high risk of flooding. While the MAF participates in logistics, evacuation and relief efforts, they work in conjunction with civilian organizations and community-based networks to provide support during times of disaster (Mumtaz & Cheema, 2025). The effective working relationship between civilian and military entities can lead to greater resource availability, faster response times and increased trust among stakeholders, all of which contribute to higher levels of preparedness. Therefore, civil-military cooperation is also hypothesized to be a significant determinant of disaster preparedness.

In this study, communication will be treated as a mediator. As noted previously, existing literature indicates that the knowledge gained from risk assessments and collaboration capabilities will result in disaster preparedness only if those assessments and capabilities are adequately communicated to all stakeholders (Rahman & Iskandar, 2022). Communication is a means to facilitate the transfer of information among various stakeholders; build situational awareness; and coordinate the actions of military units and local populations. Thus, communication is hypothesized to act as a mediating variable to explain how both risk assessment and civil-military cooperation relate to disaster preparedness.

Figure 1 illustrates the conceptual framework developed in this study, which represents the hypothesized relationships. The solid lines in the figure illustrate the hypothesized direct relationships between the independent variables (risk assessment and civil-military cooperation), and the dependent variable (disaster preparedness). The dashed lines illustrate the indirect paths that exist via the mediating variable of communication. Finally, the arrows pointing from left to right represent the hypothesized causal path of influence.

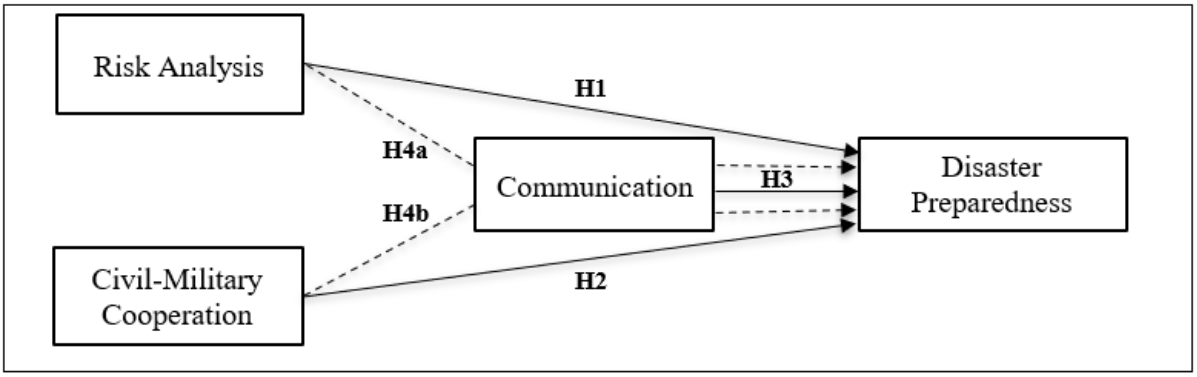


Figure 1. Proposed conceptual framework

Based on the above discussion, the following hypotheses are proposed:

H1: Risk analysis has a significant positive relationship with disaster preparedness.
H2: Civil–military cooperation has a significant positive relationship with disaster preparedness.
H3: Communication has a significant positive relationship with disaster preparedness.
H4a: Communication significantly mediates the relationship between risk analysis and disaster preparedness.
H4b: Communication significantly mediates the relationship between civil-military cooperation and disaster preparedness.

Method and study area

Sampling procedure

Kelantan is a province in eastern Peninsular Malaysia with the largest number of flood victims each year from the Northeast Monsoon. In 2014 there was the worst ever flood in history called Bah Kuning flood, where over 200,000 people had to be evacuated and large parts of the country's infrastructure and livelihood were severely damaged (Radi et al., 2019; Baharuddin et al., 2015). In addition to the fact that Kelantan has experienced many years of recurrent flood disasters, the 8th Infantry Brigade of the Malaysian Armed Forces (MAF) operates out of the region and responds to all major disasters. The 8th Infantry Brigade is one of the primary units of the MAF that have been deployed to assist with disaster relief efforts throughout the country. For the purposes of the research, the research population was defined as military personnel and civilian residents of two flood-affected districts in Kelantan: Kuala Krai District and Pasir Mas District. The selection of

these two districts was based on the differing nature of the flooding within the district; Kuala Krai District is typically an upstream area that experiences rapid and intense flash flooding, whereas Pasir Mas District is a downstream area that experiences prolonged periods of water stagnation. Using the stratified random sampling methodology, the research sample was divided into the two distinct subgroups (military and civilians) to provide a fair representation of the views of both groups. Proportional stratification was used to ensure that the number of participants from the two districts was proportionate to the total population of the two districts (the population of the 8th Infantry Brigade and the number of households in the selected districts). The use of proportional stratification will allow researchers to determine if there are differences between the two strata of the sample (military and civilian) which will increase the generalizability of the results and the accuracy of the conclusions drawn from the data. According to Krejcie and Morgan's (1970) sample size determination table, the researcher needed at least 384 participants to meet the requirements of the research design. As a measure to enhance the reliability of the research, 450 questionnaires were distributed and yielded 412 valid responses. The high response rate of 91.6% reduces the potential for nonresponse bias and increases the credibility of the research. Military respondents were assured that their participation would be voluntary and independent of the chain of command. To avoid any perceptions of coercion or pressure, the surveys were administered by independent enumerators and the respondents' identity was kept anonymous so that they could respond honestly without fear of being identified or suffering professionally as a result.

Data collection and analysis procedures

This research utilized a quantitative survey design to provide an empirical basis for statistically modelling the relationships among risk analysis, civil–military cooperation, communication, and disaster preparedness (Hair et al., 2022). A five-point Likert-type scale was used as the survey format to provide respondents with a means to express the level of agreement or disagreement with each item on the survey. The use of a Likert-type scale provides a simple means by which respondents can clearly express the degree to which they agree or disagree with each statement (Joshi et al., 2015; Sekaran & Bougie, 2019). All items measuring each construct were adapted from prior research to ensure content validity. Minor modifications were also made to adapt the survey items to fit the local context of Kelantan. Approval and permission to collect data were first obtained. Every effort was taken to safeguard the confidentiality and anonymity of participants and to ensure that all participation in the survey was voluntary. Data were subsequently analyzed using both IBM SPSS version 29 and SmartPLS version 4.1. Common method bias, which could have arisen due to the self-report nature of the survey, was addressed using Harman's single factor test. The results of this test indicated that a single factor explained 28.5% of the total variance, which is less than the 50% threshold established by Podsakoff et al. (2003). In addition, a full collinearity assessment was performed to determine if there were any issues associated with multicollinearity. Each of the VIF scores generated during this assessment fell below the established threshold of 3.3 (Kock, 2015). Collectively, these assessments indicate that common method bias was not a significant issue in this study.

Results

Demographic profile

Table 1 describes the demographics of the 412 participants; 54.4 percent were military personnel from the 8th Infantry Brigade and 45.6 percent were community residents in flood-prone areas of Kelantan. It was important to include both groups since they represent two different perspectives on disaster management, the military's strategic approach to disaster management and the community-based approaches that provide day-to-day support to people living at risk. Most participants were men (63.8%) and the average age of participants was 35.5 years with a standard deviation of 10.2 years. These data reflect the age range of young and middle-aged adults that has been identified in other research as being the most likely to be involved in preparing for disasters. Majority of the participants, 24.3 percent had completed secondary education, 36.4 percent had earned a diploma and 39.3 percent had a bachelor's degree or higher. Therefore, the participants appear to be a highly educated population that could potentially understand and engage with disaster risk-related information. Additionally, over one-half (53.4 percent) of the community participants indicated that they had experienced major flooding in the past five years. As previous research has shown, having first-hand experience with major floods creates an acute risk memory that motivates individuals to prepare for similar events.

Table 1. Description of the sample (N = 412)

Category	Frequency	Percentage (%)
Military personnel	224	54.4
Community members	188	45.6
Male	263	63.8
Age 25–40 years	240	58.2
Secondary-level education to higher	299	72.6
Experienced major floods (past 5 years)	220	53.4

Source: Data analysis performed using IBM SPSS Statistics Version 29.0 (IBM Corp., 2022)

Measurement model

Table 2 provides the results of the measurement models. For the most part, the indicator reliabilities were acceptable, as most of the outer loadings exceeded the threshold of .708. However, two items related to the Communication construct had lower loadings of .637 and .624. Although these loadings are slightly less than desired, the items were retained based on the advice provided by Hair et al. (2022). According to the authors, when evaluating indicators with loadings between .40 and .70, indicators can be deleted only if deleting the indicator will cause an increase in the Average Variance Extracted (AVE) to exceed .50. Since the AVE for the Communication construct is .518, there was no need to delete either item to maintain internal consistency, and retention of the items enhances content validity. Internal consistency was also established with Cronbach's alpha (.766 – .892) and Composite Reliability (CR) (.842 – .915), both of which exceeded the threshold of .70 (Hair et al., 2022). Convergent validity was also demonstrated with the AVE values for the constructs ranging from .518 to .644, all of which exceeded the threshold

of .50 (Henseler et al., 2016). Therefore, these validity assessments indicate that the survey questions were measuring the same thing and that each construct was separate from the others.

Table 2. Measurement model result

Construct	Items	Loadings	Average Variance Extracted (AVE)	Cronbach's Alpha (CA)	Composite Reliability (CR)
Risk Analysis (RA)	RA2	0.738	0.571	0.851	0.889
	RA3	0.787			
	RA4	0.786			
	RA5	0.747			
	RA6	0.761			
	RA7	0.713			
Civil–Military Cooperation (CM)	CM3	0.744	0.644	0.861	0.900
	CM4	0.738			
	CM5	0.859			
	CM6	0.833			
	CM8	0.830			
Communication (C)	C1	0.781	0.518	0.766	0.842
	C2	0.805			
	C3	0.733			
	C4	0.637			
	C5	0.624			
Disaster Preparedness (DP)	DP1	0.746	0.607	0.892	0.915
	DP2	0.736			
	DP3	0.804			
	DP5	0.817			
	DP6	0.792			
	DP7	0.814			
	DP8	0.742			

Source: Data analyzed using SmartPLS 4.1 (Ringle, Wende & Becker, 2023)

Table 3. Fornell-Larcker criterion

Construct	Civil–Military Cooperation (CM)	Communication (C)	Disaster Preparedness (DP)	Risk Analysis (RA)
Civil–Military Cooperation (CM)	0.802			
Communication (C)	0.589	0.720		
Disaster Preparedness (DP)	0.527	0.526	0.779	
Risk Analysis (RA)	0.470	0.495	0.542	0.756

Source: Data analyzed using SmartPLS 4.1 (Ringle, Wende & Becker, 2023)

Table 4. HTMT

Construct	Civil–Military Cooperation (CM)	Communication (C)	Disaster Preparedness (DP)	Risk Analysis (RA)
Civil–Military Cooperation (CM)				
Communication (C)	0.719			
Disaster Preparedness (DP)	0.590	0.613		
Risk Analysis (RA)	0.538	0.586	0.599	

Source: Data analyzed using SmartPLS 4.1 (Ringle, Wende & Becker, 2023)

Table 5. The Variance Inflation Factor **(**VIF) of all constructs in structural model

Construct	VIF value
Risk Analysis (RA)	1.417
Civil–Military Cooperation (CM)	1.636
Communication (C)	1.689
Disaster Preparedness (DP)	1.284

Source: Data analyzed using SmartPLS 4.1 (Ringle, Wende & Becker, 2023)

Discriminant validity was also demonstrated (please see Tables 3, 4 and 5). Based on the Fornell-Larcker criterion, the square root of the AVE for each construct (.720 – .802) was larger than the correlation between the constructs and the HTMT ratio (.538 – .719) was smaller than the conservative cut-off of .90, as recommended by Franke and Sarstedt (2019). Lastly, based on the results of the VIF calculations, collinearity was not a problem since all the VIF values (.284 – .689) were smaller than the threshold of 5.00 (Hair et al., 2022). Taken together, these results demonstrate that the constructs measured in this study were reliable, had convergent validity and discriminant validity. Thus, the measurement instruments used in this study were both reliable and valid.

Structural model results

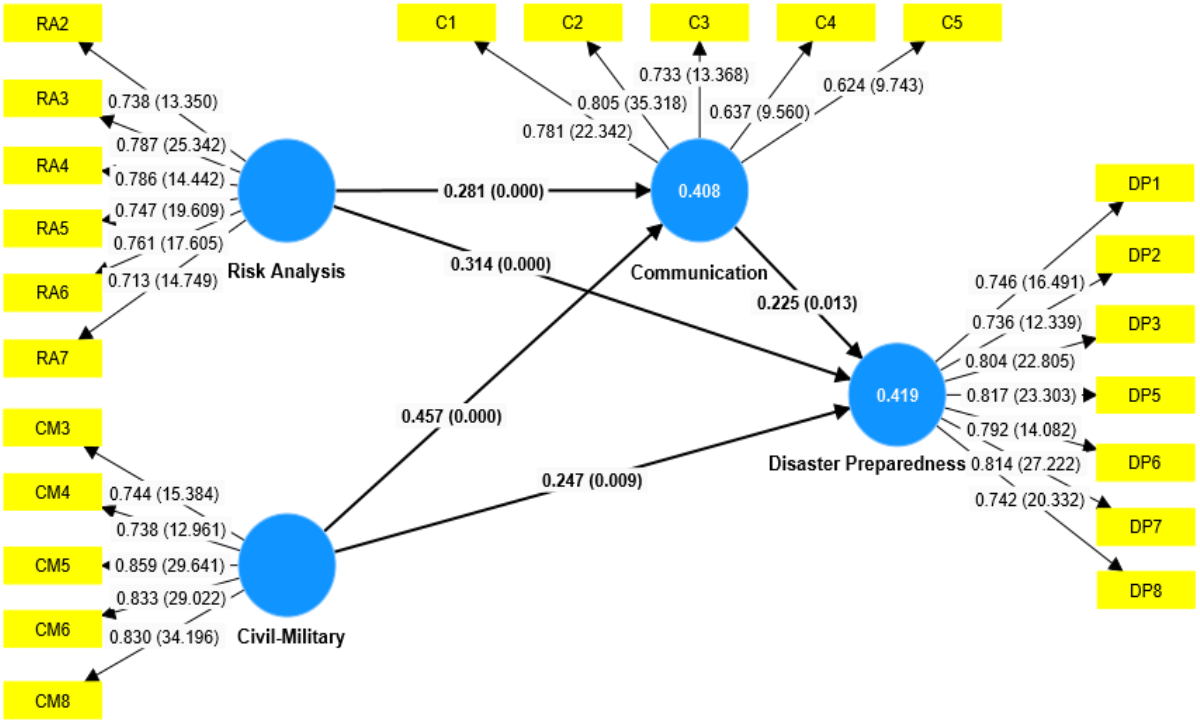
The structural model results are summarised in Table 6 which includes the path, the standardized beta coefficient (β), SD, t-value, p-value, R^2, f^2, Q^2 and the outcome of the hypothesis test.

Table 6. Hypotheses testing results

Effect	Relationship	Beta (β)	Standard Deviation (SD)	t-value	p-value	R^2	f^2	Q^2	Result
Direct effect									
H1	RA → DP	0.377	0.078	4.858	0.000	0.419	0.120	0.244	Supported
H2	CM → DP	0.350	0.083	4.240	0.000		0.064		Supported
H3	C → DP	0.225	0.091	2.479	0.013		0.052		Supported
Mediating effect									
H4a	RA → C → DP	0.063	0.031	2.053	0.040	0.408	0.104	0.193	Supported
H4b	CM → C → DP	0.103	0.043	2.363	0.018		0.274		Supported

Source: Data analyzed using SmartPLS 4.1 (Ringle, Wende & Becker, 2023)

The results of the structural model (see Figure 2) reveal significant and positive relationships among all the latent variables, providing a robust empirical foundation for the study's theoretical framework. The relationships depicted in the diagram are summarized in the Table 6.



Source: Generated using SmartPLS 4.1 (Ringle, Wende & Becker, 2023)

Figure 2. Structural model of the study

Discussion

Risk analysis and military/civilian cooperation

The results of this study have satisfied all the objectives set forth in the study. The findings verify the highly significant, positive relationship of Risk Analysis to Disaster Preparedness (H1: $\beta = .377$, $p < .001$). Therefore, identifying and assessing potential hazards, and evaluating the capacities of communities and organizations to respond to disasters can significantly predict the level of preparedness. This means that for each standard deviation increase in the quality of Risk Analysis, there will be a corresponding 0.32 standard deviation increase in preparedness. These results demonstrate the importance of using a data-driven approach to prepare for crises, consistent with Hassan et al. (2024). In the case of Kelantan, where annual flooding causes disruption in peoples' daily life, the systematic assessment of risks from both military and civilian entities enhances the efficiency of resource allocation and improves the quality of decision making. The study also verifies that Civil – Military Cooperation (CIMIC) significantly contributes to Disaster Preparedness (H2: $\beta = .350$, $p < .001$). While the effect size of CIMIC is slightly lower than that of Risk Analysis, CIMIC continues to be a critical variable. Consistent with Haliza et al. (2021) and Mohammed Zain et al. (2023), CIMIC provides the logistical support necessary to coordinate relief efforts during emergencies. An example of successful CIMIC cooperation includes the joint use of military boats and local village guides. The military supplies heavy equipment, while the local guides supply navigation knowledge. Together they create a synergistic effort that helps save lives. However, the average mean score of CIMIC is moderate and therefore CIMIC needs to be more formally institutionalized through regional platforms such as the ASEAN TWG-CIMIC.

The mediator effect of communication

A second important finding from the analysis is that Communication acts as a mediator between Risk Analysis and CIMIC and Disaster Preparedness. The study supports H3 ($\beta = .225$, $p < .001$) and shows that Communication is an independent predictor of Disaster Preparedness. Also, the study supports H4a and H4b and indicates that both Risk Analysis ($\beta = .377$) and CIMIC ($\beta = .103$) positively affect Communication. Of the two, Risk Analysis appears to have the greatest impact. The quality of Risk Analysis appears to have the greatest positive impact on providing the content for effective warnings or alerts (Levy & Bodas, 2024). This study is the first Malaysian study to model Communication as a mediator within the Civil – Military Cooperation framework. Therefore, by demonstrating that Communication mediates the relationship between Risk Analysis and Operational Readiness, this study builds upon previous studies that have modelled these variables independently. To illustrate this mediator role simply: Communication acts as a bridge. With high-quality Risk Analysis (the plan) and strong CIMIC (the team), disaster preparedness (the outcome) will fail if the information does not travel across the bridge to reach the individuals who need to know. The model's R^2 value of .41 indicates that 41% of the variation in Disaster Preparedness can be attributed to the variables included in this model. In summary, the findings indicate that disaster preparedness in flood-prone regions is most effectively accomplished when an integrated approach is employed that uses risk analysis and CIMIC to inform preparedness through effective communication mechanisms.

Theoretical contributions

Theoretically, this study adds to the body of knowledge of disaster governance by incorporating military personnel into community-based disaster risk reduction (CBDRR) frameworks. It expands the scope of CIMIC research to include not only the logistical aspects of cooperation, but also the communicative dimensions of cooperation. Importantly, the study validates that the flow of information is equally as important as the deployment of physical assets to achieve preparedness during the preparedness phase.

Practical contributions

From a practical perspective, the findings suggest the necessity of institutionalizing participatory risk analysis. One of the strategies to achieve this is to develop hybrid communication channels that link community level communication channels such as community WhatsApp groups directly to district military command centers to facilitate the rapid exchange of information, in both directions. The main takeaway for policymakers is that investments in interoperable communication systems such as shared radio frequencies are equally as important as investments in physical assets such as trucks, boats.

Conclusion

The primary goal of this study was to investigate the determinants of disaster preparedness in Kelantan, Malaysia, specifically examining the roles of Risk Analysis, Civil–Military Cooperation (CIMIC) and Communication. The findings demonstrated that while Risk Analysis and CIMIC are important to developing disaster preparedness, effective communication is the mediator that transforms these plans into actions. In conclusion, this study advocates for a paradigmatic shift: disaster preparedness should be seen as a communicative challenge of conveying information, rather than a purely logistical challenge of deploying resources. For citizens in Kelantan, the implications of this study reinforce their role as active participants in emergency response efforts and emphasize the vital contribution that their local knowledge makes to the effectiveness of military deployments.

Limitations and future research directions

While this study made several theoretical contributions to the field, it has some methodological limitations. First, the survey instrument relied on self-reporting, which may introduce social desirability bias, where citizens report higher levels of preparedness than they possess. Second, the cross-sectional design of the study restricts the ability to determine the causal relationships among the variables examined and how preparedness evolves over different stages of a disaster. Finally, although stratified sampling was employed, the sample does not adequately represent vulnerable populations such as the elderly, disabled and/or digitally disconnected. To address these limitations, future research should utilize longitudinal designs to assess changes in preparedness behaviors over time, especially prior to and after monsoon seasons. Additionally, future studies

could expand the geographic scope to include other flood-prone states such as Terengganu and Pahang to enable the examination of preparedness behaviors across the East Coast Region.

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References

Abid, S. K., Sulaiman, N., Al-Wathinani, A. M., & Goniewicz, K. (2024). Community-based flood mitigation in Malaysia: Enhancing public participation and policy effectiveness for sustainable resilience. *Journal of Global Health*, *14*, 04290.

Asian Disaster Reduction Center. (2024). Country Report: Malaysia FY2024.

Azmi, E. S., & How, V. (2025). Technology potential in improving disaster response communication: A qualitative study in Malaysia. *Malaysian Journal of Medicine and Health Sciences*, *21*(3), 51-62.

Baharuddin, K. A., Abdul Wahab, S. F., Nik Ab Rahman, N. H., Nik Mohamad, N. A., Tuan Kamauzaman, T. H., Md Noh, A. Y., & Abdul Majod, M. R. (2015). The record-setting flood of 2014 in Kelantan: Challenges and recommendations from an emergency medicine perspective and why the medical campus stood dry. *Malaysian Journal of Medical Sciences (MJMS)*, *22*(2), 1-7.

Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (2004). *At Risk: Natural Hazards, People's Vulnerability, and Disasters* (1st ed.). Routledge.

Canyon, D. V., Ryan, B. J., & Burkle, F. M. (2020). Rationale for military involvement in humanitarian assistance and disaster relief. *Prehospital and Disaster Medicine*, *35*(1), 92-97.

Cicek, D., & Kantarci, B. (2023). Use of mobile crowdsensing in disaster management: A systematic review, challenges, and open issues. *Sensors*, *23*(3), 1699.

Department of Statistics Malaysia (DOSM). (2024). Special Report on The Impact of Floods in Malaysia 2024.

Department of Statistics Malaysia (DOSM). (2025). Special Report on The Impact of Floods in Malaysia 2024.

Fu, Q., & Zhang, X. (2024). Promoting community resilience through disaster education: Review of community-based interventions with a focus on teacher resilience and well-being. *PLoS ONE*, *19*(1), e0296393.

Franke, G., & Sarstedt, M. (2019). Heuristics versus statistics in discriminant validity testing: A comparison of four procedures. *Internet Research*, *29*(3), 430–447.

Gopal, L. S., Prabha, R., Thirugnanam, H., Ramesh, M. V., & Malamud, B. D. (2024). Leveraging social media for managing natural hazard disasters: A critical review of data collection

strategies and actionable insights. *Natural Hazards and Earth System Sciences (NHESS), 26*, 215-250.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., Ray, S., & St, C. (2022). *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R*. Springer.

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook*. Springer.

Halizahari, M., Zain, R., Ismail, A., Zainol, N. A. H. M., Yaacob, S., & Che Ali, N. I. R. (2021). Accessing Malaysia armed forces logistics system in providing humanitarian logistics support. *International Journal of Advanced Science Computing and Engineering*, *3*(2), 88-93.

Hassan @ Ali, S. A., Mohd Zainol, N. A., Yaacob, S., Abidin, Z. Z., Taib, K. N., Mohd Zahari, H., & Sofian, M. H. (2024). Penerokaan elemen pengukuhan bagi kesedaran komuniti dalam menghadapi bencana banjir di zon utara Semenanjung Malaysia. *International Journal of Law, Government and Communication (IJLGC)*, *9*(37), 283-295.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2016). Testing measurement invariance of composites using partial least squares. *International Marketing Review*, *33*(3), 405–431.

Hermans, T. D. G., Sakic Trogrlic, R., van den Homberg, M. J. C., Bailon, H., Sarku, R., & Mosurska, A. (2022). Exploring the integration of local and scientific knowledge in early warning systems for disaster risk reduction: A review. *Natural Hazards, 114*, 1125-1152.

Hinata, S., Rohde, H., & Templeton, A. (2024). Communicating with the public in emergencies: A systematic review of communication approaches in emergency response. *International Journal of Disaster Risk Reduction, 111*, 104719.

IBM Corp. (2022). IBM SPSS Statistics for Windows, Version 29.0.

Joshi, A., Kale, S., Chandel, S., & Pal, D. K. (2015). Likert scale: Explored and explained. *British Journal of Applied Science & Technology*, *7*(4), 396–403.

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., Kasperson, J. X., & Ratick, S. (1988). The social amplification of risk: A conceptual framework. *Risk analysis*, *8*(2), 177-187.

Khan, S., Mishra, J., Ahmed, N., Onyige, C. D., Lin, K. E., Siew, R., & Lim, B. H. (2022). Risk communication and community engagement during COVID-19. *International Journal of Disaster Risk Reduction*, *74*, 102903.

Khan, S. M., Shafi, I., Butt, W. H., Diez, I. D. L. T., Flores, M. A. L., Galán, J. C., & Ashraf, I. (2023). A systematic review of disaster management systems: Approaches, challenges, and future directions. *Land*, *12*(8), 1514.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, *30*(3), 607–610.

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of e-Collaboration, 11*(4), 1-10.

Leong, W. (2025). Internet of things for enhancing public safety, disaster response, and emergency management. *Engineering Proceedings*, *92*(1), 61.

Levy, O., & Bodas, M. (2024). Risk messaging style and its effect on public preparedness for earthquakes: Longitudinal intervention-based study. *Journal of Risk Research, 46*, 87-109.

Malay Mail. (2024, September 26). *Monsoon ready: DPM Zahid unveils National Disaster Risk Management Policy*. Malay Mail. https://www.malaymail.com/news/malaysia/2024/09/26/monsoon-ready-dpm-zahid-unveils-national-disaster-risk-management-policy/151676

Malaysia Government. (2025). Laman Rasmi Pengurusan Bencana JKR (eBENCANA).

Malaysian Communications and Multimedia Commission (MCMC). (2024, November 23). *MCMC to explore direct mobile alerts for disasters, says Communications Minister*. Malay Mail. https://www.malaymail.com

Ma, N. N., Jaffar, A., Lugova, H., Abd Samad, B. H., Abdul Salam, M. R., & Krishnapillai, A. (2024). Civil–military coordination for health response to urban disaster in Malaysia: Document analysis. *International Journal of Academic Research in Business and Social Sciences, 14*(7), 359-381.

Marasco, S., Kammouh, O., & Cimellaro, G. P. (2022). Disaster resilience quantification of communities: A risk-based approach. *International Journal of Disaster Risk Reduction*, *70*, 102778.

Mohammed Zain, R., Mohd Zahari, H., & Mohd Zainol, N. A. (2023). Inter-agency information sharing coordination on humanitarian logistics support for urban disaster management in Kuala Lumpur. *Frontiers in Sustainable Cities*, 5, 1149454.

Mohd Radi, M. F., Hashim, J. H., Jaafar, M. H., Hod, R., Ahmad, N., Mohammed Nawi, A., Muhammad Baloch, G., Ismail, R., & Ayub, N. I. F. (2019). Lessons on environmental health and disaster preparedness, response, and recovery from the severe Kelantan flooding in 2014. *International Journal of Emergency Management*, *15*(1), 26-53.

Mowbray, F., Mills, F., Symons, C., Amlot, R., & Rubin, G. J. (2024). A systematic review of the use of mobile alerting to inform the public about emergencies and the factors that influence the public response. *Journal of Contingencies and Crisis Management*, *32*, e12499.

Mumtaz, T., Cheema, A. T., & Ramisha. (2025). Role of the military in disaster management: A case study of flood 2022. *ACADEMIA International Journal for Social Sciences, 4*(2), 1333-1345.

NADMA. (2024). Civil–Military Coordination Workshop: Enhancement of Coordination Mechanisms for Humanitarian Assistance and Disaster Relief Operations.

Nordin, N., Musa Kutty, N. F., & Fazan Ahmad, N. D. (2023). Analysis on the civil–military coordination for disaster response in Kuala Lumpur. *Zulfaqar Journal of Defence Management, Social Science and Humanities, 6*(1), 57-68.

Nordin, N., Yaacob, S., Musa Kutty, N. F., & Yusof, S. (2024). Challenges in training and simulation for enhancing civil-military coordination in Malaysian disaster response. *International Journal of Entrepreneurship and Management Practises (IJEMP), 7*(26), 183-200.

Permana, I., Dewi, R., & Budhiana, J. (2025). Mobile applications and community disaster preparedness: Insights from a scoping review. *The Malaysian Journal of Nursing (MJN), 16*(Supplementary 2), 147-157.

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879-903.

Rahman, A., & Fang, C. (2019). Appraisal of gaps and challenges in Sendai framework for disaster risk reduction priority 1 through the lens of science, technology, and innovation. *Progress in Disaster Science*, *1*, 100006.

Rahman, N. H., & Iskandar, S. (2022). Assessing civil-military coordination in disaster response operations within Kuala Lumpur. *International Journal of Social Sciences, Language and Linguistics*, 1-6.

Ramli, M. W. A., Alias, N. E., Mohd Yusof, H., Abdul Wahab, Y. F., Sa'adi, Z., Abd Rahman, A., Wan Ibrahim, W. M. M., Yusop, Z., & Mat Taib, S. (2024). Multi-hazard multidimensional disaster risk validation in Selangor's urban districts, Malaysia. *Geomatics, Natural Hazards and Risk, 15*(1), 2413683.

Ramli, M. W. A., Alias, N. E., Sa'adi, Z., Abdul Wahab, Y. F., & Abd Rahman, A. (2025). Disaster risk assessment in Malaysia: Current state, challenges, and future directions. *Natural Hazards, 121*, 13875-13898.

Ringle, C. M., Wende, S., & Becker, J.-M. (2023). SmartPLS 4.

Rosmadi, H. S., Ahmed, M. F., Mokhtar, M., & Lim, C. K. (2023). Reviewing challenges of flood risk management in Malaysia. *Water, 15*(13), 2390.

Sabri, S. S. S., Mohd Hussain, M. R., Ab Sani, J., Abdul Hamed, S., & Rusli, N. (2025). The role of communication in strengthening emergency preparedness and response plans. *Semarak International Journal of Design, Built Environment and Sustainability, 2*(1), 41-49.

Samad, M. A., Arifin, K., & Abas, A. (2025). A systematic literature review on the challenges of Southeast Asian countries in natural disaster management. *Cogent Social Sciences, 11*(1), 2435590.

Sekaran, U., & Bougie, R. (2016). *Research Methods for Business: A Skill Building Approach*. John Wiley & Sons.

Seneviratne, K., Nadeeshani, M., Senaratne, S., & Perera, S. (2024). Use of social media in disaster management: Challenges and strategies. *Sustainability, 16*(11), 4824.

Shariff, N. N. M., & Hamidi, Z. S. (2019). Community-based approach for a flood preparedness plan in Malaysia. *Jamba: Journal of Disaster Risk Studies, 11*(1), a598.

Suharini, E., Aisyah, S., & Kurniawan, E. (2020). The role of community-based disaster preparedness and response team in building community resilience. *Geografia-Malaysian Journal of Society and Space, 16*(4), 30-44.

Sulaiman, N., She, T. W., & Fernando, T. (2019). Community resilience frameworks for building disaster resilient community in Malaysia. *Planning Malaysia, 17*(1), 94-103.

The Star. (2015, March 30). *PAC: 'Communication breakdown' between NSC and Kelantan led to poor flood management*. The Star Online. https://www.thestar.com.my/news/nation/2015/03/30/pac-flood-management

The Star. (2025, June 16). *PRIME enhances disaster preparedness, says Fahmi*. The Star Online. https://www.thestar.com.my/news/nation/2025/06/16/prime-enhances-disaster-preparedness-says-fahmi

UNDRR. (2019). Global assessment report on disaster risk reduction 2019.

UNDRR. (2020). Disaster risk reduction in Malaysia: Status report 2020.

United Nations Office for Disaster Risk Reduction (UNDRR). (2015). Sendai Framework for Disaster Risk Reduction 2015–2030.

United Nations Office for Disaster Risk Reduction. (2024). Everyday counts, act for resilience: Country commitment Malaysia. Global Platform for Disaster Risk Reduction 2025.

Weichselgartner, J., & Pigeon, P. (2015). The role of knowledge in disaster risk reduction. *International Journal of Disaster Risk Science, 6*, 107-116.

Yaacob, S., Inderjit, S., & Ibrahim, N. (2021). The effectiveness of policy, planning, risk assesment, data management and communication on disaster preparedness among 8th infantry brigade in Kelantan. *Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12*(14), 2986-2993.

Yatim, L. A. M., Abdul Munir, Z., Abdul, N., Bahry, N. S., Mat, A., & Kori, N. L. (2024). Adapting the shield: Ensuring military readiness for flood disaster in Malaysia's. *Advances in Social Sciences Research Journal, 11*(2.2), 333–346.