From Risk to Readiness: Exploring Community Preparedness for Monsoon Floods in East Coast Malaysia

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Abstract
Floods during the monsoon season are a recurring phenomenon in Malaysia's East Coast, with Kelantan communities frequently affected from November to March. These floods cause significant loss of life and economic damage, emphasising the need for increased awareness and preparedness. This study employs quantitative research methods to evaluate the preparedness of the Tok Deh community in Kelantan who experienced severe floods in 2014 and 2022. Fifty respondents completed a questionnaire assessing five indicators: knowledge of floods, reading flood signs, flood adaptation, flood awareness and flood perception.

The results indicate high community knowledge about floods (mean score, M = 3.82) and a strong belief that floods are inevitable during monsoons (4.42). The community showed high confidence in Government support post-flood (4.36 - 4.42), effective sharing of flood-related knowledge (4.42) and high awareness of evacuation centre locations (4.44). However, participation in disaster awareness campaigns (3.52) and awareness of the importance of infrastructure (3.68) need improvement. Confidence in the safety of homes and buildings is moderate to low (2.32 - 2.72). Although the community anticipates large-scale flooding within the next decade (4.10), individual preparedness remains inadequate. This study highlights the community's strong flood-related knowledge and collective preparedness and calls for improved personal preparedness, expert knowledge access and communication with non-governmental organisations to enhance resilience.

Keywords: Monsoon flood, community preparedness, adaptation, resilience, local knowledge.

Introduction

The major floods that hit Kelantan and several East Coast States in Peninsular Malaysia in December 2014 have often been cited as the most severe in decades. These floods resulted in an estimated economic loss of USD 560 million and profoundly affected the daily lives of over 500,000 people in the region[7]. The incessant heavy rainfall, spanning from southern Thailand to Sungai Golok (Golok River) in Kelantan, persisted for several days, inundating most districts of Kuala Krai and Gua Musang including the previously unaffected areas. Additionally, parts of South Kelantan, particularly the districts of Gua Musang and Kuala Krai, were submerged, isolating them from surrounding areas. This inundation was exacerbated by a sudden surge in water levels in major rivers such as Sungai Galas, Sungai Dabong, Sungai Lebir, Sungai Tualang, Sungai Golok, Rantau Panjang and Sungai Kelantan, due to the persistent heavy rains between December 18th and December 28th, 2014[17].

Seasonal flooding in the East Coast States, particularly Kelantan, Terengganu and Pahang, is an annual occurrence that local communities expect between November and March due to the monsoon transition season. Kelantan State, in particular, has experienced flooding for decades, primarily due to its proximity to the Golok river which forms a border with Thailand[16]. The rapid development of border towns has led to more frequent disasters compounded by weather factors, particularly heavy rains during the monsoon season. This pattern indicates a significant influx of water into the Golok river within a short timeframe, often surpassing the river's capacity to contain it[13]. Urban development that does not consistently adhere to systematic drainage exacerbates the situation during the flood season.

The rise in natural and man-made disasters in the East Coast has led to an increase in both loss of lives and economic damage. This trend underscores the pressing need to equip communities in flood-prone areas of the East Coast with the necessary knowledge and preparation. Studies have shown that a low and inadequate level of preparedness among communities heightens the risk of fatalities, property destruction, service interruptions, public health crises and protracted recovery challenges[4].

Furthermore, a deficiency in preparedness hampers the development of community resilience and undermines coordination mechanisms essential for swift and effective crisis responses. In this light, this study aims to identify and assess the level of community preparedness in confronting recurring floods, particularly during the monsoon transition season. This will be achieved through a case study of Kampung Tok Deh in Kelantan State which was severely

affected by a mega flood in 2014 and a subsequent flood in 2022.

Monsoon Flood in Malaysia - Contributing Factors and Impacts

Over the past two decades, Malaysia has faced extreme weather and climate events, leading to significant floods in 2006, 2007, 2010, 2011 and 2014, primarily affecting eastern coastal States[5]. These recurring monsoon floods vary in their severity, location and timing[19]. Several studies conducted in Malaysia have sought to identify the causes of monsoonal floods. Omar et al[14] suggested in their research that climate change contributes to prolonged heavy rainfall events. Meanwhile, a study by Abid et al[1] focusing on floods in Sarawak, part of the Borneo archipelago, identified the northeast monsoon and climate change as natural factors influencing flooding. Floods often extend beyond river basins owing to climatic effects such as high tides at river mouths or intense storms that generate large waves that inundate coastal areas and disrupt water discharge flows.

Additionally, human intervention that alters the environment can increase the risk of monsoon flooding. According to Kamarudin et al[9], flooding is worsened by human activities or development that ignore an area's carrying capacity and alter its physical conditions. Urban areas, for instance, often experience increased flood vulnerability due to insufficient provision of green open spaces and urban parks, which often shrink due to encroachments by settlements or economically lucrative developments. Moreover, factors such as the construction of individual walls in residential estates can impede floodwater from receding quickly, thereby prolonging recovery times for residents.

Monsoon flood impacts: Monsoon flooding can have a significant impact on communities, affecting various aspects of their lives. The literature review outlines the following impacts of monsoon floods:

1. **Displacement of people:** Monsoon flooding often leads to the displacement of communities, forcing them to evacuate their homes and seek temporary shelters in relief camps or with relatives. This displacement can disrupt life and lead to psychological distress among the affected individuals[15].
2. **Economic losses:** The economic impact of monsoon flooding can be substantial and can affect livelihoods, businesses and agricultural activities. Crop damage, loss of property and disruptions to businesses can lead to long-term economic setbacks for the affected communities[6].
3. **Infrastructure damage:** Monsoon floods can cause extensive damage to infrastructure including roads, bridges and buildings, thereby disrupting transportation networks and essential services. This damage can hinder emergency response efforts and prolong recovery processes[11].
4. **Health risks:** Floodwater can become contaminated with sewage, chemicals and other pollutants, posing significant health risks to communities. Waterborne diseases such as cholera, typhoid and hepatitis can spread rapidly in flooded areas, exacerbating public health challenges[2].
5. **Psychological trauma:** Monsoon flooding can result in psychological trauma and stress among affected individuals, particularly those who experience loss of life, property, or livelihood. Trauma can have long-lasting effects on mental health and well-being[8].

Assessment of Community Flood Preparedness

When a disaster strikes, humans prioritise preparedness, highlighting the importance of readiness for unforeseen and potentially prolonged challenges. From a humanistic viewpoint, it is crucial to equip individuals and communities with knowledge and readiness[12,14,18]. The evaluation of community preparedness can be based on the framework and indicators outlined in fig. 1 as per the literature review.

Knowledge (CP1): The concept of measured knowledge encompassed two key aspects. First, it pertains to understanding disaster risk including information about various types of disasters and indicators that signal their potential occurrence. This knowledge is crucial for individuals to enhance their preparedness in the event of a disaster. Second, it involves local practices and insights into the effective management of flood disasters.

Reading early signs (CP2): The sub-indicators include prevention, recovery activities and disaster response training. Prioritising access to information and following authorities' instructions during disasters are crucial for individuals, communities and organisations.

Adaptation (CP3): Sub-indicators encompass various disaster experiences including type, frequency, duration and pre-, during- and post-event effects and actions. Such experiences can alleviate stress initially but may lead to shock and confusion afterwards.

Awareness (CP4): The sub-indicators focus on flood awareness including knowledge of flood threats, proactive measures and risk-reduction decisions. This involves educating individuals and communities about the causes, management and prevention of floods. Enhancing flood awareness significantly reduces flood impacts and safeguards communities.

Perception (CP5): The sub-indicators encompass how individuals and communities perceive and interpret flood events. This includes their understanding, beliefs, attitudes and subjective experiences related to floods. Variations in flood perceptions arise from differences in knowledge, past experiences, cultural beliefs and socio-economic factors.

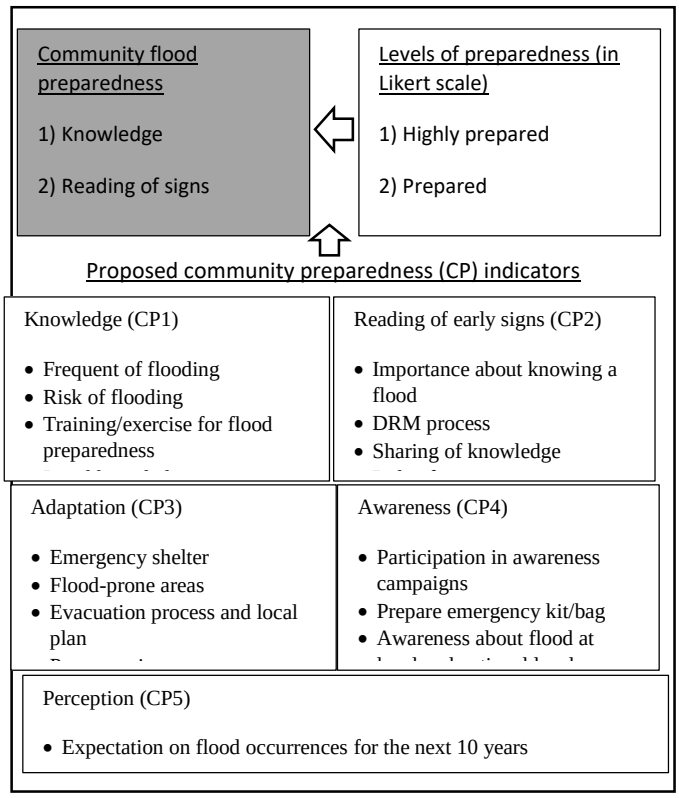

Fig. 1: Factors for community flood preparedness and assessment indicators.

Material and Methods

This study employed a quantitative research method which is a systematic approach utilised for collecting, analysing and interpreting numerical data[3]. To gather data, the researchers used a questionnaire that consisted of two main parts: socio-demographic profiling and flood awareness and preparedness. The instrument contains questions aligned with five main indicators (CP1-5): knowledge about floods, reading signs and flood preparedness, flood adaptation, awareness about floods and perception about floods. The questionnaire was administered to 50 respondents from Kg. Tok Deh, Kelantan State. Sample size was calculated as follows:

$$\text{Sample size} = \frac{\frac{z^2 \times p\,(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p\,(1-p)}{e^2 N}\right)}$$

where S represents the minimum sample size for this study, N = total population size, that is, the size of the segment or population for evaluation (180 people), e = margin of error that is permissible for the sampling of a population, z = confidence level that the population will choose answers within a given range and p = standard deviation (in this case, 0.5%).

$$S = \frac{\frac{1.65^2 \times 0.5\,(1-0.5)}{0.1^2}}{1+\left(\frac{1.65^2 \times 0.5\,(1-0.5)}{0.1^2\,180}\right)} = 50 \text{ respondents}$$

where N value is 80, e = 10%, z=1.65 and p=0.5

Study Area of Tok Deh Village, Kelantan State: In 2022, Kelantan was identified with 595 flood hotspots, the highest in Malaysia, by the Ministry of Environment and the Department of Irrigation and Drainage[10]. The major flood in 2014 and subsequent floods in 2022 cemented Kelantan's status as a high-risk area for floods, leading to significant socio-economic losses.

This research focuses on Kampung Tok Deh in the Rantau Panjang district of Pasir Mas, Kelantan (Fig. 2). With a population of 180 spread across 117 hectares, the village comprises of 98 houses. The village was selected because of its low-lying position near the Golok river, which acts as the Malaysia-Thailand border, making it prone to flooding during heavy rainfall. The area witnessed six major floods in 1926, 1962, 1971, 2004, 2014 and 2022. The household surveys were conducted between March and April 2023 with the consent of the village leader.

Results and Discussion

Respondent profile: Table 1 provides an overview of the demographic characteristics of the participants. The sample comprised of 56% male and 44% female respondents which suggested a slightly higher representation of men. Respondents were primarily between the ages of 31 and 40 (32%) and between 41 and 55 (34%), accounting for 66% of the total sample. The youngest age group, 19–30, accounted for 26% of the respondents while those over 56, accounted for only 8%. All survey respondents were Malay, indicating a homogeneous racial composition.

In terms of occupation, 50% of the respondents (50%) worked in the private sector while 26% were self-employed. Government employees make up 10% of the population while unemployed people make up 8% and non-governmental organisation workers make up 4%. The income distribution shows that the vast majority (88%) of respondents are in the B40 income group, earning less than RM4,849 per month, with only 6% earning between RM4,850 and RM10,959, classified as the M40 income group. This demographic profile reveals a predominantly lower-income Malay community with a sizable proportion working in the private sector or self-employment.

Community flood preparedness and assessment: Table 2 shows the various aspects of flood preparedness including knowledge (CP1), readiness (CP2), adaptation (CP3), awareness (CP4) and perception (CP5). This provides an evaluation of how well the community is prepared to face monsoon floods. These findings are critical for identifying the strengths and areas for improvement in community preparedness efforts.

Knowledge about Flood: The findings show that the community has a high level of knowledge about floods with many members knowing when floods typically occur (M = 3.82) and accepting that floods are unavoidable (M = 4.42). Furthermore, a large number of people have received relevant risk management training (M = 3.74). This high level of awareness and training demonstrates a proactive approach to flood preparedness that is critical for successful risk management. However, the relatively low mean attendance rate indicates the need for greater participation in such programmes.

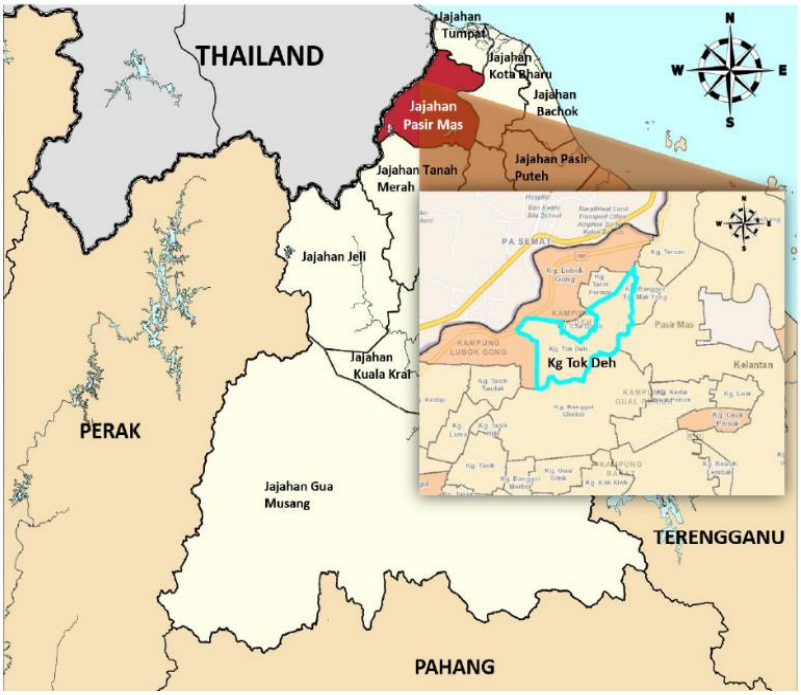

Fig. 2: Location of the study area of the Tok Deh settlement in Kelantan State.

Table 1
Respondent profile (n=50)

	%			%
Gender			***Occupation***	
Female	44		Self-employed	26
Male	56		Government employee	10
			Not employed	8
Age, years			Private sector	50
19-30	26		NGO	4
31-40	32			
41-55	34		***Income per month***	
>56	8		<RM4,849 (B40)	88
			RM4,850-RM10,959 (M40)	6
Race				
Malay	100			

Readiness and Preparedness of Flood: The community's flood readiness and preparedness can be seen in their very high confidence in Government post-flood support (M = 4.36 - 4.42) and the importance they place on sharing flood-related knowledge and experience (M = 4.42). These findings highlight the community's reliance on government support as well as its strong communication networks. Nonetheless, there is room for improvement in terms of access to expert knowledge (M = 3.62) as well as ensuring comprehensive training for all community members. Policymakers should prioritise increasing the dissemination of expert knowledge and ensuring that training programmes are accessible to all.

Adaptation to Flood: In terms of adaptation, the community was very much aware of shelters and evacuation centres (M = 4.44) and placed a high value on community-led disaster risk reduction activities. There was a high awareness of disaster-prone areas (M = 4.24) and the importance of coordinating with government offices following floods (M = 3.44). These high scores indicate a well-informed community that recognises the value of planning and coordination. However, personal preparedness, such as the development of flood-response equipment (M = 3.04), requires improvement. This suggests that while the community is aware and informed, there is a disconnect in translating awareness into personal action. Community-based programmes should be strengthened to promote the development of personal flood response equipment and increase individual preparedness.

Table 2
Community flood preparedness and assessment (n=50)

Items		Sample Mean (M)	Level of Preparedness
Knowledge about flood			
1.	I know when the usual flood will happen.	3.82	Prepared
2.	I know that floods cannot be avoided.	4.42	Highly prepared
3	I have attended risk management and management training or seminars.	3.74	Prepared
Readiness and preparedness for flood			
1.	I know the government is ready to help after the flood.	4.36	Highly prepared
2.	I know the importance of sharing knowledge and experience about floods.	4.42	Highly prepared
3.	I know the government will provide adequate facilities after the flood.	4.32	Highly prepared
4.	I believe that reconstruction activities can be implemented after the flood.	3.56	Prepared
5.	I realize the importance of conversations about floods with family members, relatives and neighbours.	4.10	Prepared
6.	I get enough knowledge about floods from experts who work or carry out activities for disaster risk reduction and management.	3.62	Prepared
Adaptation to flood			
1.	I am aware of the shelter or evacuation centre.	4.44	Highly prepared
2.	I know which government offices need to be coordinated after the flood.	3.44	Prepared
3.	I am informed about disaster-prone areas.	4.24	Highly prepared
4.	I get enough information about disaster adaptation from non-governmental organizations (NGOs).	3.48	Prepared
5.	I have knowledge of evacuation areas during disasters.	4.42	Highly prepared
6.	I know the importance of community activities for disaster risk reduction.	4.44	Highly prepared
7.	I am fully aware and informed about the transfer system and local plan.	3.68	Prepared
8.	I have developed/created my own equipment to deal with the coming flood.	3.04	Minimum preparation
Awareness of flood			
1.	I actively participate in disaster awareness campaigns.	3.52	Prepared
2.	I am aware of the importance of infrastructure construction or renovation.	3.68	Prepared
3.	I am prepared with an emergency kit and bag in case of disaster.	3.66	Prepared
4.	I have good relationships with my neighbours and community.	4.82	Highly prepared
5.	I give priority to disaster awareness at the local, regional and national levels.	3.50	Prepared
6.	I know flood recovery is important work.	4.52	Highly prepared
Perception of flood			
1.	I strongly believe that large-scale flooding will definitely occur within the next 10 years.	4.10	Prepared
2.	My place is safe from all kinds of disasters.	2.72	Minimum preparation
3.	I think my building is well-designed and strong in the event of a flood.	2.64	Minimum preparation
4.	I am confident that my bedroom is safe during the flood.	2.32	Not prepared

Awareness of Flood: Awareness campaigns and strong community relationships (M = 4.82) are critical to disaster preparedness, but there is room for improvement in disaster awareness campaign participation (M = 3.52) and infrastructure importance awareness (M = 3.68). High participation in community activities and strong relationships help to support collective flood response efforts, but more engagement in awareness campaigns is needed to ensure that all community members are adequately prepared.

Perception of Flood Risks: The community's perception of flood risks reveals a strong belief in the likelihood of large-scale flooding within the next decade (M = 4.10) but personal safety perceptions are significantly lower, with confidence in home and building safety moderate to low (M = 2.32 - 2.72). The disparity between knowledge and perceived safety emphasises the need for targeted interventions to improve individual preparedness and safety perceptions. Addressing these concerns necessitates not only improved physical infrastructure but also increased confidence through education and community involvement.

Conclusion

This study highlights the importance of a well-prepared community with a solid foundation of flood knowledge and readiness, particularly in terms of Government assistance and community activities. Nonetheless, it also identifies areas in need of improvement such as improving personal flood response capabilities, increasing access to expert knowledge and improving non-governmental organisation communication. The findings imply that despite the community's collective preparedness, individual preparedness, particularly in terms of personal safety and equipment development, requires more focus.

Policymakers and community leaders should prioritise comprehensive training programmes, infrastructure improvements and community-based initiatives to improve both individual and collective preparedness. Addressing these gaps through targeted interventions and additional research on personal safety perceptions will strengthen the community's resilience to monsoon flooding. Future research should look into the underlying causes of low personal safety perceptions and should assess the effectiveness of various strategies for increasing community readiness.

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