

# The Assessment Of Climate Hazard Management in Malaysia With in The Strengths, Weaknesses, Opportunities, And Threats (SWOT) Perspective

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## 1. Abstract

With the anticipation of the increasing and changing nature of disaster risks due to climate change, it is crucial to recognize the need for a holistic and integrated approach to climate disaster management at both policy and institutional levels. This study examines Malaysia's preparedness and response to climate-related risks, emphasizing the necessity for comprehensive disaster management frameworks to address the growing impact of climate-induced disasters. Malaysia's vulnerability to extreme weather events, such as floods and droughts, has been exacerbated by the ongoing effects of climate change. With the input from the stakeholder interview sessions, the SWOT analysis was conducted to identify key aspects of Malaysia's disaster management capabilities. The study highlights strengths, including strong governmental commitment and established policies, while also addressing weaknesses, such as limited public awareness and financial constraints. Opportunities for improvement include harnessing global climate finance and adopting green technologies. However, significant threats remain, including the increasing frequency of climate hazards and potential political instability. The findings of this study underscore the need for proactive, rather than reactive, disaster management strategies. It advocates for a comprehensive

approach that integrates climate change considerations into the decision-making process.

## 2. Keywords:

Climate hazard, disaster risk management, institutional framework, SWOT analysis,

## 3. Introduction

Over the past decade, there has been a growing trend in the number of lives lost and financial loss because of climate-related calamities. The Intergovernmental Panel on Climate Change (IPCC) has also indicated a crucial threshold for severe occurrences, ranging from 1.5°C - 2°C of warming based on different projections and climate models. Climate catastrophes would result from this warming's stimulation of storm surges, coastal floods, infrastructure destruction, ecological instability, and other factors (IPCC, 2021). Through examinations of historical data, Malaysia has also seen increasing temperatures and irregular rainfall due to climate change, and this is a growing concern compared to those other countries that also have experienced extreme climates (Shariffah & Jemain, 2012). In Malaysia's case, studies have shown that especially the north-eastern region of Malaysia is more likely to be exposed to floods and droughts, brought by the tropical cyclones. It has been discussed repeatedly in recent years how to polish and perfect Malaysia's disaster management system and the ever-changing climate. Thus, comprehensive and integrated plan to combat climate catastrophe is required to be addressed at the policy and institutional levels due to the expectation of the rising and changing nature of climate disaster because of climate change. However, there is still relatively little interaction between the national agencies on the topic of climate change and disaster management in Malaysia (Tan & Pereira, 2013). Hence, there is a need to bridge the climate change and disaster management process in this country, in which an idea of a Climate Hazard Decision Support System (DSS) is proposed. Tan et al. (2019) highlights the idea of integrating DSS with climate hazard has gained attention in recent years, and the benefits of applying DSS to decision problems are that they can support policy-relevant questions, focus on long-term and strategic issues, and most importantly, facilitate effective decision outcomes in a complex situation. Moreover, there is also an immense body of literature and decades of experience to draw upon about managing risk.

Various studies have shown that global temperatures, as well as greenhouse gas emissions, are rising uncontrollably. Extreme weather events like droughts and floods are occurring more frequently because of a changing climate, which has led to more climate-related catastrophes like reduced

agricultural growth and yields. (Sillmann et al., 2017). These hazards happened once in a blue moon and used to be manageable, however, with climate change they are getting out of control. Uncertainties in the changing climate have made the accurate projection of climate models very difficult, leaving us with insufficient confidence in project and design responses to the likely changes in precipitation patterns and temperature. Over the year many of these extreme weather events can be seen happening over the globe. Even Malaysia has been caught off-guard by various climate hazards over the years, the more recent one being the flood disaster occurred in Sri Muda, Selangor on 20 December 2021. During the disaster, the local community expressed significant disappointment with the authorities' delayed response and poor coordination in handling the flood crisis.

Some of the cases have shown that Malaysia currently lacks adequate response to that climate disaster. For instance, there would be a delay in declaring the recent Selangor flood situation as a crisis, when the situation is clearly out of control (Zainuddin, 2021); the flood situation in east coast Malaysia continues to worsen, as the flood was not predicted for countermeasure and many more. To minimise the damage caused by different types of climate hazards, it must be accomplished with a good decision-making process. Decision makers, however, are not always equipped with proficient scientific knowledge of climate science, even so, there are still insufficient to address the complexity and dynamic environment of climate change. Therefore, the decision support system (DSS) has been proliferated to meet the demands of different situations and adhere to the needs of decision-makers. Despite the increasing reliance on DSS in decision-making, much is still unknown about their effectiveness, especially when implemented in Malaysia. Hence, this research attempts to design the framework of a decision support system (DSS) for climate risk management in Malaysia. The paper aims to provide an overview of the existing institutional framework on disaster risk management based on policy, procedures, and legal perspective. The results of the SWOT analysis were discussed, focusing on Malaysia's current capabilities in managing risks and enhancing resilience to climate change and climate-induced disasters.

#### 4. Methodology

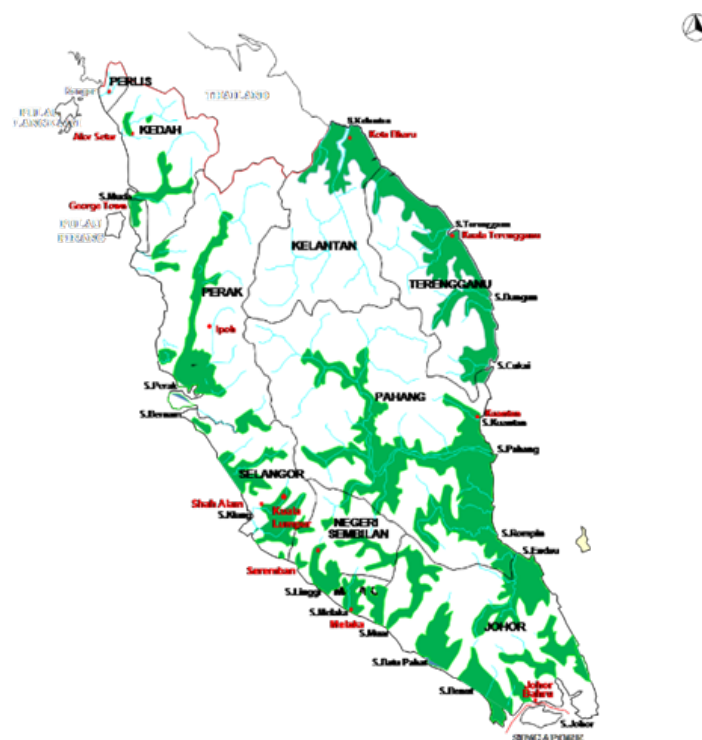
Interviews serve as an invaluable tool for uncovering the underlying ideologies and past experiences of participants. They allow for the exploration of in-depth information on the topic and provide an opportunity to delve further into the participants' responses. This particular interview aims to assess the range of perspectives, agreements, or differences of opinion regarding various anticipated hazards. In this study, the criteria for selecting interviewees were set as (i) a background in climate hazard studies or environmental research (ii) minimum 5 years working in the related field, to ensure they could provide informed insights. To provide a comprehensive view of the study, interviewees are drawn from both academic fields and government, and non-governmental organizations (NGOs). In total 5 government officers related to the natural disaster management, 3 experts from academic and 1 NGOs were interviewed

with the open-ended questions. During the interview, participants are asked to share their views on Malaysia's climate hazard institutional framework and SWOT aspects. When exploring Malaysia's disaster institutional framework, questions are deliberately open-ended to capture the respondents' suggestions and perspectives. This approach encourages a more thorough study of the policies, procedures, and legal aspects, acknowledging that individuals may hold diverse opinions on the same topic.

### 5. The Climate Hazard in Malaysia

#### 5.1. Flooding

Lies in the equatorial region, Malaysia experiences a very hot and humid climate. There are two monsoon seasons: the Southwest Monsoon (April – September) and the Northeast Monsoon (October – March). In the past, heavy rainfall brought by the monsoons was believed to be the basic cause of river flooding, in which the large concentration of runoff exceeded the river's capacity. However, in recent years, increasing development within river catchments has led to greater runoff and degraded river capacity, which in turn has led to a rise in the frequency and volume of floods (Sani, et al., 2014). With more than 60% of the Malaysian population now residing in urban areas, flash flooding in urban areas is perceived to be the most critical flood type since the mid-1990s, and one of the most common natural disasters in Malaysia (Department of Irrigation & Drainage, 2017). Research has shown that urbanization, deforestation, and poor drainage systems exacerbate the risk of flooding (Sani, et al., 2014). Moreover, the study was conducted by Malaysia's Department of Irrigation and Drainage in 2017 have shown that 9% of Malaysia's total land area is considered a flood-prone area, making Malaysia highly vulnerable to flood hazards (Figure 1).



**Figure 1:** Maps showing that 9% of Peninsular Malaysia's total land area is identified as flood-prone area (Source: Department of Irrigation & Drainage, 2017).

Besides the flash floods in urbanized areas, the rising frequency of other flood-related calamities such as debris flood flows, mudflows, and landslides in mountain streams and hill slopes is also a major reason for concern, not to mention the property damage caused by the aftermath of flooding. Urban areas are particularly vulnerable to flash floods because of the high proportion of impervious surfaces, which increase runoff during heavy rainfall. On the other hand, riverine floods are exacerbated by deforestation because it reduces the capacity of forests to absorb water and slow down runoff. In addition, climate change is expected to increase the frequency and intensity of floods in Malaysia (Tabari, 2020). In recent years, Malaysia has experienced several devastating floods that have affected both urban and rural areas. In 2014, Malaysia was hit by the worst floods in decades, affecting more than 200,000 people and causing over RM1.5 billion in damages (Shah, 2015). The floods were caused by heavy rainfall and exacerbated by poor urban planning and inadequate drainage systems. The state of Kelantan was the hardest hit, with more than 100,000 people displaced and several deaths reported. The flood also disrupted transportation, communication, and essential services such as healthcare and education. Similarly, the northern of Penang State in Malaysia was hit by flash floods in 2017, that caused unexpected economic loss. These real-life cases of flooding in Malaysia highlight the need for better urban planning and infrastructure development, as well as forest conservation to mitigate the impact of floods on communities.

## 5.2. Droughts

In contrast, drought is a less common but equally important climate hazard in Malaysia, particularly in rural areas that rely on agriculture. Research has indicated that climate change and variability are expected to increase the incidence and severity of drought in the country (Yohannes, 2016). According to the same study, droughts can be defined as prolonged dry period that lasts more than 15 days of below-average rainfall and can lead to difficulties with public health such as increasing mortality rates, water scarcity, forest fires, harm to natural habitats, lower agricultural yields or even complete crop failures, and damage to natural habitats. These will in turn bring about land deterioration, food price increases, and forced migration of living beings. A higher unpredictability of droughts is becoming more unpredictable, which worsens farmer problems by reducing local crop production and jeopardising food security (Yohannes, 2016). More drought events are expected to occur across peninsular Malaysia, and they are exceptionally affecting the north-eastern region the most.

Droughts in Malaysia can be classified into two types: meteorological droughts and hydrological droughts which depend on the frequency, duration, and severity (Hasan et al. 2021). The meteorological droughts are caused by a prolonged period of below-average precipitation, while hydrological droughts are caused by a reduction in water availability due to low river flows, declining groundwater levels, or reduced soil

moisture. The same study found that climate change and variability are expected to increase the incidence and severity of drought in Malaysia, exacerbating the existing challenges faced by the agriculture sector. Unsustainable agricultural practices, such as monoculture and excessive water usage, worsen the impact of drought on agriculture. Therefore, the study recommended the use of sustainable agricultural practices and water conservation measures to mitigate the effects of drought in Malaysia. In response to these climate hazards, various strategies have been proposed to mitigate their effects. One of the strategies are related to the use of green infrastructure, such as rain gardens and bioswales, to manage stormwater runoff and reduce the risk of flooding (GoldenandHoghooghi 2018). Another approach is related to the implementation of water conservation measures, such as rainwater harvesting and efficient irrigation systems, to address the impact of drought. Additionally, efforts to promote sustainable agriculture and reduce water usage can help to mitigate the effects of drought.

## 5.3 Socioeconomic Impacts of Climate Hazards

Although the goal of social sustainability is to protect social capital by developing and investing in the services that support our communities in Malaysia. However, climate change tends to threaten to exacerbate poverty. Malaysia's labour forces working in agriculture, fishing, and informal sectors in the metropolitan region are typically low-income earners. There economically depend on occupations where climatic conditions play a key role. According to research, there is a chance that poverty levels will rise due to climate change, and low-income groups that are currently just above the poverty line may drop below it (Salleh & Ghaffar, 2009). For instance, many of the predicted climatic changes are anticipated to disproportionately affect the socially weakest segments of society. Heavy manual labour jobs are frequently among the lowest paid and most at risk of productivity losses from heat stress in the extreme climate. On the other hand, the majority of businesses albeit some of the poorer ones still are at least able to afford air conditioning.

Besides that, even though everyone faces the threat of climate change, not everyone is equally impacted. Various recent studies have shown that women are vulnerable to the effects of climate disaster than men, disproportionately affected by its impacts (Rainard, et al., 2023). This is because gender-based inequities lead women to face more adverse climate change impacts than men. When women are particularly exposed to disaster risks, they are more likely to suffer higher rates of mortality, morbidity, and post-disaster ruin to their livelihoods (Sharmin et al., 2024). Although there is lack of simple remedy to this issue, investing in these groups with special care and needs as part of the climate change adaptation and disaster risk reduction effort can lead to greater returns across the Sustainable Development Goals (SDGs) and fundamentally, overcome the climate crisis. In Malaysia, promoting social equality will challenge the established power dynamics and federal authority. However, only time will reveal if the climate crises serve as significant leverage points for meaningful systemic reform.

#### 5.4. The Climate Hazard Management, Policies and Legal Framework in Malaysia

To mitigate the impacts of climate hazards, it is essential to have a comprehensive set of policies to manage disaster risks. In Malaysia, the National Security Council (NSC) is the council that oversees the planning and operation of disaster management. Although it was later incorporated into the National Disaster Management Agency (NADMA) that is under the lead of the Prime Minister's Office of Malaysia in 2015, the agency has continued to hold the responsibility related to disaster risk management over the years (Mageswari, 2022). Some of the crucial policies involved with disaster risk management include the Malaysia National Security Council (MNSC) Directive 20 (1997), National Security Policy (2019), and the National Policy of Climate Change (2009). The MNSC Directive 20 provides the crucial foundation in Malaysia to provide a framework for disaster management at the national level. It aims to ensure that Malaysia has a systematic and coordinated approach to managing disasters, including prevention, mitigation, preparedness, response, and recovery. The MNSC recognizes the importance of involving all stakeholders in disaster management, including the government, non-governmental organizations (NGOs), the private sector, and the community.

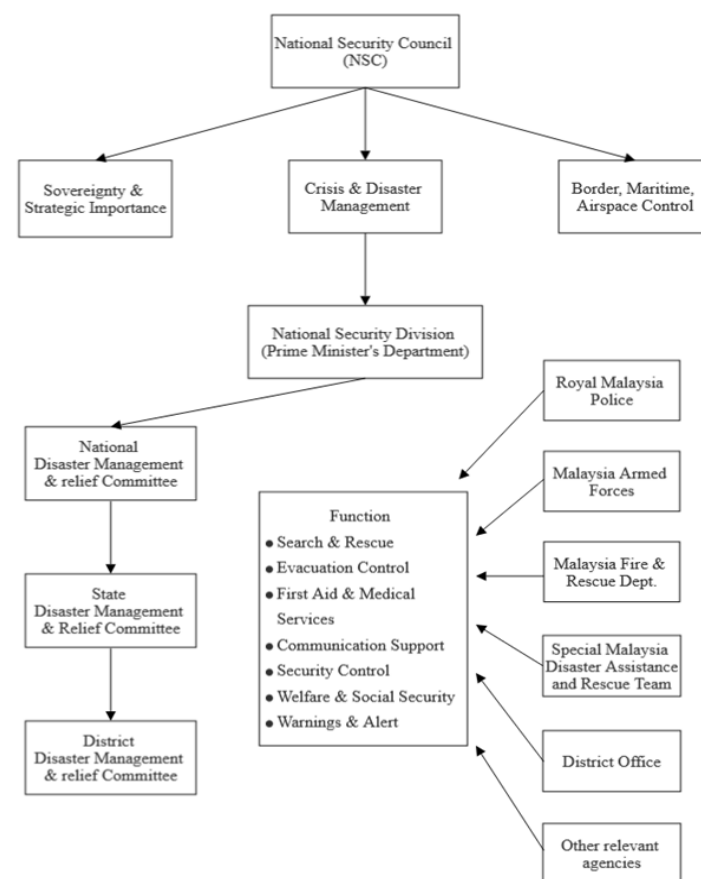
Besides, the National Policy on Climate Change (NPCC) was developed in 2009 by the Ministry of Natural Resources and Environment at that time to address the challenges of climate change in Malaysia (Sarkar, et al., 2013). The policy aims to encourage climate-resilient development through the reduction of greenhouse gas emissions, increase resilience to climate change, and promote sustainable development. The NPCC recognizes that climate change can exacerbate natural disasters and emphasizes the need for integrated disaster risk management and climate change adaptation strategies. Besides that, the Environmental Quality Act 1974 also acts as the basic tool for attaining environmental policy goals. Other regulations related to earthwork and land-use planning e.g the Street, Building and Drainage Act 1974, Town and Country Planning Act 1976, and Land Conservation Act 1960 also contribute significantly to lowering Malaysia's catastrophe risk. The primary target of implementation of the National Security Policy (NSP) has always been introduced as the principal policy in confronting the various national security threats such as terrorism, cyber threats, and transnational crimes. The latest revision in 2019 however has included a section on disaster management, as well as environmental degradation (National Security Council, 2019). Climate disasters as a form of complex travails and of great magnitude occurring, thus the NSP recognizes that climate disasters can have significant impacts on national security and emphasizes the importance of a coordinated and integrated approach to disaster management.

#### 5.5. Stakeholders Involved in Climate Hazard Management

Numerous disaster management committees have been established at the federal, state, and local levels. The relevant stakeholders are crucial for creating and carrying out disaster management plans, performing risk assessments, and organizing disaster response activities. The stakeholder that is high influential and low interest in the framework, may bring significant opportunities that can be identified through detailed study

and analysis of their strength, weaknesses, opportunities, and threats. Various stakeholders are involved in the climate hazard and disaster relief mechanism in Malaysia as shown in Figure 2. The major stakeholders in Malaysia's disaster risk management are the National Disaster Management Agency (NADMA) and the Special Malaysia Disaster Assistance and Rescue Team (SMART), both under the command of the Prime Minister's Department (Mageswari, 2022). NADMA spearheaded Malaysia's disaster risk management and policy-making, while SMART focused on disaster relief and recovery. There is also the Malaysian Meteorological Department (DM) provides information and early warnings on weather, sea, and seismicity conditions; the Department of Drainage and Irrigation (DID) oversees aspects related to flood; and other actors such as the Non-Governmental Organization, Public Works Department (JKR), Malaysian Armed Forces, Firefighter and many more. Each of the agencies has its roles and responsibilities, and they will exchange information relating to weather forecasts, water levels for rivers and dams, as well as risky slopes. At the same time, the enforcement agencies will report on the readiness of their resources, logistics, and manpower strength (Noorhashirinet al., 2016).

**Figure 2:** Malaysian Disaster Relief Mechanism System



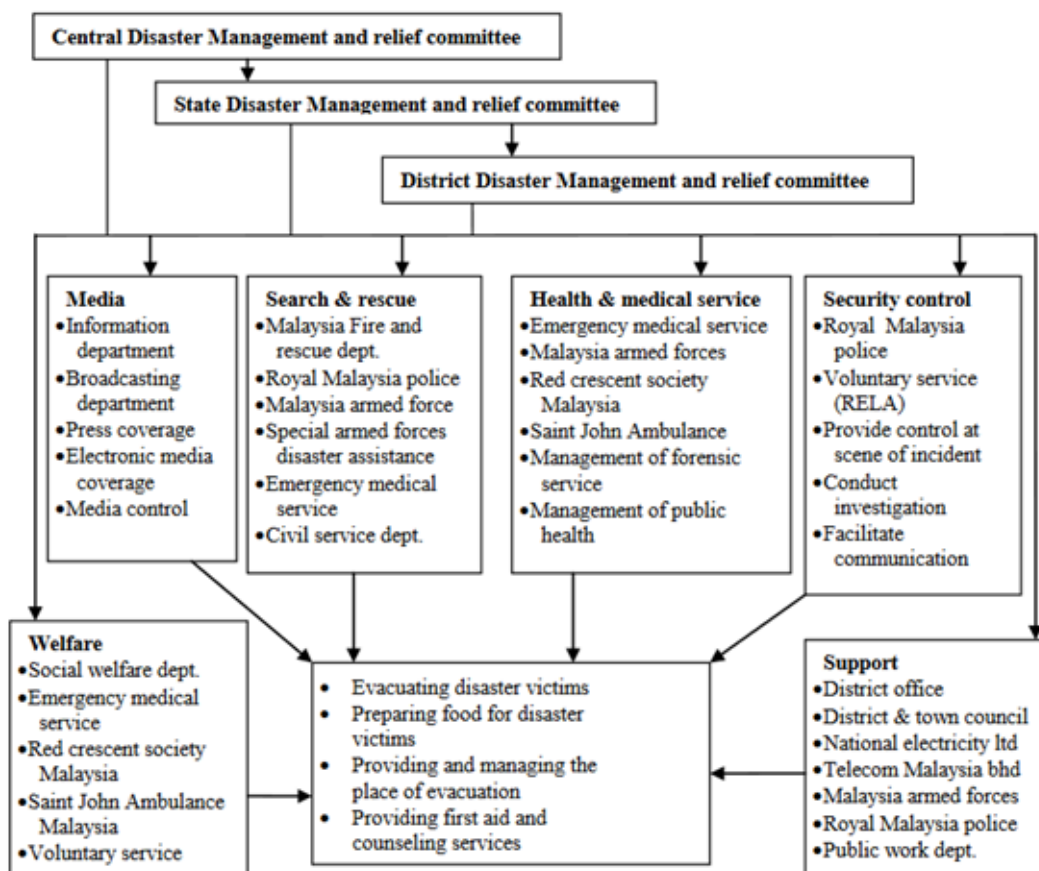
#### 6. Discussions

Malaysia as a country that is almost annually affected by climate hazards, the national government employs countless measures and

strategies to reduce the impacts of climate disasters. The National Security Council(MNSC) Directive No. 20 — a “Policy and Mechanism on National Disaster and Relief Management” is Malaysia’s integrated system for primary policy-making and coordination organization for disaster management in Malaysia. The objective of this directive is to provide guidelines on all aspects of disaster management under different disaster levels. This Directive came into existence when Malaysia required a policy and a framework to coordinate and integrate natural catastrophes on land in a systematic manner. The MNSC Directive No. 20 also documented a committee system of the Disaster Management and Relief Committee (DMRC), established in 2012 under the lead of the National Disaster Management Agency (NADMA). The Royal Malaysian Police, Royal Malaysian Army, Department of Public Works, Social Welfare Department, Local Authorities, Malaysia Civil Defence Force, Malaysian Meteorological Department, and various NGOs or international corporations are among the few organisations that make up the committee system (Rahman, 2012).

Malaysia’s institutional framework for climate disaster risk management exists on both the national and subnational levels, with disasters regulated into 3 levels of severeness, regulated with DMRC of different district level. Figure 3 shows the disaster management mechanism of Malaysia. The district DMRCoversees handling Level I Disaster, which is an under-controlled local disaster that has no potential for further outbreak. At this level, the district, sub-district, and village levels, disaster management procedures are straightforward and effective. On level II Disasters, the State DMRC oversees level 2 disasters. Such calamities affect two or more areas, and both people and property sustain substantial damage. In the meanwhile, the Federal DMRC manages Level 3 disasters when their complexity is high, and they have a widespread impact. This will be handled by the federal government, either on their own or with assistance from overseas (Ramli et al., 2021).

**Figure 3:** Disaster management mechanism of Malaysia (Sarkar et al., 2013)



Malaysia’s national policies related to climate disaster risk management are informed by the National Policy on Climate Change (NPCC), which was launched in 2009. Compared to the MNSC Directive No. 20 which focuses on disaster management, this policy outlines several measures to address climate change. NPCC promotes multiplesuccesses by reducing disaster vulnerability and its effects, combating climate change by reducing GHG emissions, and preserving economic growth and development. However, there is a need for greater integration between climate change and disaster

risk management policies at the national level. Furthermore, there is a lack of specific policies related to the management of climate disasters, with most policies focusing on post-disaster recovery rather than prevention and mitigation. Looking back at Malaysia’s history with climate disasters, it can be observed that disaster management in Malaysia tends to adopt a more reactive action rather than a proactive mode. In many instances, our response is activated after a disaster has occurred. Therefore, this suggests that to reduce the occurrence of future potential disasters, Malaysia needs

to develop a throughout and comprehensive approach to hazard management strategy. This all-encompassing strategy must incorporate a proper balance between the components of climate disaster pressures and impact; while also covering the four phases of the disaster management cycle, namely preparedness, mitigation, response, and recovery to be effective. Given the risk that climate-induced disaster poses for the country's stability in the long run, understanding the country's preparedness for climate disaster risk management is crucial to responding to these hazards. Therefore, this following section analyses the strengths, weaknesses, opportunities, and threats (SWOT) for Malaysia's existing institutional framework, as a method to determine Malaysia's preparedness for climate disaster risk management. Through the SWOT analysis, the respective stakeholder's significance can be exploited by raising their interest level in the project or organization. The Figure 4 summarised the SWOT analysis outcome which conducted in this study.

**Figure 4:** The SWOT analysis outcomes of Malaysia's current climate-related institutional framework.



### 6.1. Strengths

Malaysia has demonstrated a strong government commitment to climate action, with established policies and regulations such as the National Security Council (NSC) Directive No. 20 and the National Climate Change Policy (Hamin et al., 2013; Ridzuan et al., 2022). The country's well-developed disaster management system, including the National Disaster Management Agency, and National Water Research Institute of Malaysia (NAHRIM) has enabled Malaysia to respond effectively to natural disasters and climate hazards (Ridzuan et al., 2022). Malaysia also has strong institutional capacity through organizations like the Department of Environment Malaysia and the Malaysian Green Technology and

Climate Change Centre, which have played key roles in developing and implementing climate policies. This has shown that Malaysia is indeed committed to tackling climate disasters. The Malaysian Government has established the Ministry of Natural Resources and Environmental Sustainability (MNRES) to look into the governmental policies related to climate change and disaster. In technical support, various universities and research institutes, for example, the National Water Research Institute of Malaysia (NAHRIM) dedicated to conducting different scopes of studies on the water sector and climate change.

Further more, Malaysia has made significant progress in the preparation of disaster guidelines and standards over the years. For river catchments and their reserves, as well as for projects aimed at mitigating flooding and improving urban drainage, suitable guidelines and design standards have been created making up of Malaysia's well-developed disaster management system with rules and principles for design (Noorhashirinet al., 2016). If the public and commercial sectors completely adhere to these rules and design requirements, it will help minimise the risk of flood. Besides that, there are also more than twenty Hydrological Procedures, and the Urban Drainage Planning and Design Procedure No. 1 have been made available by the Department of Drainage and Irrigation for use by all planners, consultants, and other government agencies across the nation as reference materials and guidelines (Hamin et al., 2013).

### 6.2. Weaknesses

This study identifies several weaknesses in Malaysia's disaster management efforts. One significant issue is the low level of public awareness regarding climate action, which greatly hampers progress. Despite the government's attempts to raise public understanding of climate change through various programs, a broader and more comprehensive public awareness education campaign is still needed to prepare civilians for responding to disasters. This involves implementing comprehensive public education and training programs that equip communities with the necessary knowledge and skills to act effectively during emergencies. Public awareness campaigns, disaster preparedness drills, and the dissemination of practical information about evacuation procedures, emergency contacts, and first aid can significantly enhance community resilience. Additionally, fostering community-led disaster response initiatives ensures that civilians are not only informed but also actively involved in local risk reduction and response strategies.

However, the limited financial resources have constrained Malaysia's capacity to effectively implement and enforce its climate policies (Ridzuan et al., 2022). Some experts from academic argue that instead of prioritizing reaction and recovery activities, there should be a stronger emphasis on funding disaster risk reduction and preparedness initiatives. This includes investing in early warning systems, enhancing infrastructure resilience, and supporting community-based disaster risk reduction programs. While the government has been increasing its investment in disaster management, there is still room for improvement. Ongoing monitoring and evaluation are crucial to ensure that resources are allocated efficiently and effectively to strengthen Malaysia's climate resilience. Additionally, there is limited coordination among stakeholders, including government agencies, civil

society organizations, and the private sector. The lack of coordination has led to inefficiencies and redundancies in climate action efforts. There is a noticeable lack of coordination and communication between agencies involved in disaster management. According to Malaysia's Federal Constitution, the State government is responsible for managing water supply, rivers, land, and forests, including flood management, land use along river corridors, urban development, timber harvesting, and water supply preservation for drought emergencies. Conversely, the federal government handles catastrophe management through the National Security Council and environmental outcomes through the Department of Environment. This distribution of powers results in both State and Federal governments having concurrent roles in irrigation and drainage, including various aspects of flood management (Noorhashirinet al., 2016). The overlap of roles and responsibilities can weaken coordination and communication between stakeholders and agencies. Without a unified legal framework for flood risk management, Malaysia may face issues where solutions are tailored to local community demands rather than a cohesive national strategy.

### 6.3. Opportunities

Despite the weaknesses outlined the previous section, there are opportunities for improvement. The growing global focus on climate change has heightened awareness and interest in addressing this issue in Malaysia (Hamin et al., 2013). This has spurred increased interest from both the public and private sectors in renewable energy and other climate solutions. Climate financing is crucial for adaptation, requiring substantial financial resources, particularly for developing nations. According to Ibrahim et al., Malaysia's access to climate finance and technologies is also expanding, providing the nation with the necessary resources to implement its climate policies. This financing may come from various sources, including private, public, local, or transnational funds. Adequate climate finance is essential, as significant investments are needed to reduce emissions, especially in high greenhouse gases (GHGs) emission industries. Additionally, infrastructure solutions e.g flood diversion channels or tunnels, successfully implemented in other countries, can be introduced in Malaysia. There is a growing interest in developing green technology, which could create new economic opportunities for Malaysia while also contributing to climate action efforts. According to Rahman (2012), Malaysia is slow in this matter, but we are slowly implementing policies such as a carbon tax and increasing support for renewable energy. This indicates that strong private sector engagement in Malaysia is required, which could drive innovation and investment in climate-friendly technologies and practices. Additionally, the government has provided research grants to national research institutes and universities e.g National Water Research Institute (NAHRIM) to develop new and effective structural measures.

### 6.4. Threats

In this study, the threats are identified based on Malaysia's existing institutional framework related to climate hazards. One major threat is the increasing frequency and intensity of climate hazards in Malaysia. Observational evidence suggests that climate change has led to more

severe weather events, including a rise in tropical cyclone activity, an increase in the number of hot days, nights, and heat waves, and more heavy precipitation events (Haliza, 2018). These changes pose a significant threat not only to Malaysia but also to humanity as a whole. As the risk of climate hazards continues to rise, Malaysia must be even more prepared and adaptable to these changes. Another significant threat is the instability in Malaysia's political environment. Despite the country's strong institutional capacity and existing policies, relief efforts are often politicized, and there are obstacles to implementing and enforcing these policies (Haliza, 2018). While there are always plans and engagements for disaster prevention projects, conflicts between government and opposition parties over differing views and budget issues often obscure the true goal of infrastructure improvement. Ruling authorities tend to provide less support for disaster management initiatives initiated by opposing governments, and vice versa. This political environment, characterized by persistent disagreements between parties, complicates the country's disaster management efforts and may hinder progress in addressing climate change.

Malaysia faces significant challenges in adapting to climate change, such as the need to strengthen infrastructure and improve water management (Ibrahim et al., 2016). These challenges could be exacerbated by the increasing frequency and severity of natural disasters due to climate change. One major threat is the limited enforcement of existing regulations. While Malaysia has established policies and regulations to address climate change, their enforcement is often weak (Ibrahim et al., 2016). This lack of enforcement can undermine the effectiveness of Malaysia's climate policies and impede progress in addressing climate change. Malaysia's disaster management system involves several agencies and organizations responsible for various aspects of disaster management, which sometimes lead to coordination challenges (Haliza, 2018). With so many stakeholders involved in the climate disaster mechanism in Malaysia, the responsibilities of agencies and organisations must be clearly defined and coordinated effectively to provide a comprehensive response that addresses all aspects of the disaster.

The Malaysian government has its in-house methods in which multiple agencies are involved in handling climate hazards. Various government agencies with different roles are involved in the disaster management, which might be confusing the public. However, the hierarchy of command has to establish comprehensive protocols for inter-agency cooperation, conduct regular training and exercises to test the system's effectiveness and invest in communication technology and infrastructure (Haliza, 2018). The strength can become a weakness in the management plan, due to the redundancies of roles and responsibilities from the saturated roles of agencies. This hierarchy of command might become a weak point during an emergency when multiple agencies must work together. Addressing these weaknesses and threats will be crucial to ensuring that Malaysia can effectively address the challenges posed by climate change. Building on its existing strengths, Malaysia has the potential to play a leading role in the global transition to a low-carbon, climate-resilient economy. However, this will require continued political commitment and

investment in institutional capacity, as well as greater public awareness and engagement.

## 7. Conclusion

In conclusion, a holistic understanding of the models, policies, procedures, and legal perspectives in Malaysia's disaster management system will provide stakeholders with better insights into how to address opportunities, challenges, and threats. Currently, most policies in Malaysia emphasize post-disaster recovery rather than prevention and mitigation. Consequently, Malaysia's disaster management approach has been more reactive than proactive, with responses often initiated only after a disaster has occurred without consideration of potential climate induced disasters. Hence, the further studies are suggested to investigate the comprehensive disaster risk reduction management framework as well as the decision support system which integrated the climate change elements.

## References

1. Department of Irrigation & Drainage Flood Management - Programme and Activities. [Online] Available at: <https://www.water.gov.my/index.php/pages/view/419?mid=244> (2017); [Accessed 2 April 2024].
2. Golden HE, Hoghooghi N. Green infrastructure and its catchment-scale effects: an emerging science. *WIREs Water*. 2018; 5(1):1254.
3. Haliza A. R. Climate Change Scenarios In Malaysia: Engaging the Public. *International Journal of Malay-Nusantara Studies*, November, 2018; 1(2), pp. 55-77.
4. Hamin Z, Othman M. B. & Eliasc Z Floating on a Legislative Framework in Flood Management in Malaysia: Lessons from the United Kingdom. *Procedia - Social and Behavioral Sciences*, 2013; 101, 277-283.
5. Hasan H. H, Mohd Razali S. F, Muhammad N. S, and Ahmad A. Hydrological Drought across Peninsular Malaysia: Implication of Drought Index, *Nat. Hazards Earth Syst. Sci. Discuss.* [preprint], 2021; <https://doi.org/10.5194/nhess-2021-249>.
6. Ibrahim K, Shabudin A. F. A, Koshy K. C & Asrar G. R. A new framework for integrated climate finance and inclusive responses to sustainable development in Malaysia. *Geomatics, Natural Hazards and Risk*, 2016; 7(6), 1754-1768.
7. IPCC Climate Change The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, In press, 2021; 2021: doi:10.1017/9781009157896.
8. Mageswari M Ensuring Malaysia's Disaster Preparedness. [Online] Available at: <https://www.nadma.gov.my/en/media-en/news/302-ensuring-malaysia-s-disaster-preparedness>. 2022; [Accessed 29 January 2023].
9. National Security Council National security policy. Putrajaya Malaysia. Noorhashirin H., Nor Faiza T., Mohammad Farhan R. & Juni M. H. Assessing Malaysian Disaster Preparedness for Flood. *International Journal of Public Health and Clinical Science*. 2019; 2016: 3(2).
10. Rahman B. A. Issues of Disaster Management Preparedness: A Case Study of Directive 20 of National Security Council Malaysia. *International Journal of Business and Social Science*, March, 2012; 3(5),85-92.
11. Rainard M, Smith C & Pachauri S. Gender equality and climate change mitigation: Are women a secret weapon? *Frontier in Climate*, 2023; 5(1), 17.
12. Ramli M.W.A, Alias N.E, Mohd Yusof H, Yusop Z and Taib S.M. Development of a Local, Integrated Disaster Risk Assessment Framework for Malaysia. *Sustainability*, 2021; 13, 10792.
13. Ridzuan M. R, Razali J. R, Soon Ye J & Amira N. An Analysis of Malaysian Public Policy in Disaster Risk Reduction: An Endeavour of Mitigating the Impacts of Flood In Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 2022; 12(7), 2006-2021.
14. Salleh K. O. & Ghaffar F. A. Climate Change And Its Implications On Poverty In Malaysia. *Jurnal Sarjana Jilid*, 2009; 24(1).
15. Sani G. D, Barzani Gasim M, Ekhwan Toriman M. & Abdullahi M. G. Floods in Malaysia: Historical Reviews, Causes, Effects and Mitigations Approach. *International Journal of Interdisciplinary Research and Innovations*, 2014; 2(4),59-65.
16. Sarkar M. S. K, Begum R, Pereira J. J. & Jaafar A. H. Addressing Disaster Risk Reduction in Malaysia: Mechanisms and Responsds. Kuala Lumpur, Malaysia, 2nd International Conference on Environment, Agriculture and Food Sciences 2013.
17. Sharmin Akter Moyna, Kamrul Hasan, Kazi Humayun Kabir, Md. Ayatullah Khan and Shantanu Kumar Saha Depressive symptoms among women in disaster-prone region in Bangladesh, *Journal of Affective Disorders Reports*, 2024; 16,100762.
18. Shariffah S. S. J & Jemain A. A. Spatial analysis of daily rainfall intensity and concentration index in Peninsular Malaysia. *Theoretical and Applied Climatology*, 2012; 108(1), 235-245.
19. Sillmann J, Thorarinsdottr T, Keenlyside N, Schaller N, Alexander L.V, Hegerl G, Seneviratne S.I, Vautard R, Zhang X and Zwiers F.W. Understanding, modeling and predicting weather and climate extremes: Challenges and opportunities. *Weather and Climate Extremes*, 2017; 18,65-74.
20. Shah A.A. Understanding and managing flood hazards in Malaysia. *Current Science*, 2015; 106(5).
21. Tan C. T. & Pereira J. Management of Climate Change and Disaster Risk: The Malaysia Perspective. In: W. L. Filho, ed. *Climate Change and Disaster Risk Management*. Berlin Heidelberg: Springer. 2013; 193-204.
22. Tan, K. W., Loh P.N. & Huang Y.F. Development of Climate Hazards Decision Support System: A Study of Cameron Highlands, Malaysia.. *Carpathian Journal of Earth and Environmental Sciences*, August,



- 2019; 14(2), 495-504.
23. Tabari H. Climate change impact on flood and extreme precipitation increases with water availability. *Sci Rep* 2020; 10, 13768. <https://doi.org/10.1038/s41598-020-70816-2>
24. Yohannes H. A Review on Relationship between Climate Change and Agriculture. *Journal of Earth Science & Climatic Change*, 2016; 7(2).
25. Zainuddin A. Frustration Grows in Malaysia Over Government's Slow Flood Response. [Online] Available at: <https://thediplomat.com/2021/12/frustration-grows-in-malaysia-over-governments-slow-flood-response/> 2021; [Accessed 9 August 2023].