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Tackling Malaysia's Flood Management Challenges: Pathways to Resilience

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***Abstract*: Flooding has now become one of Malaysia's most intractable natural disasters, which is getting worse every year due to rapid urbanization, deforestation, and climate change. Apart from displacing the community, such disasters take a heavy toll on national resources and infrastructure. The 2014 Kelantan flood marked a critical turning point in evaluating Malaysia's flood management strategies—the catastrophe displaced more than 200,000 people and resulted in huge property damage. This incident, along with the floods that hit Kelantan and Terengganu in 2024, exposed systemic gaps in governance, technology adoption, and community preparedness in dealing with natural disasters. These gaps highlight the integrated and adaptive flood management approaches to address emerging challenges in the face of evolving problems [3], [5], [14]. This study examined Malaysia's flood management framework and reviewed the effectiveness of the structural and non-structural measures adopted to date, particularly in light of the major flooding events referred to above. Drawing from qualitative methods, including government reports, expert interviews, and academic literature, the study identifies some areas of improvement in policy enforcement, technological applications, and grassroots involvement [9]. Recommendations are concentrated on community participation, real-time data-driven systems, and updated infrastructure that can resist future disasters. These findings provide valuable recommendations to policymakers, urban planners, and disaster response organizations to make Malaysia more resilient and sustainable against flood hazards [4], [18].**

***Keywords*: Flood Management, Malaysia.**

1. Introduction

A. Background

Among all natural disasters that usually affect Malaysia, flooding can be highlighted as one of the most important; due to its tropical climate and northeast monsoon from November to March, the region receives sudden torrential rains. Historically, Malaysia had been hit by recurring floods whose scale and impact increased in intensity owing to the increase in climate variability and anthropogenic factors: urban sprawl and forest conversion [4]. The 2014 Kelantan floods, also known as the "Yellow Flood," destroyed much infrastructure, displaced more than 200,000 people, and caused an estimated RM 2 billion in damages [5]. In 2024, the floods in Kelantan and Terengganu affected over 90,000 residents and exposed new vulnerabilities of disaster preparedness and mitigation systems [14].

Figure 1 shows some major flood areas highlighted in Malaysia, including Kelantan, Terengganu, Johor, and Selangor. Each area falls into different categories of flood proneness due to the topographic and climate conditions, further worsened by urbanization and other factors such as climate change.

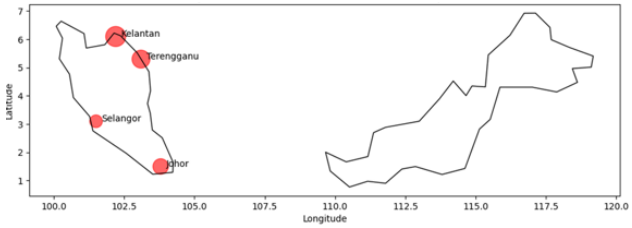

Fig. 1. Flood-prone areas in Malaysia
Source: Researcher's Own Compilation

It has been that cumulative processes of both natural and human-induced factors contribute to flood vulnerability in Malaysia. Urban areas, like Kuala Lumpur, are easily subject to flash flooding due to their ineffective drainage systems. Rural areas suffer from riverine flooding, while coastal flooding also threatens low-lying coastal states like Johor and Selangor. These different flood typologies require tailored holistic approaches in mitigation [3], [12].

B. Problem Statement

The flood management framework of Malaysia is still fraught with difficulties despite current efforts. Fragmented multi-agency governance creates inefficiency, and outdated infrastructure cannot sustain the volume of water brought by flood events [3], [18]. Apart from this, limited involvement of communities in disaster preparedness increases the

Table 1
Summary of impacts from the 2014 and 2024 floods

Event	Displacement (Persons)	Economic Loss (RM Billion)	Major Affected Areas
2014 Kelantan Flood	200,000	2.0	Kelantan
2024 Kelantan Flood	90,000	1.5	Kelantan, Terengganu

Source: Researcher's Own Compilation

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vulnerability of society through a lack of preparation to respond appropriately during emergencies [24]. The recurrence of such high-impact floods, most notably in 2014 and also again in 2024, exposes these systemic gaps and serves to reaffirm that a wholesale reevaluation of current policies and practices is sorely needed [14].

In addition, there is unpredictability in climatic change that has increased instances of heavy rainfall. These increase prevailing vulnerabilities and call for adaptive strategies with a view of future uncertainties too [8]. Such challenges therefore require integrated approaches incorporating structure-based approaches such as modern floodwalls to non-structure based approaches of policy reform to community-based initiatives.

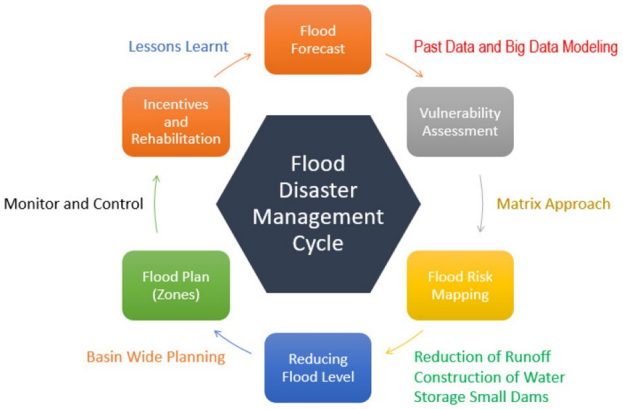

Fig. 2. Flood disaster management cycle framework
Source: Syed et al., Proposed Framework for the Flood Disaster Management Cycle in Malaysia

C. Research Objectives

The main objectives of the study are:

1. Assess the strengths and weaknesses of various structural and non-structural flood mitigation measures that have so far been implemented in Malaysia, drawing from experiences of the 2014 and 2024 floods [9], [14].
2. Identify gaps that are related to governance, policy frameworks, and enforcement mechanisms for effectively managing floods [3].
3. Understand the potential of emerging technologies—IoT-based early warning systems and GIS mapping—in improving flood forecasting and responses [19].
4. Propose actionable strategies for enhancing community resilience and preparedness to mitigate future flood risks [24].

D. Scope and Significance

This research concerns major flood events in Malaysia, such as the 2014 Kelantan flood and the Kelantan and Terengganu floods of 2024, while incorporating insights from other relevant events post-2014. The paper identifies recurring patterns through these case studies, assesses the effectiveness of current flood management strategies, and highlights areas that need urgent intervention.

The study is important because it can give practical, evidence-based recommendations to enhance Malaysia's flood resilience. These findings are useful for policymakers, urban planners, and disaster management practitioners, advocating for the integration of advanced technologies, sustainable infrastructure, and active community participation in addressing immediate and long-term flood risks [18]. This research contributes to a more sustainable and disaster-resilient Malaysia by bridging governance, technology, and social dimensions.

2. Literature Review

A. Flood Characteristics in Malaysia

Geographically and climatically, Malaysia is one of the most flood-prone countries in the world. In fact, three major types of floods have been reported to take place in Malaysia due to various environmental and artificial causes:

1) Riverine Flooding

In most instances, this occurs during the northeast monsoon seasons and is a concern for states like Kelantan and Terengganu due to overflow from rivers such as the Kelantan River [11]. The destructive nature of this kind of flood—displacing thousands of people and causing unprecedented damage—is highlighted by historical events such as the 2014 and 2024 Kelantan floods [14].

2) Flash Floods

These usually occur in urbanized areas such as Kuala Lumpur and Selangor due to inadequate drainage systems that fail to handle high-intensity rainfall in a short time. Flash floods disrupt traffic and business activities, highlighting the immediate need for urban planning solutions [12].

3) Coastal Flooding

Low-lying coastal areas, such as those in Johor and Perak, face frequent threats from rising sea levels and storm surges. Coastal flooding poses a long-term risk, particularly as climate change accelerates sea-level rise and increases the frequency of extreme weather events [13].

B. Recent Flood Events and Their Implications

1) 2014 Kelantan Flood

Also known as the "Yellow Flood," the sediment-rich water flows during the 2014 Kelantan flood are considered one of the most disastrous catastrophes in Malaysia's history. The flood displaced more than 200,000 people and caused property damage with losses amounting to over RM 2 billion [5]. The event revealed serious lapses in the national flood management system, including delays in responding to emergencies and a lack of community preparedness [3].

Figure 3 represents the inundated areas in Malaysia, presented on the basis of flood frequency.

2) 2024 Kelantan and Terengganu Floods

Over 90,000 people were displaced due to inundated infrastructure, including roads and fallen buildings [14]. Such phenomena emphasize the need to enhance the efficiency of aging floodwalls, upgrade relevant technologies, and improve early warning policy measures [18].

Table 2
Structural vs. Non-structural flood measures

Type of Measure	Examples
Structural Measures	Floodwalls, Levees, Retention Ponds, Dams
Non-Structural Measures	Early Warning Systems, Land Use Planning, Public Awareness Campaigns, Community Engagement

Sources: Researcher's Own Compilation

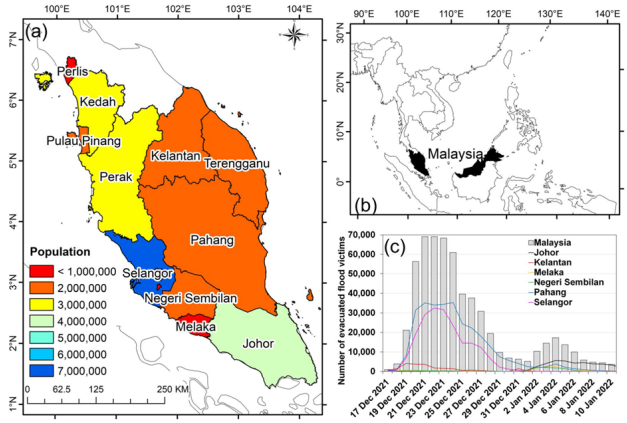

Fig. 3. Framework (RETRACE): Initial testing for the 2021–2022 Malaysia flood
Source: Yi et al., Rapid Extreme Tropical Precipitation and Flood Inundation Mapping

3) 2024 Kelantan and Terengganu Floods

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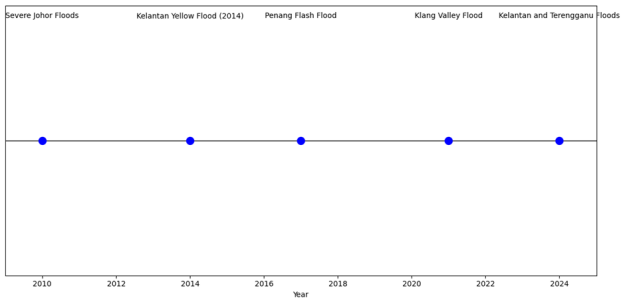

Fig. 4. Timeline of major flood events
Source: Researcher's Own Compilation

C. Flood Control: Current Situation

1) Structural Measures

Structural measures aim to mitigate flood impacts through engineered solutions. While effective to some extent, they often fall short under extreme conditions:

- *Floodwalls and Levees*
  Critical in urban centers, these structures protect against moderate flood levels but fail when maintenance is inadequate or floodwaters exceed design capacity [19].
- *Retention Ponds*
  Serving the purpose of managing urban runoff, retention ponds delay the discharge of water into the drainage systems. However, in highly urbanized areas where runoff exceeds storage capacity, their effectiveness is reduced [20].

2) Non-Structural Measures

Non-structural measures supplement physical defenses through preparedness and planning:

- *Early Warning Systems*
  Although Malaysia has enhanced its flood warning systems, timeliness and accuracy are still inconsistent, as seen during the 2024 floods [20].
- *Land Use Planning*
  While policies exist to limit developments in flood-prone areas, enforcement is generally poor, adding to urban vulnerability [23].
- *Public Awareness Campaigns*
  Community-based engagement programs are important in building preparedness. However, such initiatives have limited coverage and cannot bring widespread behavioral change, particularly in rural areas [18].

3) Gaps in Flood Management

The floods of 2014 and 2024 reflected systemic deficiencies in governance, infrastructure, and community engagement:

- *Fragmented Governance*
  Overlapping roles among agencies lead to inefficiency in disaster responses and resource allocation [24].
- *Aging Infrastructure*
  Most flood control systems are outdated, making them less reliable during extreme weather events [25].
- *Underutilization of Technology*
  Emerging tools like GIS and IoT for real-time monitoring and flood forecasting are still in their nascent stage in Malaysia [26].
- *Low Community Involvement*
  Inadequate involvement of the public in risk assessment and preparedness reduces resilience at the societal level [27].

3. Methodology

A. Research Design

This paper adopts a qualitative approach to assess the challenges and effectiveness of flood management strategies in Malaysia. The methodology has been developed based on case study analysis of the 2014 Kelantan flood and the 2024 Kelantan and Terengganu floods, together with a review of government policies and scholarly research. By synthesizing insights from multiple sources, this study attempts to provide a comprehensive understanding of the gaps and opportunities that exist within Malaysia's flood management framework [4].

B. Data Collection

Data for this research were gathered from the following three key sources:

1) Government Reports

Various reports on the agencies' policies regarding flood management and their implementations were drawn from agencies like NADMA and DID. These provided a detailed account of the policies for flood management and their execution [9].

2) Academic Literature

Relevant peer-reviewed research studies on flood impacts, mitigation strategies, and climate change implications in Malaysia were used to develop the theoretical framework for this study [6].

3) Expert Interviews

In-depth interviews with disaster management practitioners, urban planners, and community leaders provided real-life scenarios of the issues encountered during significant flooding incidents, including the 2014 and 2024 floods [15].

C. Analytical Framework

The study uses the Integrated Flood Management (IFM) framework to assess Malaysia's policies. According to this approach, water management, disaster risk reduction, and sustainable development should be closely interlinked. The main assessment criteria include:

- *Effectiveness*
  The degree to which the available measures reduce flood impacts.
- *Efficiency*
  Resource use and cost efficiency of flood management programs.
- *Sustainability*
  Long-term viability of structural and non-structural measures [7].

D. Tools and Techniques

- *GIS Mapping*
  Geographic Information Systems were utilized to study areas prone to flooding, including the visual mapping of the extent of the 2014 and 2024 floods, for assessing the adequacy of flood mitigation infrastructure [12].
- *Comparative Case Analysis*
  A parallel comparison between the 2014 and 2024 floods shed light on how challenges have evolved and improved response practices in flood management issues [14].
- *Policy Review*
  Review of current policies, including Malaysia's National Water Resources Policy and Directive No. 20, to outline gaps in governance and enforcement aspects [9].

E. Scope and Limitations

The scope of this study is confined to the analysis of the 2014 Kelantan flood, the 2024 Kelantan and Terengganu floods, and relevant events that occurred post-2014. While the findings are valuable for understanding Malaysia's flood management challenges, limitations include:

- Reliance on secondary data for certain aspects of policy evaluation.
- Lack of real-time data from specific flood-prone regions [16].

Future research could benefit from incorporating quantitative data and advanced hydrological modeling to supplement qualitative findings [18].

4. Results and Discussion

A. Effectiveness of Existing Flood Management Practices

Malaysia adopts a combination of structural and non-structural measures in managing its floods. However, an examination of the 2014 Kelantan flood and the Kelantan and Terengganu floods of 2024 reveals significant deficiencies that render these measures ineffective in extreme weather conditions.

B. Structural Measures

1) Floodwalls and Levees

Floodwalls and levees are primary protection mechanisms against riverine flooding in urban and semi-urban areas. These structures provided partial protection during the 2014 Kelantan flood but failed to contain water levels as rainfall exceeded historical records. During the 2024 floods, several levees along the Kelantan River were overtopped, causing widespread inundation of nearby settlements, schools, and health facilities [14]. Critical weaknesses included insufficient height and lack of regular maintenance. Additionally, many floodwalls were not well integrated into larger drainage systems, leading to backflow problems in urban areas [12].

2) Retention Ponds and Urban Drainage Systems

Retention ponds, designed to handle runoff from urban areas, have helped lessen flash flooding in cities like Kuala Lumpur and Johor Bahru. However, these facilities are typically undersized for extreme events. For instance, rapid urbanization in Klang Valley has dramatically increased impervious surfaces, exceeding the capacity of existing drainage and retention systems [15]. The 2024 Kelantan floods also demonstrated the need for retention infrastructure in rural areas, as floodwaters overflowed onto roads and farmlands, crippling supply chains and economic activities for weeks.

3) Dam Infrastructure

Dams play a dual role in Malaysia's flood mitigation infrastructure, balancing water supply for irrigation and flood control. During the 2014 floods, inadequate protocols for

Table 3
Comparison of structural measures effectiveness

Measure	Strengths	Weaknesses	Key Locations
Floodwalls and Levees	Localized flood protection	Limited capacity; overtopping risk	Kelantan, Kuala Lumpur
Retention Ponds	Urban runoff management	Capacity limits in dense urban areas	Klang Valley, Johor Bahru

Source: Researcher's Own Compilation

coordinated dam releases exacerbated downstream flooding in Kelantan [9]. By 2024, some improvements had been implemented, but real-time coordination among dam operators remained a critical issue.

C. Non-Structural Measures

1) Early Warning Systems

While Malaysia has made progress in implementing early warning systems, these systems were found lacking during both the 2014 and 2024 floods. For example, the Malaysian Meteorological Department issued warnings days in advance during the 2024 floods. However, delays in disseminating these warnings hindered timely evacuations, especially in rural Kelantan [3]. The reliance on regional predictions rather than localized data often led to inaccurate risk assessments. Improved use of IoT and AI-driven models could enhance forecasting precision [18].

2) Land Use and Zoning Policies

Land use planning remains a contentious issue in Malaysia's flood management framework. Encroachment on floodplains, particularly along the Kelantan River, has significantly increased vulnerability to floods. Despite zoning regulations, housing projects and agricultural expansion continue unabated. Policy revisions after 2014 aimed at restricting such practices were poorly implemented, resulting in similar patterns of encroachment and damages during the 2024 floods [6].

3) Public Awareness and Education

Public awareness of flood preparedness remains uneven. While urban residents in cities like Kuala Lumpur and Penang demonstrated greater awareness of evacuation routes and safety measures, rural communities in Kelantan and Terengganu were poorly prepared. Delays by residents in evacuating these rural areas have caused unnecessary casualties during the 2024 floods. Above all, urgent community-based education programs need to be planned, especially for flood-prone rural areas [16].

4) Governance and Institutional Challenges

The Malaysian governance of flood involves fragmented roles by agencies such as NADMA, DID, and local authorities. This lack of a clear leading agency results in inefficiencies and waste of resources. For example, mobilization during the relief of the 2014 flood was hampered because of communication breakdowns at federal and state agency levels [4].

Similarly, the 2024 floods have shown identical governance gaps; for instance, local authorities in Terengganu have expressed that they are not getting enough funding and technical support from national agencies. Unclear agency roles and inconsistent data sharing further impeded the recovery process. A clear mandate and coordination mechanism of a central flood management authority may help resolve these issues 9.

5) Community Involvement and Preparedness

Community participation is essential to improve resilience against flood hazards; however, Malaysia's current approach to resilience remains top-down, with grassroots input at a minimum. Indeed, during the 2014 Kelantan flood, spontaneous community-led initiatives were extremely valuable in providing immediate assistance and support, especially in many areas that were inaccessible to the official rescue teams. Similar patterns occurred during 2024 when unorganized volunteer networks organized evacuation and relief efforts in Terengganu. Institutionalization of the community-based disaster risk management programs, training, drills, and resource allocation may significantly strengthen grassroots preparedness [10].

D. Climate Change Impacts

Climate change has greatly increased the frequency and intensity of floods in Malaysia. For one, the rise in sea levels is very threatening to the coastal states, while variability in rainfall increases riverine and flash flooding. In the 2024 floods, the prolonged monsoon rains were partly intensified by climate change that saw record-high river levels in Kelantan [14].

Projections indicate that flood risk will increase significantly by 2050, with extreme inundation expected in low-lying areas such as Selangor and Penang without sufficient mitigation. Current strategies of flood management, with short-term interventions, are ill-equipped to deal with the challenge of long-term management. Nature-based solutions-mangrove restoration and wetland conservation-offer sustainable options for conventional flood defenses [20].

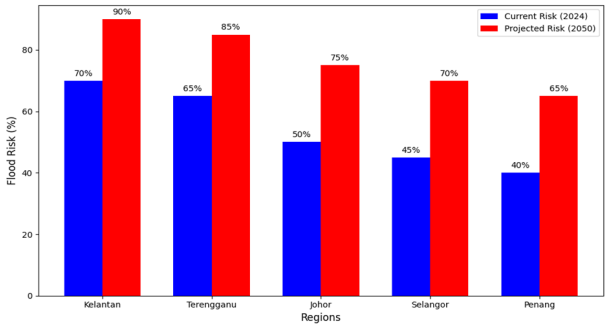

Fig. 5. Projected flood risk under climate change scenarios (2050)
Source: Researcher's Own Compilation

E. Technological Integration in Flood Management

Technological tools like Geographic Information Systems (GIS), IoT-based monitoring systems, and AI-driven predictive models have the potential to transform flood forecasting and mitigation. GIS mapping can enhance zoning policies, while IoT sensors provide real-time data on river levels, rainfall, and dam operations.

During the 2024 floods, pilot projects using IoT devices in Selangor demonstrated their effectiveness in delivering localized flood warnings. Scaling up such initiatives nationwide could significantly enhance Malaysia's disaster readiness. However, widespread adoption of these technologies is

Table 4
Technological gaps in flood forecasting

Technology	Current Use	Potential Improvements	Example Applications
GIS	Basic mapping	Real-time flood zone updates	Land use planning
IoT Sensors	Limited pilots	Nationwide deployment for monitoring	River level tracking

Source: Researcher's Own Compilation

hindered by funding constraints and a lack of technical expertise [19].

F. Recommendations

The findings from this study have identified various areas for improvement in Malaysia's flood management framework. The following recommendations address the identified challenges and aim to enhance Malaysia's resilience to flooding.

1) Establishment of a Centralized Flood Management Authority

The current fragmented governance structure is inefficient in disaster response and policy implementation. A centralized authority within the National Disaster Management Agency (NADMA) should coordinate flood management across federal, state, and local levels, ensuring resource allocation, communication, and policy implementation with full accountability [9].

Key Activities:

- Develop an integrated database for real-time data sharing among agencies.
- Align federal and state flood mitigation plans to eliminate duplication of efforts [4].
- Standardize emergency response and recovery practices nationwide.

2) Enhancing and Expanding Structural Measures

Flood defense structures, such as floodwalls, levees, and retention ponds, urgently require upgrades to handle increasing rainfall intensities and urbanization. Adaptive designs are essential to ensure functionality under evolving climate conditions.

Critical Tasks:

- Increase the height and capacity of floodwalls and levees in vulnerable areas, such as Kelantan and Kuala Lumpur [12].
- Construct additional retention ponds in urban regions prone to flash floods, like Klang Valley [15].
- Upgrade dam systems with real-time coordination mechanisms for water release during peak rainfall events [17].

3) Utilization of Advanced Technologies for Flood Forecasting and Monitoring

The integration of technologies like GIS, IoT sensors, and AI can improve the accuracy of flood forecasting and disaster response.

Key Activities:

- Deploy IoT devices along major rivers to monitor water levels, rainfall, and sediment flow in real time [19].
- Leverage AI-driven predictive models for localized and precise flood warnings [14].
- Prepare flood risk maps using GIS to inform land use planning and emergency preparedness [7].

4) Enhance Land Use Planning and Enforcement

Revised land use policies and strict enforcement of zoning laws are essential for effective flood risk management, particularly in urbanizing regions.

Key Actions:

- Conduct detailed land use assessments to identify high-risk zones and allocate resources accordingly [6].
- Provide incentives for businesses and communities to relocate from vulnerable areas [11].
- Strengthen penalties against non-compliance with zoning regulations to deter illegal construction [9].

5) Institutionalize Community-Based Disaster Risk Management

Empowering communities to actively participate in disaster preparedness and response is crucial for building resilience.

Key Actions:

- Establish disaster management committees at the village level to develop and coordinate evacuation plans [10].
- Conduct regular training programs and drills to enhance community preparedness [18].
- Provide financial and logistical support to grassroots organizations involved in flood response and recovery [5].

6) Adopt Nature-Based Solutions

Nature-based approaches, such as mangrove restoration and wetland conservation, provide sustainable alternatives to conventional flood defenses.

Key Actions:

- Restore mangroves along coastlines to reduce storm surge impacts and mitigate coastal flooding [20].
- Rehabilitate wetlands to absorb excess rainfall and reduce heavy storm impacts [13].
- Incorporate green infrastructure, such as permeable pavements and urban greenery, into city planning to manage stormwater effectively [12].

7) Improved Public Awareness and Education

Escalating public awareness campaigns can enhance preparedness among urban and rural communities, considering their distinct vulnerabilities.

Key Activities:

- Launch targeted campaigns via social media, local radio, and schools to communicate evacuation procedures and safety measures [16].
- Develop educational materials in multiple languages for inclusivity [3].
- Partner with NGOs to extend preparedness resources to remote and underserved communities [9].

Table 5
Recommended actions for governance improvement

Challenge	Recommended Action	Stakeholder(s) Involved
Fragmented Governance	Establish centralized flood management body	NADMA, local authorities
Delayed Resource Allocation	Develop integrated data-sharing platforms	Federal/state agencies

Source: Researcher's Own Compilation

Table 6

Recommendation	Intended Outcome	Stakeholders Involved
Centralized Flood Management Authority	Improved coordination and policy implementation	NADMA, federal/state/local governments
Enhanced Structural Measures	Increased resilience of flood defense systems	DID, urban planners, construction firms
Advanced Technologies for Flood Monitoring	Precise flood forecasts and timely responses	Tech firms, NADMA, local authorities
Strengthened Land Use Planning	Reduced encroachment on flood-prone areas	Government agencies, businesses, communities
Community-Based Risk Management	Improved grassroots disaster preparedness	Local communities, NGOs, disaster agencies
Nature-Based Solutions	Sustainable flood mitigation strategies	Environmental groups, urban planners
Public Awareness Campaigns	Increased public knowledge and readiness	NGOs, media, local governments
Sustainable Funding	Long-term investments in flood resilience	Government, private sector, international bodies

8) Sustainable Funding for Flood Mitigation

A dedicated funding mechanism is essential for long-term investments in flood management infrastructure and programs, involving government, private sector stakeholders, and international organizations.

Key Activities:

- Establish a national flood resilience fund to finance infrastructure upgrades, technology adoption, and community programs [4].
- Explore public-private partnerships to share the financial burden of large-scale flood mitigation projects [18].
- Seek technical and financial support from international agencies, such as the World Bank and United Nations, for climate adaptation initiatives [9].

G. Summary of Recommendations

The table 6 summarizes the key recommendations, their intended outcomes, and the stakeholders involved:

5. Conclusion

Flooding is one of the most critical natural disasters that has continuously caused widespread devastation to property and life, economic loss, and disruption to livelihoods in Malaysia. The frequency and intensity of floods have increased over the years, driven by rapid urbanization, deforestation, and climate change. This paper, focusing on the 2014 Kelantan flood and the 2024 Kelantan and Terengganu floods, has highlighted systemic weaknesses in Malaysia's flood management strategies and proposed ways to address these challenges.

The 2014 Kelantan flood, often described as one of the worst in the nation's history, displaced over 200,000 individuals and caused extensive damage to infrastructure, homes, and livelihoods. Similar patterns of disregard for flood mitigation repeated during the 2024 floods, showing that most lessons from 2014 were poorly addressed. The 2024 flood has exposed the weakness in governance, infrastructure, and community resilience, displacing over 90,000 residents, besides massive public health concerns due to waterborne diseases. These incidents underline the dire need for an integrated approach to flood management, balancing short-term responses with sustainability in the long term.

The results of this research show that, while Malaysia has made efforts in the field of flood defense systems with levees, floodwalls, and retention ponds, these are often insufficient under extreme conditions. Structural defenses frequently fail due to inadequate maintenance, capacity limitations, or outdated designs, as was also seen during the 2024 floods. Non-structural measures, such as early warning systems and land use policies, show promise but are plagued by weak enforcement, lack of localized implementation, and a general lack of integration of advanced technologies. Governance and Coordination Challenges

Fragmented governance is one of the most important issues brought to light in this study. Poor coordination among agencies such as NADMA, DID, and local governments leads to inefficiencies in policy implementation and resource allocation. Due to the absence of a single authority governing flood management, Malaysia cannot respond appropriately in emergency situations or plan well for long-term mitigation.

A. Role of Community Involvement

Another key area for improvement is community involvement. Grassroots efforts were central in evacuation and relief following the 2014 and 2024 floods but are generally ad hoc and unsupported. Community involvement could be institutionalized through training, education, and disaster preparedness to greatly strengthen societal resilience. Public awareness campaigns, appropriate to the specific local context, may help to empower the most vulnerable segments of society with knowledge and tools that can be valuable in responding to emergencies.

B. Climate Change Impacts

Climate change has accentuated flood management challenges, which include highly unpredictable and extreme weather patterns. Urban and rural areas are increasingly at risk from rising sea levels, heavier rainfall, and extended monsoon seasons. These long-term climate-induced risks are inadequately met by mitigation strategies that remain essentially oriented toward immediate responses. Nature-based solutions complement the structural defense system with options like restoration of mangroves and conservation of wetlands, therefore reducing the environmental impacts of the traditional infrastructure projects.

C. Recommendations and the Way Forward

The recommendations in this study give the way forward in addressing flood management in Malaysia. A centralized flood management authority would ensure smooth coordination and accountability. Advanced technologies, such as GIS, IoT sensors, and AI models, could be used to improve the accuracy of flood forecasting and real-time monitoring. Land use policy enforcement, infrastructure upgrade, and institutionalization of community-based disaster risk management are all vital in reducing vulnerabilities and enhancing preparedness.

To realize these, sustainable funding mechanisms are paramount. A national fund for flood resilience may support

large-scale infrastructure upgrades, community programs, and technological advancement through public-private partnerships and international collaborations. This will ensure equity in resource distribution so that no one is left behind in the processes, from urban to rural disparities.

In conclusion, the approach towards flood management in Malaysia needs a paradigm shift from the present reactive responses to proactive, integrated strategies. This will require balanced structural and non-structural measures, strengthened governance, and community participation for Malaysia to build resilience in preparation for the next flood. The floods of 2014 and 2024 have taught lessons that offer opportunities for reassessment and reshaping by the nation in its quest to manage disasters. By acting in unison at all levels of society and governance, Malaysia has the opportunity to reduce vulnerability to the increasing threats from climate-induced flooding.

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