

Flood Resilience in Malaysian Housing: A Critical Review and Proposed Planning Law Framework

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ABSTRACT

The country is now facing a serious challenge which is frequent floods and in areas that have never been hit by such disasters. Before development order of a housing estates could be granted, the housing developers must comply with few laws through various federal and states' legislations to ensure the sustainable development of the housing estates which will not bring negative impact to the environment, public and residents. Assuming all the procedures have been complied strictly, there should not be an issue of flood and its disaster. The problem that arises is why are there still many housing estates that have been given legal approval for development still affected by flood issue? Thus, the researchers employ a legal research approach, where the researchers examined available primary data from available statutes. Literally, the researchers have also been using secondary sources by using library based and online research for example publication of primary literatures while qualitative research methodology is used to do in-depth research on the issue. The Malaysian government has implemented several laws and policies aimed at preventing and mitigating the impacts of floods. However, despite the existing legal framework, Malaysia continues to face significant challenges in preventing and mitigating floods, including urbanisation and land use, climate change and inter-agency coordination. Urban flooding can lead to significant economic losses and displacement, challenging the sustainability of cities. While the existing laws provide a sturdy foundation, challenges such as urbanisation, climate change, and inter-agency coordination need to be addressed to improve the country's resilience to floods. By strengthening regulations, improving coordination between agencies, and raising public awareness, Malaysia can better mitigate the risks and impacts of floods, safeguarding its population and economic stability.

1. Introduction

Malaysia is one of the countries in the world that receives the highest number of rains as state in Diagram 1 below shows average rainfall in Malaysia for the year 2020 to 2022.

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Fig. 1. Average rainfall in Malaysia for the year 2020 to 2022
 Source: Malaysian Meteorological Department

Before development order of a housing estates could be granted, the housing developers must comply with few laws through various federal and states’ legislations to ensure the sustainable development of the housing estates which will not bring negative impact to the environment, public and residents. Assuming all the procedures have been complied strictly, there should not be an issue of flood and its disaster. The problem that arises is why are there still many housing estates that have been given legal approval for development still affected by flood issue? According to research done by Bank Negara Malaysia, climate change may cause flooding episodes in Malaysia to become more severe. A flood that occurs once every 20 years by 2030 would wipe out as much as 4.1% of Malaysia’s GDP, highlighting the financial dangers connected to these natural disasters [1].

Malaysia is now facing a significant challenge which is frequent floods and floods in areas that have never been hit by such disasters, said Director General of National Security Datuk Raja Nurshirwan Zainal Abidin [2]. He said that currently the rate and intensity of flooding is increasing, and the number of disaster days is also increasing in several states, such as Selangor, Johor and Melaka. Floods caused many losses to human beings as shown in figure 2 below.

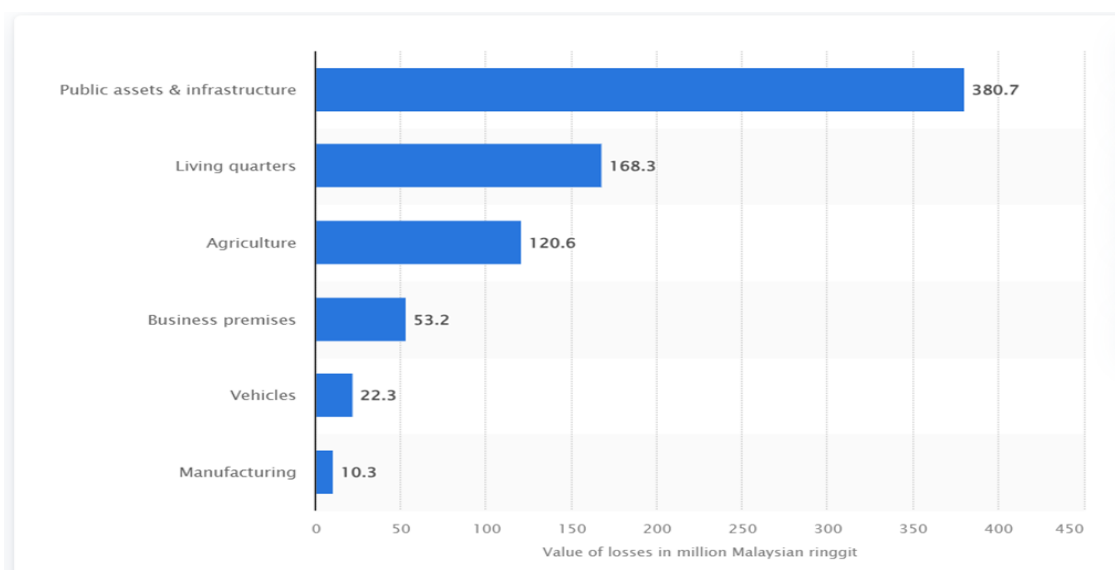


Fig. 2. Value of financial losses caused by flood in Malaysia in 2023, by category.
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Romali and Yusof [3] found that flood risk in Malaysia is a multifaceted challenge, with the country experiencing recurring inundations that often result in substantial economic and social disruptions. A study by Nurfashareena and Husna [4] discovered that identified flood occurrences in Selangor from 2012 to 2021 were nearly 150 flood events, with a notable spike in incidents around the Selangor Great Flood. Rahman [5] also found that major floods have occurred repeatedly in several Malaysian states, nearly paralysing governmental operations. Thus, the objective of this research is to study the essential laws to regulate measures for prevention and preparation for the floods in Malaysia and to study the method to compel state and local governments to follow federal policy on flood prevention and preparation for the floods in Malaysia and to what extent the existing laws for prevention and preparation for the floods in Malaysia can be improved. Chan [6] found that it is time for a drastic shift to a more people-friendly "horizontal" or "bottom-up" strategy to flood catastrophe management in Malaysia, which has historically placed too much emphasis on a top-down, government-centric approach. To become more resilient, people—especially those affected by disasters—need to be empowered and involved. Otherwise, they will continue to rely heavily on government assistance, which is not what the Malaysian government desires.

2. Methodology

The researchers employ a legal research approach, where the researchers examined available primary data from available statutes. Literally, the researchers have also be using secondary sources by using library based and online research for example publication of primary literatures. The researchers adopted qualitative research methodology too to do in-depth research on this issue by studying geographic proximity, to study the legal phenomenon and focuses on obtaining data through open-ended and conversational communication. Further thereto, the relevant empirical data and/or case studies pertaining to the issue have been reviewed too in order to generalise the relevant findings and assess the real-world applicability of the proposed framework.

3. Problem Statements

3.1 Inadequacy of the Separate Constitutional Authorities Possessed by the Federal Government Agencies and the States' Agencies in Approving Housing Development Projects

Department of Irrigation and Drainage ('JPS') which is currently under purview of Ministry of Natural Resources, Environment and Climate Change and a federal agency will adopt the policies against floods in housing estates set by the federal government. However, these policies against floods may not be adopted by the states' agencies as they are not binding policies. For example, the JPS, may require the housing developers to provide certain retention ponds at every housing unit, but this may not be required for the issuance of Planning Permission and Certificate of Completion and Compliance ('CCC') by the local planning authority as the local planning authority is an agency of the state government only. The CCC can only be issued when all parties concerned are satisfied that the building construction have been supervised and completed full compliance with the provisions of the law and technical conditions in approving the Planning Permission and Building Plan. As such, the policies imposed by the federal agencies will not bind the states' agencies. Certain articles in the Federal Constitution on making uniform laws on local government (Art 76(4)) and town planning (Art 94(3)) may be relevant.

Meanwhile, inefficient coordination among government agencies responsible for flood mitigation can lead to a lack of synchronised action, delaying the implementation of effective

solutions, which may be attributed to inadequate planning, deficient infrastructure development, and insufficient information sharing.

Additionally, *Syed et al.*, [7] are of the view that many housing developers have also ignored the issue of sustainability but rather focus on their profit only. *Desa* [8] also mentioned that although flood risk management does not directly fall under any of the 17 Sustainable Development Goals (SDGs) from the United Nations' 2030 Agenda for Sustainable Development, it does span several of the SDGs related to water management, resilient infrastructure, climate change, sustainable cities and communities, and sustainable use of terrestrial ecosystems.

3.2 There is a Lacuna in the Planning Law that has Contributed to Flooding Occurrences in Housing Areas

Only official housing buildings are subject to the numerous rules and standards that govern housing provisions in Malaysia. In many states, a large number of housing units, mostly villages that were constructed outside of these regulations and guidelines have been labeled as 'informal housing'. Therefore, it should come as no surprise that many of the homes damaged by the water were destroyed.

In Malaysia, the principal statute to regulate town and country planning, including the preparation of development plans is the Town and Country Planning Act 1976 (Act 172). However, other statutes such as Housing Development (Control & Licensing) Act 1966 (Act 118), City of Kuala Lumpur (Planning) Act 1973, Environment Quality Act 1974 (Act 127), Federal Constitution, and National Land Code 1965 would be relevant too. Recently Kuala Lumpur City Hall (DBKL) announced 14 interim measures to fight flash floods as Kuala Lumpur city centre was attacked by flash floods [9]. The government is considering building more SMART tunnels in major cities, such as Shah Alam, putting the bill at more than RM300 billion for long-term flood-mitigation [10]. Although currently there are many relevant laws in housing development, there are many lacunae about the floods issue. For example, there is no mandatory provision in the Town and Country Planning Act 1976 (Act 172), the States' Planning Control Rules and the planning guidelines of the local planning authority in dealing with applications for planning permission to refer to the relevant technical agencies for comments and views for instance views in the face of flood disasters. Meanwhile, the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 (PU (A) 362/87) does not require the housing developer to provide an Environmental Impact Assessment report ('EIA') if the housing development project covers less than 50 hectares in area. This would result that any development in the land less than 50 hectares in area will not comply with the environment safety requirement. Despite section 22(2)(a) of the Town and Country Planning 1976 (Act 172), which requires the local planning authority to comply with the development plans (local and structure plans), if any, in considering applications for planning permission, the development plans need not be followed in a servile or submissive manner.

4. Literature Reviews

4.1 Adequacy Authorities between Agencies

Flood risk management in Malaysia is a top-down government approach that requires shared responsibility in between government agencies. However, *Ashikin, Nakamura, Yasmin* raised the concern about the issues and challenges faced by the relevant agencies is a neglected area of research [11]. In Malaysia, management of flood risks is regulated by Directive No. 20 under the auspices of the National Disaster Management Agency (NADMA). NADMA took over the

responsibility from the National Security Council (NSC) on 1st October 2015 and they consolidated NSC's Disaster Management Division, Post Flood Recovery Unit of the Prime Minister's Department and the Special Malaysia Disaster Assistance and Rescue Team (SMART) [12]. Flood is categorised as 'disaster' in Directive No. 20 and every government agency which is involved in the disaster must act according to the guidelines and instructions written in the Directive No. 20.

As stated in Directive No. 20, flood risk management requires coordination, corporation, and commitment between flood-related agencies. However, Beanmon [13] was of the view that the coordination of supply between agencies involved in disaster relief is challenging. Meanwhile, Shahid, Xinhai *et al.*, [14] argued that inter-agency coordination challenges during disasters are a well-known area, but a neglected area of research. According to Salmon *et al.*, [15], the challenges of disaster agencies are due to unpredictable outcomes, massive causalities, shortages of resources, lingering side effects, disruption of public service, collapsed infrastructures, enormous time pressures, high stakes, highly interdependent tasks, and communication breakdowns.

A study by Chong and Kamarudin [16], identified three main challenges faced by disaster agencies in Malaysia. The challenges are unproportioned disaster management planning between top-down and bottom-up approaches, lack of coordination in the entire disaster management cycle and a greater focus on the disaster emergency response stage, and insufficient planning for a long-term recovery (post-disaster) process that results in lack of community and stakeholder resilience towards disasters.

4.2 Limited Authorities and Lack of Enforcement Power

The Department of Irrigation and Drainage Malaysia (DID) is the main agency responsible for flood management in Malaysia under the Ministerial Functions Act 1969 (amendment 2008) P.U. (A) 170. However, DID has limited authority and enforcement power to manage the flood risk management. Every development in Malaysia must get Planning Permission (Kebenaran Merancang) before the developer can start any new development [17].

NADMA works at a federal level for disaster management, and they have overall responsibility for the implementation of Directive No. 20 which they will work closely with other flood-related agencies. However, as stated by Elias *et al.*, [18] and Yusoff *et al.*, [19], Directive No. 20 is just a paper document that provides guidelines on disaster management and does not include comprehensive flood risk management. There is no specific law for NADMA to influence flood risk management too.

Many individuals' property is at danger from flooding, yet according to World Resources Institute [20], the current framework speculations can fundamentally bring down flood hazards. In this respect, Nuarrual [21] commented that the local planning authority and the State Planning Committee may provide ad hoc planning, not restricted to the un gazetted development of local plans.

4.3 Case studies in the Kampung Baru, Kuala Lumpur

Approximately 19,000 people live in Kampung Baru, a historic Malay agricultural settlement that spans 100 hectares with more than a century. Despite having seen the city grow and currently facing redevelopment pressure, this region nevertheless has a distinctive building style that preserves the traits of both traditional Malay architecture and the ethnic Malay way of life. Due to geographical location, Kampung Baru is vulnerable to flash floods and river flooding, in part because of its inadequate drainage system. The existing drainage system in Kampung Baru is outdated and insufficient to handle heavy rainfall, leading to rapid water accumulation and overflowing drains. For

example, a major flood event in December 2021 caused widespread damage in Kampung Baru, highlighting the vulnerability of the area to extreme weather events.

One of the relevant laws to overcome the above issue is Street, Drainage and Building Act 1974 (Act 133) which regulates the construction and maintenance of drainage systems, including the responsibility of local authorities to ensure adequate drainage capacity and prevent obstructions. Meanwhile, National Water Services Commission Act 2006 (Act 655) which governs water resource management and includes provisions for flood control and mitigation would be relevant too. It mandates the relevant authorities to implement flood mitigation measures and ensure the proper maintenance of drainage systems. However, the effectiveness of these laws depends on their proper enforcement by relevant authorities, including the Department of Irrigation and Drainage (DID), local councils, and NADMA. Lack of adequate enforcement can lead to non-compliance with regulations, contributing to flood risks.

The recurring flooding in Kampung Baru highlights the importance of a robust legal framework and its effective implementation to address urban flooding. By strengthening enforcement, improving coordination, and promoting public awareness, we can ensure the compliance of relevant laws and regulations, leading to better flood mitigation and protection of the community.

5. Findings

5.1 The Existing Laws and Policies in Mitigating the Impact of Floods

The Malaysian government has implemented several laws and policies aimed at preventing and mitigating the impacts of floods. These laws encompass urban planning, environmental protection, and disaster management, forming a comprehensive framework for flood prevention and preparedness.

5.1.1 Water Services Industry Act 2006 (Act 655)

The Water Services Industry Act 2006 governs the management and regulation of water resources in Malaysia. It includes provisions on flood prevention, particularly regarding drainage systems and water flow management. Under this Act, local authorities and agencies are responsible for ensuring that infrastructure such as drains, water channels, and flood mitigation structures are properly maintained.

The Act emphasizes sustainable water management practices, which are critical for preventing floods. Proper drainage systems are essential in urban areas where rapid development and land use changes can increase the risk of flooding. The National Water Services Commission (SPAN), under this Act, works with local councils to regulate and improve drainage systems to prevent water stagnation and overflow during heavy rains.

5.1.2 Town and Country Planning Act 1976 (Act 172)

The Town and Country Planning Act 1976 plays a significant role in regulating land use and development planning, which directly affects flood risk. Under this Act, local authorities are required to consider environmental and topographical factors when approving development projects. This includes conducting Environmental Impact Assessments (EIA) to evaluate the potential impact of land development on flood risks and implementing a system for assessing the suitability of land for housing development, taking into account flood risks and other environmental factors.

The Act also encourages the integration of flood prevention strategies in urban planning. Local governments are empowered to impose conditions on developers to ensure that drainage and flood control measures are part of construction projects. Through this legislative framework, urban development can be more controlled to minimize flood risks, particularly in flood-prone areas.

The National Housing Policy (DPN) and Housing Development Guidelines should be amended to include specific requirements for flood-resistant design and construction, including mandatory flood risk assessment. In such a case, all the housing developers should be required to conduct comprehensive flood risk assessments before commencing any housing project in flood-prone areas. A more systematic drainage and stormwater management should be undertaken to ensure adequate drainage systems and stormwater management infrastructure are in place to minimize flood risks.

5.1.3 Environmental Quality Act 1974 (Act 127)

The Environmental Quality Act 1974 focuses on preventing environmental degradation, which is intricately linked to flood risks. Deforestation, land clearing, and other environmentally damaging activities contribute to increased flooding due to the reduction in natural water absorption and drainage capacity. Under this Act, the government regulates activities that could harm the environment and exacerbate flood risks.

The Department of Environment (DOE) oversees the enforcement of the Act and ensures compliance with regulations related to environmental conservation. For instance, the Act mandates that large-scale projects undergo environmental impact assessments (EIAs) to identify and mitigate potential environmental damage, including the impact on flooding. By protecting natural ecosystems such as wetlands and forests, this law helps in managing floodwaters and reducing the likelihood of floods in vulnerable regions.

Meanwhile, the Environmental Quality Act should integrate flood risk assessment to consider flood risks and incorporate flood mitigation measures in development plans and encourage the preservation of natural floodplains and wetlands to act as natural buffers against floods. Meanwhile, infrastructure development should be re-regulated in order to implement regulations that ensure infrastructure development, such as roads and bridges, does not exacerbate flood risks.

5.1.4 Drainage Works Act 1954 (Act 354)

The Drainage Works Act 1954 focuses on the construction, maintenance, and management of drainage systems. It grants local authorities the power to construct drainage works, such as canals, drains, and other water control structures, to prevent and mitigate the impact of floods.

Under this Act, local councils can enforce regulations on property owners to ensure that drainage systems on private land are properly maintained. This Act plays a crucial role in reducing urban flood risks, where blocked or inadequate drainage systems can cause severe flooding, especially during heavy rainfall.

The Act also gives the government power to allocate funds for the construction of large-scale drainage projects. This is especially important in areas where natural drainage is insufficient, and human-made solutions are necessary to control water flow and reduce the likelihood of flooding.

5.1.5 Disaster Management under the National Security Council (NSC) Directive No. 20 and the Disaster Management Act 2007

Floods in Malaysia are managed under the broader framework of disaster management. The National Security Council (NSC) Directive No. 20, which is part of Malaysia's disaster management policy, establishes the guidelines for managing natural disasters, including floods. The directive outlines the roles and responsibilities of federal, state, and local agencies in disaster preparedness, response, and recovery.

Under NSC Directive No. 20, flood preparedness measures include early warning systems, flood evacuation plans, and public awareness campaigns. The National Disaster Management Agency (NADMA) coordinates flood response efforts across multiple government agencies, ensuring that resources are mobilized swiftly and efficiently during flood emergencies.

The directive also mandates that government agencies work closely with local communities to raise awareness about flood risks and preparedness measures. This involves educating the public on how to respond during a flood event, including evacuation procedures and safety protocols.

The Disaster Management Act 2007 primarily focuses on post-disaster response and recovery, lacking a strong emphasis on proactive flood mitigation. This reactive approach often leads to insufficient resources and inadequate preparedness for future flood events. The lack of comprehensive flood preparedness strategies was evident during the recent floods in Malaysia. Many communities lacked access to timely warnings, evacuation routes, and adequate emergency supplies. The Disaster Management Act should strengthen the proactive measures by incorporating a stronger emphasis on proactive flood mitigation strategies, including flood-resistant infrastructure, early warning systems, and community preparedness programs and encourage a holistic approach to flood management, involving collaboration between government agencies, communities, and private sector stakeholders. Meanwhile community participation should be enhanced by providing mechanisms for community involvement in flood risk assessment, planning, and implementation of mitigation measures.

5.1.6 Irrigation Areas Act 1953 (Act 386)

The Irrigation Areas Act 1953 primarily addresses water management in agricultural areas, but it also plays an important role in flood prevention. Irrigation systems that control water flow in agricultural regions can help prevent excess water from accumulating and contributing to flood conditions.

Under this Act, the Department of Irrigation and Drainage (DID) is responsible for regulating water usage and ensuring that irrigation systems are designed and maintained to prevent water overflow during the rainy season. By managing water in rural and agricultural areas, the Act helps to reduce the risk of floods spreading to nearby urban areas.

5.2 Challenges and Gaps in Current Legislation

However, despite the existing legal framework, Malaysia continues to face significant challenges in preventing and mitigating floods. Some of these challenges include:

5.2.1 Urbanisation and land use

Rapid urbanisation, particularly in flood-prone areas, often overwhelms existing drainage systems. Unplanned development in low-lying areas or riverbanks exacerbates the risk of flooding, and enforcement of planning laws is sometimes inadequate.

5.2.2 Climate change

Climate change is increasing the frequency and intensity of floods. Rising sea levels, heavier rainfall, and more extreme weather events mean that existing flood prevention measures may no longer be sufficient.

5.2.3 Inter-agency coordination

While several laws exist to regulate flood prevention, the coordination between various agencies, such as the Department of Irrigation and Drainage (DID), local councils, and NADMA, can sometimes be lacking, leading to delays in flood response and mitigation efforts.

5.2.4 Public awareness and preparedness

Public participation in flood prevention is still limited. Many communities in flood-prone areas lack awareness of flood risks and preparedness measures, making them more vulnerable to flood events.

5.3 Recommendations for improvement

This research would suggest several steps that can be taken to enhance the effectiveness of flood prevention and preparedness laws in Malaysia.

5.3.1 Strengthening urban planning and development control

One of the primary causes of flooding in Malaysia is unregulated and rapid urbanisation. Currently, the Town and Country Planning Act 1976 (Act 172) provides the legal framework for development control and urban planning. However, many areas still suffer from insufficient drainage and encroachments on flood-prone areas, such as riverbanks and wetlands, increasing flood risk. Therefore, there are several improvements to the Act that could be suggested.

For example, to have stricter zoning laws and enforcement. Authorities must enforce more stringent zoning laws to prevent development in flood-prone areas. Currently, regulations exist, but enforcement is inconsistent across states and local councils. A standardized approach to enforcing zoning restrictions and improving coordination between federal, state, and local authorities is necessary. Additionally, developments that proceed against zoning laws should be met with heavier penalties to deter illegal construction in at-risk areas.

Secondly, improvement in terms of mandatory integration of green infrastructure. To reduce the urban flood risk, development plans should be legally required to incorporate green infrastructure solutions. Green infrastructure includes permeable surfaces, green roofs, retention ponds, and wetlands, which can absorb excess rainwater and prevent surface water flooding. Existing laws could

be updated to require developers to include these sustainable solutions in both new and existing projects.

Thirdly, on the retrofitting of older urban areas. It is noted that many older cities and towns were not built with current flood risks in mind. Urban planning laws should include mandates for retrofitting these areas with improved drainage systems and flood defenses. The law could also incentivize private property owners to upgrade their flood resilience through grants or tax relief for flood-proofing measures.

5.3.2 Enhancing the Environmental Quality Act 1974

The Environmental Quality Act 1974 (Act 127) is designed to protect the environment from activities that could degrade natural ecosystems, which includes reducing flood risk. However, environmental degradation such as deforestation and land clearing continue to contribute to increased flooding.

This Act could be improved by imposing tighter regulation of land use and deforestation. The Act should be strengthened to place more restrictions on deforestation and land clearing in vulnerable areas, particularly near rivers and watersheds. Logging permits and land conversion for agriculture or construction should be subject to more rigorous environmental impact assessments (EIA), with a specific focus on how these activities increase flood risks. Any activities found to heighten flood risks should be prohibited or require mitigation measures like reforestation and flood defense construction.

Additionally, the law on mandatory reforestation and wetland conservation could also be added to the Act. Reforestation and the preservation of wetlands are crucial in reducing flood risks by enhancing natural water retention and absorption. Wetlands act as natural sponges, slowing down water flow and reducing the severity of floods. The Environmental Quality Act could be improved by introducing stricter legal obligations for developers and industries to engage in reforestation or conservation projects, particularly in flood-prone regions.

5.3.3 Revising the Drainage Works Act 1954

The Drainage Works Act 1954 is key to managing Malaysia's drainage infrastructure, which is critical in controlling floodwaters. However, with urbanization, increasing rainfall, and outdated drainage systems, the Act needs modernization to effectively address contemporary flood challenges.

The Act should be updated to include modern drainage standards that consider increased rainfall due to climate change. Local councils should be mandated to conduct regular assessments of drainage capacity and upgrade or expand drainage systems to meet the demands of growing urban populations. Furthermore, new developments should be required to adhere to stricter drainage capacity guidelines. In addition to that, the Act should also introduce penalties for local governments or developers that fail to maintain or upgrade drainage systems in flood-prone areas. Regular inspections and maintenance of drains, culverts, and flood defenses should be legally required, and their outcomes made transparent to the public to ensure accountability. Moreover, a system for citizens to report inadequate or blocked drainage systems should be institutionalized to facilitate faster response times.

5.3.4 Improving flood forecasting and early warning systems

The National Security Council (NSC) Directive No. 20, which governs disaster management, and the work of the NADMA are crucial in handling flood emergencies. However, gaps remain in flood forecasting and early warning systems that could be addressed through legal and policy enhancements.

However, while early warning systems exist, they are not uniformly implemented across the country. Laws should be enacted to mandate the nationwide use of modern flood forecasting technologies, such as satellite monitoring, real-time rainfall gauges, and hydrological modeling. These systems should be integrated with community-based early warning systems to ensure that even the most remote areas receive timely flood alerts.

Besides, the law should require local governments and NADMA to conduct public training and awareness campaigns on flood risks and emergency response. Regular community drills and educational programs should be institutionalized to ensure that citizens know how to respond during floods. This effort should target both rural and urban populations, as well as vulnerable groups such as the elderly and disabled.

In addition to that, the law should also mandate that flood risk maps be regularly updated and made publicly accessible to inform community planning and development. Developers and the public should have access to up-to-date flood data to guide decision-making in construction and disaster preparedness.

5.3.5 Addressing climate change impacts

Flood risks are exacerbated by climate change, and existing laws should be adapted to mitigate these impacts. Currently, there is no direct legislation that comprehensively integrates climate adaptation strategies into flood prevention laws.

The law should be updated to require all new infrastructure projects, including roads, bridges, and drainage systems, to be designed to withstand the increased frequency of extreme weather events. This can be done by adopting climate-resilient building codes that consider the higher likelihood of intense rainfall and flooding.

Furthermore, Malaysia's National Policy on Climate Change should be better integrated into flood management laws, particularly in the development of climate adaptation strategies. Legal mechanisms should be established to ensure that all flood prevention measures, from infrastructure development to environmental protection, align with broader climate adaptation goals.

5.3.6 Introducing financial mechanisms for flood mitigation

One area of improvement is the introduction of financial incentives to promote flood mitigation efforts. The laws should encourage public-private partnerships and community involvement in flood prevention through financial mechanisms.

The government could introduce tax incentives for property owners and developers who implement flood protection measures, such as installing flood barriers, elevating homes, or creating flood retention ponds. In addition, a national flood insurance scheme could be introduced to provide financial protection to those living in high-risk areas, helping them recover from flood damage more quickly.

Besides, laws should establish dedicated flood mitigation funds at both the federal and state levels. These funds could be used for flood defense construction, upgrading drainage systems, and

maintaining flood-prone infrastructure. The funds could be replenished through levies on industries or developers whose activities increase flood risks.

5.3.7 Public education and involvement

It is important to increase public awareness through education campaigns on flood risks, early warning systems, and safety measures as these can improve community preparedness and reduce the impact of floods on lives and property.

5.3.8 Stakeholder engagement

Hogan *et al.*, [22] corroborated that the social support should be reciprocated, wherein the level of received support should be balanced with the provided support. This is also related to the social influence of the support. When faced with disasters people rely on others going through similar experience with them for support. For example, individuals with stronger social support have been found to be able to quickly respond to evacuation notices. In this situation, stakeholder involvement is essential because it may help identify requirements unique to the community, create customized mitigation plans, and gather resources and knowledge from a variety of sources. Policymakers and planners can gain a more thorough grasp of the risks and vulnerabilities associated with flooding by interacting with a variety of stakeholders, such as local communities, government organizations, and businesses. The mobilisation of resources, the exchange of knowledge, and the creation of cooperative solutions that meet the demands of various stakeholders can all be facilitated by this kind of involvement.

The Department of Irrigation and Drainage (JPS), local authorities, and relevant ministries play a crucial role in developing and implementing flood mitigation policies, infrastructure projects, and regulatory frameworks. Developers are responsible for designing and constructing flood-resistant housing projects, adhering to building codes and incorporating appropriate flood mitigation measures. The National Housing Policy (DPN) and housing development guidelines should be revised to incorporate stricter regulations for flood-resistant construction and development in flood-prone areas. This includes ensuring that developers obtain necessary approvals from relevant agencies like JPS. Meanwhile, Along *et al.*, [23] found that in the state of Pahang, local communities, including Orang Asli communities, have been actively involved in flood preparedness and response efforts, sharing their indigenous knowledge and collaborating with NGOs and government agencies.

Meanwhile, the Malaysia Country Water Partnership (MyCWP), in collaboration with partners like the Global Environment Center (GEC), has implemented pilot projects focusing on community-based flood preparedness. These projects involved a wide range of stakeholders, including government agencies, NGOs, community leaders, and residents. Stakeholder engagement is a cornerstone of building flood resilience in Malaysia. By fostering collaboration, promoting knowledge sharing, and empowering communities, a more effective and sustainable approach to flood risk management can be achieved. This requires ongoing commitment from all stakeholders to work together, building trust and understanding, and prioritizing the well-being of communities most vulnerable to flood risks.

4. Conclusions

According to Aldrich [24], social capital plays a critical role in catastrophe recovery, particularly in post-crisis resilience. Similar findings were made by Hossain and Kuti [25] about the significance of using social networks to coordinate disaster response preparation. Undeniably, the flood prevention and preparedness in Malaysia must rely on a comprehensive legal framework that includes water management, urban planning, environmental protection, and disaster management. While the existing laws provide a sturdy foundation, challenges such as urbanization, climate change, and inter-agency coordination need to be addressed to improve the country's resilience to floods. By strengthening regulations, improving coordination between agencies, and raising public awareness, Malaysia can better mitigate the risks and impacts of floods, safeguarding its population and economic stability.

It is also recommended to strengthen the agencies capacities for better and comprehensive flood risk management. As a country with frequent flooding, the government needs to develop a cohesive national mechanism and supporting organisational framework for flood risk management to help in better coordination between agencies.

In the perspective of economy, the United Nations Environment Programme (UNEP) and partners have been working to help lessen the impact of flooding in countries around the world. Flooding destroys biodiversity, lives, livelihoods, infrastructure and other assets. During the inaugural Climate Crisis Symposium 2022 at the Parliament building on Sept 5, the former Environment and Water Minister Datuk Seri Tuan Ibrahim Tuan Man expected Malaysia to spend RM392 billion in the next 78 years on flood mitigation measures [26]. Thus, if Malaysia could have the proper planning law to have a systematic flood management, we could save these unnecessary expenses.

Improving flood resistance in Malaysian housing necessitates a multifaceted strategy that combines strong planning laws with efficient community involvement and environmentally friendly methods. Malaysia may better prepare for future flooding occurrences and protect its infrastructure and populations from climate-related threats by updating current frameworks, such as the Town And Country Planning Act 1976, and implementing comprehensive flood risk management methods. Due to Malaysia's susceptibility to flooding, which is made worse by urbanization and climate change, flood resistance in housing is a critical issue. Along with suggestions for improving flood resilience through legislative reforms, a critical evaluation of current planning laws and frameworks identifies both their advantages and disadvantages in tackling this problem.

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