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Research Article

A review on disaster risk reduction and climate change adaptation: Gaps of governance in Malaysia

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ABSTRACT

As global climate factors have changed, the number and severity of climate-related disasters has enormously increased. Adapting the strategy to the disaster risk reduction objective and factoring in climate change are essential for optimal disaster risk governance. The purpose of this article is to examine the current gaps in Malaysia practices on disaster risk reduction and adaptation to climate change. This study used the search in Science Direct, Web of Science, Scopus, and Google Scholar to conduct a literature assessment of journal articles published in the last decade on disaster risk reduction, climate change, and governance under specific conditions. DRR and CCA's purview includes the overarching topic of search. Due to the scarcity of data on DRR and CCA in Malaysia, we have reviewed local publications, policy documents, and other sources of information. There is a lack of study on contemporary governance in Malaysia, such as the lack of an updated and complete policy, obstacles in the involvement of many disciplines and the sharing of data, and a lack of a prominent plan, despite evidence that the subject is actively debated around the world. The study concluded that it is promising area for future study to enhance disaster risk governance on how to incorporate the climate change agenda into disaster risk reduction plans in Malaysia.

Keywords: Disaster Risk Governance; Disaster Risk Reduction; Climate Change Adaptation

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1. INTRODUCTION

Human activities, together with natural influences, have contributed to the 1.1-degree Celsius temperature increase that has resulted in global warming over the last 200 years. As a result, numerous climate-related hazards are merely increasing over time, putting the community at risk. Anthropogenic activities contribute to greenhouse gas emissions, with CO2 emissions totaling 2400240 GtCO2 from 1850 to 2019 (IPCC, 2023).

To prevent further catastrophe, it is required that the global temperatures increment to be controlled below 1.5°C before the year 2025. This can be performed by limiting carbon emissions gradually by 43% by 2030, continues to 60% by 2035 and reaching net-zero in early 2050 (IPCC, 2022).

Climate-related hazards, such as floods, cyclones, droughts, heat waves, rising sea levels, rapid wildfires, and infectious diseases, have emerged as a direct impact of climate change (UNDRR, 2022b). Climate-related disasters account for 6,681 of the 7,348 foremost

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catastrophes that have been documented between 2000 and 2019. More than 1.2 million human lives were lost, with over 4 billion populations were disrupted, all while economic losses totaling US$2.97 trillion were incurred (CRED & UNDRR, 2020).

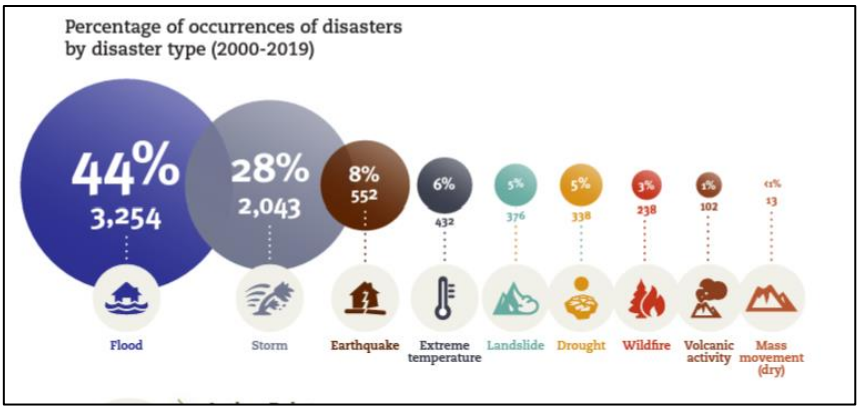

Fig. 1. Percentage of disasters occurrence between 2000 and 2019 (CRED & UNDRR, 2020)

Number of tropical thunderstorms and cyclones is rapidly increase with global warming (Bacmeister et al., 2018; Roberts et al., 2020) with total of 2,034 cases between 2000 and 2019 as compares to 1,457 cases between the period of 1980 and 1999 (CRED & UNDRR, 2020). The percentage of land area and population in the world threatened by extreme droughts and water scarcity is expected to more than double between 1976 and 2005, when it was 3 percent previously, and by 2100, when it is expected to be 7 percent or 8 percent(Pokhrel et al., 2021) and it has greatest influence on agricultural drought(Qiu et al., 2023). With each degree of global warming, the likelihood of extreme daily precipitation events that may contribute to water inundation by about 7 percent (IPCC, 2021). As result by referring to Fig. 1 above, total flood events have more than doubled, with 3,254 cases (2000-2019) compared to 1,389 in 2000 (1980-1999) (CRED & UNDRR, 2020).

While human activity contributes to climate change, heatwaves not only become more common but also occurs at a higher rate (Perkins-Kirkpatrick & Lewis, 2020). As the impact of a climate change, the ocean level rises, and it will cause floods which will occur along 68% of the world's coastline due to tides and storms and 32% due to regional sea level rise. By 2100, 48 percent more land, 52 percent more people, and 46 percent more assets worldwide will be susceptible to flood(Kirezci et al., 2020). Moreover, it is estimated that in some part of the world, the current 100-year extreme sea-level event at least once a year by 2100, with a temperature increase of 1.5 °C (Tebaldi et al., 2021).

Climate change increases the frequency with which some human-made fires and drought overlap, extending the fire season and boosting the total amount of dry years (Pausas & Keeley, 2021). Wet bulb globe temperature has reached 33 degrees Celsius as a result of the increase in global-mean surface air temperature of 1 degree Celsius above preindustrial levels, which will have negative effects on human health, agronomy, the economy, and the global atmosphere (Li et al., 2020). In addition, more people will be exposed to Aedes-borne viruses, despite the fact that disease can be transmitted by many other complex factors, such as constraints on mosquito distribution and virus adaptation.

Under moderate climate change scenarios, the spread of Ae. albopictus is expected to rise at the extremes. It is estimated that 500 million more people will be affected by vector-borne disease by 2050 (Ryan et al., 2019).

In summary, climatological (climate) and meteorological (weather) hazards have the potential to degrade ecosystems, reduce water and food availability, and alter lifestyles in the food and agriculture sectors, followed by the water sector, the environment, health, and finally the industrial sector. (Valente et al., 2022). As an adverse impact of climate change becomes greater, it is critical that climate-related hazards are properly managed through the implementation of an enhanced climate risk governance system (UNDRR, 2022b).

Since the UNFCCC Bali Action Plan, researchers have been investigating how to incorporate climate change adaptation into disaster risk reduction efforts (UNISDR, 2009), nevertheless, it is an emerging field with enormous growth potential.

In tandem with the Sustainable Development Goals (SDGs), Paris Agreement and the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) seeks to create a resilient nation that can face and adapt to changing weather patterns and natural calamities. The aforementioned global frameworks hope to address disaster and climate risk governance in the long-term by fostering risk-informed communities as one of the four Priorities for Action outlined in the Sendai Framework which is to improve disaster risk governance (UNFCCC, 2015; UNISDR, 2015; United Nations, 2015). We can draw the conclusion that 2015 is an important milestone for the sustainable development goals, disaster risk reduction target, and integration concept of climate change adaptation (Wen et al., 2023)

In common, DRR and CCA as part of climate risk management initiative aims to risks associated with climate, especially extreme weather events and environmental degradation due to climate change, has to be controlled (Begum et al., 2014; Forino et al., 2015a). However, DRR is not primarily focuses on the hazards connected with climate change, yet it includes addresses risks related with other natural phenomena, for example volcanic eruptions and earthquakes (UNDRR, 2019; Wen et al., 2023). Adaptation to climate change addresses the climate change's impact on biodiversity, ecosystems, human health, and pandemic outbreak whereas disaster risk reduction prioritizes preventing losses to people and property (IPCC, 2022; Wen et al., 2023). Thus, CCA and DRR can be combined into an integrated governance system which both agenda is focusing on building resilient (UNDRR, 2022a, 2022b; Wen et al., 2023).

2. METHODOLOGY AND APPROACH

There are limited sources which discussed on how Malaysia could improve its disaster risk governance by combining climate change adaptation and disaster risk reduction strategies. Most researchers concentrate on a single aspect of either disaster risk reduction, climate change adaptation, or community resilience (Forino et al., 2017; Rahman, 2018; Rani et al., 2017; UNDP, 2017).

To ensure that no highly relevant papers are overlooked, it is essential to search for related papers published by all journals that have discussed the relevant topic in terms of the world concept. Using the databases Web of Science, Scopus, ScienceDirect, and Google Scholar, a series of literature reviews were conducted to identify the connection between disaster risk reduction and climate change adaptation that linked with disaster risk governance. The term “disaster risk reduction”, as well as “climate change adaptation” and “governance”, were included in the initial search for papers. Papers were carefully chosen to only discuss the idea of DRR and CCA integration with the element of governance so as to better concentrate on the concept.

Unfortunately, this may not have produced the expected outcomes. The vast majority of these papers focus on global disaster risk governance as it relates to disaster risk reduction and climate change adaptation. Therefore, to support for this extensive research in Malaysia context, the current national policy of DRR and CCA, as well as reports from the UNDRR, the World Bank, and local researchers, were retrieved to help fill the information gap regarding the adaptation of climate change into disaster risk reduction in Malaysia.

3. MALAYSIA CLIMATE PROFILE

The Koppen-Geiger Climate Classification categorizes Malaysia as having an Af climate. Mostly humid tropical climate, and warm with all month’s temperature above 18 °C. The climate of Malaysia is tropical rainforest. The average temperature is 24.5 degrees Celsius, with a low of 24.9 degrees Celsius in January and a high of 25.9 degrees Celsius in May. From 1991 to 2020, the average annual precipitation for Malaysia was estimated at 3,085.5 mm, with relatively stable monthly averages ranging from 200 mm in June and July to 250 mm in November and December (The World Bank Group and the Asian Development Bank, 2021).

It's predicted that by 2050, the average temperature in Malaysia will have risen by 1.5 degrees Celsius. Peninsular Malaysia is experiencing more negative anomalies than Sabah and Sarawak, which will likely lead to higher-than-average simulated rainfall in that region between 2020 and 2029. The Meteorological Department of Malaysia predicts that precipitation will rise most dramatically between the years 2090 and 2099. (Rahman, 2018). It was found that between 2000 and 2007, the annual average downpour in Malaysia increased by 17% for one hour, 29% for three hours, and 31% for six hours compared to the 1970s and 1980s (UNDRR, 2020).

This climate characteristic has made Malaysia prone to natural disasters like floods, landslides, droughts, and even infectious disease outbreaks. Due to precipitation and sea level rise caused by global warming, storm surge, saline intrusion and coastal erosion have become more frequent (CFE-DM, 2019; World Bank Group, 2021; UNDRR, 2020). High tide and sea level rise, the spread of disease, threats to biodiversity, changes in land cover and crop yields are just some of the other effects of climate change in Malaysia (Rahman, 2018).

Projections indicate that by 2030, the impact of multiple climate-induced disasters will have reduced Malaysia's annual GDP by 6% compared to a baseline scenario. The collapse of the logging and fishing industries, along with the accompanying drop in export demand, were to blame. Threats that degrade the environment and, presumably, cause and economic disturbances(World Bank and Bank Negara Malaysia (BNM), 2022). Therefore, it is important to monitor Malaysia's disaster risk governance and conduct research into the connection between disaster risk reduction and climate change adaptation in Malaysia.

4. DISASTER AND CLIMATE GOVERNANCE IN MALAYSIA

4.1. MALAYSIA DRR GOVERNANCE

In the wake of the 1993 collapse of the Highland Towers apartment building the Directive No. 20 issued by the National Security Council has been the disaster management policy in Malaysia and it was originally set up in 1997(Norizan et al., 2021a). At the national level, the assigned minister leads the Disaster Management Committee, while at the state and local levels, it is led by the state secretary and the district officer in charge (MKN, 2012). Several laws, including the Malaysia Civil Defence Force Act 1951 (Amended in 2016), the Fire Services Act 1988, the National Security Council Act of 2016, as well as the Prevention and Control of Infectious Diseases Act 1988, are also determining on disaster management in Malaysia, but their scope is rather limited to response and recovery only (UNDRR, 2020)

The mechanism encompasses the local, state, and federal levels of government, with responsibilities allocated according to factors including (1) severity and complexity; (2) damage and destruction; (3) the availability of financial, human, and other resources; (4) subject matter expertise; (5) available aid; and (6) the required response time (MKN, 2012).

Changes to Malaysia's disaster management strategy in 2015 included assigning the National Disaster Management Agency (NADMA) to the role of committee secretary at the national level and the Malaysia Civil Defence Force to that role at the state and district levels. Previously, all secretarial duties were handled by the National Security Council (CFE-DM, 2019). When it comes to disaster reduction in Malaysia, NADMA is in charge of crafting national policies, while state and municipal governments are responsible for implementing them on the ground (CFE-DM, 2019; MKN, 2012; UNDRR, 2020). Fig. 2 below shows the current Malaysia’s disaster management mechanism.

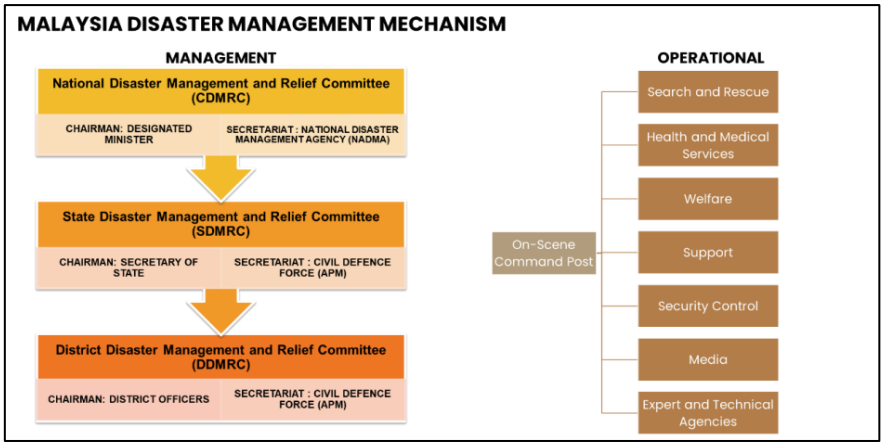

Fig. 2. Malaysia's Disaster Management Mechanism New Structure (CFE-DM, 2019; MKN, 2012; UNDRR, 2020)

Malaysia is now providing a significant amount of relevant public data on disaster damage and loss starting from year 2005 since the debut of the online Sendai Framework Monitor in 2018. In 2020, a new national damage and loss database will be built using the DesInventar software. This database will be freely available to the public and may be used to inform DRR policy and planning (Muhamad et al., 2021; UNDRR, 2020).

4.2. Malaysia Climate Change Governance

Since 2009, Malaysia's National Policy on Climate Change has served as the country's framework for addressing climate change. The primary goals are to preserve the environment, manage resources effectively, fortify the country against climate-related risks, and incorporate other applicable policies on adapting to this phenomenon (Norizan et al., 2021a; NRE, 2009).

The three pillars of climate governance in Malaysia are divided into policy makers, development planners and implementers, and guidance and reporting agencies (KASA, 2020). The structure of governance for climate change in Malaysia as Fig. 3 below.

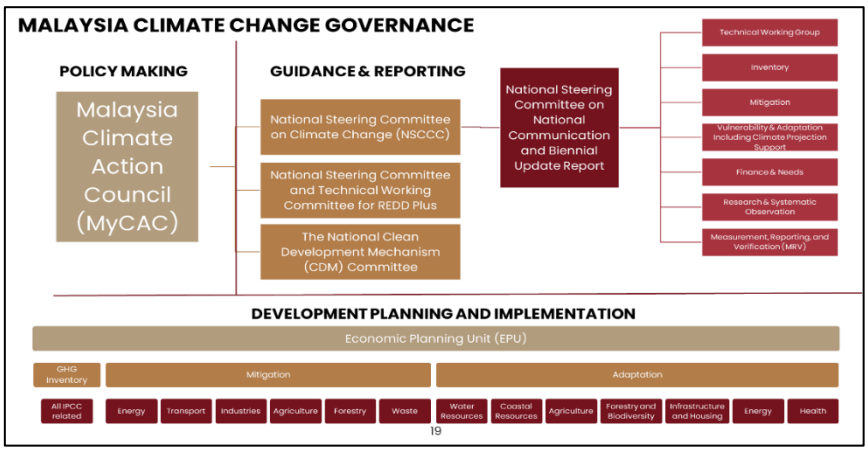

Fig. 3. Structure of Climate Change Governance in Malaysia (KASA, 2020)

Major roles in enforcing climate change policy are played by the National Green Technology and Climate Change Council which was formed in 2009. It was renamed as

Malaysia Climate Change Action Council (MyCAC) later in December 2020. Members of MyCAC includes the Minister of Environment and Water (KASA) and other prominent Cabinet members who act as a reactive secretariat, with the Prime Minister serving as its chair (KASA, 2020).

As the ruling government shifted in December 2022, the Ministry of Environment and Water (KASA) was unified with the Ministry of Ministry of Energy and Natural Resources (KeTSA). The merged ministry was later known as the Ministry of Ministry of Natural Resources, Environment, and Climate Change (NRECC)(NRECC, 2022).

Secretary General of the NRECC presides over the National Steering Committee on Climate Change (NSCCC), which is responsible for submitting national communications (NCs) and biennial update reports (BURs) to the United Nations Framework Convention on Climate Change (UNFCC). Six Technical Working Groups (TWGs) formed to assist the steering committee in terms of data and mitigation activities reporting (KASA, 2020).

The National Steering Committee and Technical Working Committee for REDD Plus is another set of committees with the same goal in mind, which is to lessen the impact that deforestation and forest degradation have on the global climate (KeTSA, 2021).

In 1994, the Malaysia established its Clean Development Mechanism (CDM) Committee as an additional steering committee. The Deputy Secretary-General of the Ministry of Environment and Water serves as the Chair of the Clean Development Mechanism Committee, while the Secretary General serves as the Designated National Authority (KASA, 2020; Malaysia Energy Center, 2009).

The Economic Planning Unit (EPU) has been tasked with overseeing the rollout of Malaysia's five-year Rolling Plan for Development, much of which focuses on addressing the effects of climate change (KASA, 2020).

On November 27th, 2015, Malaysia submitted its first INDC to the UNFCCC Secretariat, pledging to reduce its the percentage of GDP attributable to greenhouse gas emissions by 45 percent from 2005 levels by 2050. This target includes a 35% unconditional reduction and a further 10% conditional reduction, both relative to 2005 emissions intensity of GDP (Rasiah et al., 2017; Zen & Mohamad, 2021).

Later, on 30th July 2021, Malaysia has revised the plan to cut its carbon intensity (as a percentage of GDP) by 45 percent by 2030, compared to its 2005 level. As an improvement upon the last target, the amended NDC is more ambitious in the following ways: a decrease in carbon intensity of at least 45 percent is now mandatory (UNDP, 2021; UNFCCC, 2021).

5. COMPLEXITY OF COMBINING DRR AND CCA

5.1. GLOBAL GAPS OF INTEGRATING DRR AND CCA

While the idea of disaster risk governance is vital, it can be challenging to bring together disaster mitigation efforts and climate change adaptation strategies. Different DRR and CCA policies, different actors, and different ideologies and goals, inadequate funding, a

lack of information sharing, and poor resource governance all contribute to the hurdles of integrating both agendas (Fleming et al., 2020; Forino et al., 2014, 2015a; Hallwright & Handmer, 2021a; Islam et al., 2019, 2020; Nemakonde & Van Niekerk, 2017; Rahayu et al., 2020).

Furthermore, studies have shown that development plans give inadequate weight to the agenda for reducing disaster risks and adapting to climate change, with countries instead prioritizing the response and recovery stages of disaster management (Tierney, 2012a). Inadequate adaptation of disaster risk reduction effort in policy and climate management and environmental protection plans are being conducted in silos across a number of different countries, and there are also gaps in implementing good disaster risk governance (Forino et al., 2015a, 2017; UNDP, 2017).

Inadequate funding for national and local government to adapt the disaster risk reduction strategy and only focus on the emergency phases is a common challenge in disaster risk governance, especially when compared to international and regional multi-stakeholder platforms. Most national strategies treat climate change adaptation as a reactive response for emergencies, rather than tackling through a long-term, global risk factor. As a result, disaster risk reduction strategies have not been effectively implemented, posing a new and unprecedented threat to urban populations (Gall et al., 2014).

Although DRR projects, programmes, and interventions are very similar to CCA ones in many respects, however, actors for implementing DRR and CCA face the same bureaucratic and institutional hurdles. Many was due to a lack of resources, causing neither DRR nor CCA can take any further action (Islam et al., 2020).

Scientists and people who work in the field agree that the best way to reduce climate risks around the world is to make policies based on facts. But most of the past talks about how to use science to reduce the risk of disasters have been about how to share information better. But the actual claims that guide action have gotten less attention (Nohrstedt et al., 2022).

The recent change in the global climate has proven that enacting an efficient policy to lower the risk and impact of natural hazards is the utmost importance to considers the impact of climate change. The purpose of this study is to learn more about disaster risk governance in Malaysia, specifically on how disaster risk reduction policy and climate change adaptation can be interacted to strengthen local communities.

5.2. Gaps in Disaster Risk and Climate Change Adaptation in Malaysia

As evidenced by the available literature conducted for this project, there is a paucity of studies conducted in Malaysia that examine how the government can adjust to the new global climate risk and lessen the impact of future natural disasters.

Malaysia still needs help implementing good policy to further enhance either within the scope of sustainable development, disaster risk reduction or adaptation to climate change which are essential. Even though the country faces a low risk of climate-induced

disasters compared to its neighbours, the current disaster risk reduction policy is a top-down notch that needs a noticeable and effective integration with the climate change adaptation up to the local level (Shariff & Hamidi, 2019; UNDRR, 2020). The policy isn't very far-reaching, it hasn't been updated much, and it's being implemented inefficiently (UNDRR, 2020). The National Policy on Climate Change was also published in 2009, but it has not been revised since then, and its agenda remains out of date(NRE, 2009; UNICEF, 2021).

Previous studies have shown that ineffective policy making in Malaysia, particularly in regard to climate change and urban planning, is hindering the country's efforts to improve its disaster resilience. Most problems stem from insufficient preparation, a lack of dedication and investment from key players, and a failure to adhere to the law. The bureaucratic and compartmentalised nature of the Malaysian government can make it difficult for information to be shared between agencies (Rani et al., 2017).

The National Security Council's current policy on disaster risk reduction is outlined in Directive No. 20, first released in 1997 and most recently revised in 2012. Meanwhile, in 2009, the Malaysian government issued its National Policy on Climate Change (MKN, 2012; NRE, 2009). Since they were both passed before the Sendai Framework for Disaster Risk Reduction and the Paris Agreement on Climate Change were signed in 2015, it is safe to say that they do not reflect the new global approach to reducing climate and disaster risks (UNFCCC, 2015; UNISDR, 2015).

Climate Change Act and Disaster Risk Reduction Act are also not present. Although there has been prior effort to enact both acts, they remain in the drafting stages and have not yet been passed(Abdul Majid, 2021; CFE-DM, 2019; NADMA & JICA, 2021; UNDRR, 2020). It has been found that neither agenda provides a coherent policy framework, nor does it specify how much money will be spent or what goals will be set (Varkkey, 2019).

The International Federation of Red Cross and Red Crescent Societies describes Malaysia's management strategy for emergencies as Type C. Type C systems focus primarily on emergency preparation and response in the face of natural and some technological hazards, while the systems are more nuanced and should include elements of early warning and recovery as well (IFRC, 2015, 2022). The lack of enforcement, legislation, and policies related to climate change, especially in regard to monitoring the development and economic activities that severely damage the ecosystem, is compounded by the absence of a readily adoptable established competence framework on climate change. When it comes to monitoring the growth and economic activities that are damaging the environment and possibly contributing to the emergence of new man-made hazards, not enough is being done to enforce existing laws and create new ones concerning climate change (CAN & CGM, 2022; Yaacob et al., 2022). The fact that Peninsular Malaysia, Sabah, and Sarawak have not all adopted the same set of environmental protection laws makes it more difficult to put the climate change act into effect (UNICEF, 2021).

Disparity among federal, state, and local governments inhibit full implementation of the national disaster mechanism outlined in NSC Directive No. 20 to the grassroot level

(Khairilmizal et al., 2016). In a similar vein, climate change has risen to prominence at the federal level but has failed to permeate state and local governments (Zen et al., 2019).

Past disaster management's top-down, authoritarian approach may have contributed to a lack of community participation, empowerment, and preparedness for future climate-induced hazards (Sandaran & Selvaraj, 2021; Shariff & Hamidi, 2019). The lack of inter-agency collaboration at all levels, from the local to the federal, and the inadequate incorporation of climate change policy into local governance make it exceptionally difficult to collect relevant data and to implement the initiatives to the grassroot level (CAN & CGM, 2022; Palermo & Hernandez, 2020). In order for Malaysia to make a visible and fruitful local-level integration with the adaptation to climate change, it is crucial that public policy in Malaysia demonstrate action plans and commitments at the grassroots level of government (Marquardt et al., 2022; UNDRR, 2020).

It is also found that multi-stakeholder collaboration and cross-sectoral participation are hindrances in addressing climate change and disaster management in Malaysia. Malaysia must be flexible, innovative, and transboundary in its approach to regulating climate risk (Mustafa et al., 2018). It is recognised that the scope of Malaysia's current disaster management policy is rather limited(UNDRR, 2020). Upon a natural disaster strike, the government is fully in charge of all aspects of disaster response and recovery, including search and rescue, distribution of aid, and management of temporary housing (Salleh et al., 2020). Since disaster education, information dissemination, and post-disaster development are not specifically mentioned in the current DRR policy, public participation in these efforts is rather low (Sobian, 2016). Disclosure policy on data sharing regarding sustainability and climate change discourage public participation in the prevention of climate-related disasters, and similarly discourage private participation in data reporting (Apurva Sanghi, 2022; Omar & Amran, 2018; UNICEF, 2021). Therefore, Malaysia's public, private sector, and government must have access to environmentally sound policies that address green development planning, public education, and the inculcation of environmentally responsible values (Mustafa et al., 2018; Yaacob et al., 2022).

Due to a lack of openness in public finances and the difficulty of ensuring adequate allocations to preventative measures, disaster risk management in Malaysia is difficult(UNDRR, 2020). There is lack of comprehensive policies available to the public that would help the government maximise its data-sharing potential (Palermo & Hernandez, 2020; UNICEF, 2021). Inadequate reporting structures and a lack of transparency regarding data resources at all levels contribute to a severe lack of quality, quantity, and breadth of data in the field of climate risk adaptation (CAN & CGM, 2022).

Districts becomes more indecisive because of ineffective communication, coordination, and collaboration at the state level (Radi et al., 2019). This issue arises because there is no doubtful legal basis for line agencies to coordinate their activities(UNDRR, 2020). Conflict arose not only between emergency workers but also between different branches of government, businesses, and non-governmental organisations (Zubir et al., 2018). There is a lack of coordination between relevant ministries to take policy action to reduce climate

risk, and most organisations are only concerned with their own goals and tasks (Apurva Sanghi, 2022; CAN & CGM, 2022; Palermo & Hernandez, 2020; UNICEF, 2021).

Communities affected by a climate-related disaster are classified as victims by the government, making them appear passive, dependent, and helpless. Malaysian disaster management continues to use the conservative disaster management formation(Sandaran & Selvaraj, 2021; Shariff & Hamidi, 2019). The NSC Directive No. 20 and National Policy on Climate Change are not available to the public; the policy lacks clear direction and goals for response agencies incorporating disaster resilience; and the disaster policy hierarchy is incomplete (Salleh et al., 2020). As a result, the local community lacks both culture of disaster risk awareness and a disaster preparedness(Shakirand & Utaberta, 2019). Diverging priorities, visions, and values among urban planners result in a breakdown in community participation within the development plan, a lack of participation from other relevant disaster-related stakeholders, and a failure to incorporate adaptive disaster preparedness measures into the local development plan (Norizan et al., 2021b).

Therefore, we can conclude that there is a deficiency in a comprehensive policy approach in Malaysia because there are no additional details on the monetary allocation or specific targets to accomplish both the DRR and CCA agendas. In addition, there are no specific targets to reduce carbon emissions (Varkkey, 2019). There is a disconnect between the policies of DRR and CCA, with the former failing to set up adequate budget measures for DRR and the latter failing to integrate the two into a unified strategy (UNDRR, 2020).

Specifically, the failure to set up adequate budget measures for DRR includes the following: there is currently no strategy in place to deal with disasters that are caused by climate change. Thus, to achieve sustainability in the face of the unpredictability of climate change, the acceleration of flood events, and coastal erosion, Malaysia needs an efficient strategy for reducing the risk of natural disasters, as well as an adaptation plan for climate change that is integrated into urban planning and management(Palermo & Hernandez, 2020; The World Bank Group, 2022; UNDRR, 2020), the majority of the actions taken in response to the disaster were not preventative but rather reactive (Shariff & Hamidi, 2019), and when it comes to adapting to the effects of climate change while simultaneously lowering the country's vulnerability to natural disasters, this has been one of Malaysia's greatest challenges(Begum et al., 2011).

To be precise, the current policy does not precisely cover the effects of climate change or any of the other factors that contribute to the risk of natural disasters. At this early stage of UNFCCC and Kyoto Protocol implementation, Malaysia's policy places a greater emphasis on environmental hazards rather than adapting measures to climate change with the intention of reduce the risk of natural disasters (Mustafa et al., 2018; UNICEF, 2021).

Given the foregoing, it should come as no surprise that planning for the effects of climate change while reducing disaster risks poses considerable issues for Malaysia, as it does for many other countries. This suggests that stronger policy execution could help Malaysia's disaster risk governance advance. Climate change's consequences are not well known or

comprehended. Despite government efforts to improve awareness, many Malaysians still do not have a full understanding and awareness of climate change and its consequences on their communities. As a result of sloppy construction practices and careless planning, Malaysians are especially exposed to the consequences of climate change and natural disasters. Although the Malaysian government has taken steps to lessen the impact of global warming and natural catastrophes, currently, there is an obstacle in terms of discrepancy of resource. As a result, efforts to adjust to changing situations and mitigate possible harm may be hindered. Communities are frequently actively engaged and participate in climate change adaptation and catastrophe risk reduction measures. However, community involvement in such endeavours is frequently inadequate in Malaysia. It will be impossible to implement effective adaptation and risk reduction efforts without widespread support and cooperation.

6. RESOLVING DRR AND CCA INTEGRATION THROUGH ENHANCED GOVERNANCE

The term "disaster risk governance" was coined by the United Nations Office for Disaster Risk Reduction describing the frameworks that steer, coordinate, and manage disaster risk reduction and correlated policy areas. Good governance requires openness, inclusion, collaboration, and efficiency to effectively mitigate existing disaster risks and prevent the emergence of new ones (UNDRR, 2016). A comprehensive policy that takes into account the influences of climate change on disasters is an integral part of effective disaster risk governance (Tierney, 2012b).

Good urban governance is crucial to building resilient communities, as the UN Development Program has stressed (UNDP, 2017), thus adaptive governance can be used when there is inflexibility within governance, and anticipatory governance is used when responses are reactive, as suggested in the assimilation of disaster risk reduction with the climate change adaptation (Ni'mah et al., 2021).

Solving real-world or complex problems, such as the assimilation of DRR and CCA, necessitates providing alternative perspectives on those problems, conducting in-depth research, reaching consensus on definitions and guidelines, and providing all-encompassing services through a collaboration of multidisciplinary concept of governance (Choi & Pak, 2006; Matsuura & Razak, 2019; Serrao-Neumann et al., 2014).

Coordination, unification, and synergies inter-processes and activities at the national or international policy level are required for both DRR and CCA (Valente et al., 2022). Several scholars have developed conceptual frameworks to connect disaster risk reduction and adaptation to climate change. Sustainability in implementing DRR with CCA at all levels (international, national, regional, and local) is the focus of the research presented here. Organizational capacity building, efficient funding allocation, educational and awareness programmes, a comprehensive stakeholder network, coordinated efforts, a focus on vulnerable groups, the involvement of political institutions, and a shared political will are all major components of the framework (Begum et al., 2014; Forino et al., 2015a).

The intention on accomplishing better disaster risk governance, is to harmonise the action plan and strategies for reducing the risks of natural disasters with those relating to climate change (Forino et al., 2015b; Islam et al., 2020; Nemakonde & Van Niekerk, 2017; Serrao-Neumann et al., 2015; UNDP, 2017). The coordination, sharing of information, and productive network collaboration between the main actors in both fields can help achieve this goal (Forino et al., 2015b; Ni'mah et al., 2021; Pereira et al., 2010; Serrao-Neumann et al., 2015; Shaw et al., 2010).

Comprehensive policy and effective implementation are needed to address the gaps between reducing disaster risks and adapting to a changing climate and bridging the two concepts (Begum et al., 2014; Forino et al., 2015b; Hallwright & Handmer, 2021b; Islam et al., 2020; Serrao-Neumann et al., 2015). Financial stability and adequate budget allocation for disaster risk reduction and climate change adaptation agendas are also prerequisites for effective disaster risk governance (Hallwright & Handmer, 2021b; Islam et al., 2020; Pereira et al., 2010; Shaw et al., 2010; UNDP, 2017).

The primary goal of efforts to incorporate DRR and CCA should be to achieve sustainability at the macro, meso and micro stage of administration (global, regional, national, and local levels). This includes organisational capacity building, efficient resource allocation, educational and awareness programmes, a comprehensive network of stakeholders, coordinated and collaborative efforts, a focus on vulnerable sectors, common policy and political will, and the establishment of political institutions (Begum et al., 2014; Forino et al., 2015a).

A transdisciplinary approach can bring together multiple actors which include members of the government, the nonprofit sector, and the business community, to create adaptation strategies that are effective, equitable, and socially inclusive against the consequence of climate change. Giving a voice to marginalized groups is possible through the practice of participatory approach with the incorporation of local and indigenous knowledge (Serrao-Neumann et al., 2014, 2015).

Many social, economic, and environmental factors contribute to disaster risk, so addressing the issue from multiple perspectives is necessary. Inclusion of public participation and relevant stakeholders in decision-making and incorporating social and economic analysis into hazard and vulnerability assessments can strategized the governance better (Matsuura & Razak, 2019).

Science and technology are important parts of creating and using major international DRR frameworks, and this has been recognised. But bridging the gap between scientists and policymakers, like those who deal with climate change, is important if we want to get the most out of what we learn from scientific research and technological development for DRR. In a similar way, the UNISDR Science and Technology Advisory Group (STAG) has suggested that DRR policymakers and actors from all sectors, including the science and technological research organisation, to be unified in decision making process. This would strengthen the link between research and policy (Matsuura & Razak, 2019).

To address this issue of scientific integration, the DRR and CCA research field should establish a set of research priorities, establish connections between different bodies of knowledge, and devise strategies to overcome the challenges of working across fields of study. Conceptualization, measurement, and tracing back causes all present challenges (Nohrstedt et al., 2022).

Promoting research innovation centres is an example of cross-disciplinary work that can aid in the assimilation of disaster risk reduction and climate change adaptation (Zuccaro et al., 2020). In another aspect, network cooperation in times of tourism-related disaster(Aliperti et al., 2019), ecosystem-focused vulnerability assessment for local governments.(Myers et al., 2019), incorporating health care systems in DRR plans(Burkle, 2019), disaster financing advocacy, risk assessment integration, risk perception evaluation(Ishiwatari & Sasaki, 2023) are primary efforts to promoting the inception of CCA into DRR and identifying gaps and priorities for research and innovation.

While incorporating climate change into disaster risk reduction is difficult, it is essential if we are to improve our disaster risk governance. If actors from both fields can work together toward a common goal, establish an appropriate network, coordinate their efforts, allocate their resources wisely, and build a solid institutional framework, then integration could be achieved.

7. CONCLUSION

Evidence abounds that climate change poses a global threat. Most countries are feeling the social, economic, or vulnerability effects of an increase in climate-induced disasters. Improving disaster risk governance requires incorporating climate change into disaster risk reduction strategies. The analysis shows that the topic is important, and each year there are more and more studies conducted on it. There has been a lot of talk about incorporating climate change into disaster risk reduction policies, and Malaysia should do more to integrate climate change into the disaster risk governance system. Given the paucity of research into Malaysian governance policy, the time is right to look into the current strategies and identify the key actors who should be responsible for deriving it.

Therefore, the research presented in this paper has the potential to contribute to knowledge gaps and improve disaster risk governance in Malaysia by presenting future trends by focusing on the aspects of disaster risk reduction and climate change adaptation. The laws and regulations enacted in Malaysia for disaster risk reduction and climate change adaptation could be the subject of future study into the current state of disaster risk governance theory and practise. As such, it needs to be broadened to incorporate an examination of the current stakeholders and the network formation between the actors in both fields.

Further study could investigate the current international framework and the difficulties inherent in implementing international agendas in Malaysia. In order to integrate both agendas into Malaysian policy, it is necessary to take a close look at the similarities and differences between disaster risk reduction and climate change adaptation. This allowed us to foresee the incorporation of climate change adaptation into disaster risk reduction

policy and formulate a workable policy recommendation for enhancing disaster risk governance in Malaysia. In the not-too-distant future, hopefully, we'll be able to accomplish the goals set forth in the Paris Agreement, the Sustainable Development Goals, and the Sendai Framework for Disaster Risk Reduction 2015-2030.

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Mohd Syukri Madnor, contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. Aizul Nahar Harun and Faizah Che Ros verified the analytical methods, encouraged to investigate the integration concept of DRRR and CCA and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

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