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Enhancing Malaysia's Resilience: Integrating Sustainability in Disaster Risk Reduction Management and Environmental Stewardship

(Meningkatkan Daya Tahan Malaysia: Mengintegrasikan Kelestarian dalam Pengurusan Risiko Bencana dan Pengawasan Alam Sekitar)

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ABSTRACT

Disaster risk reduction (DRR) plays a vital role in maintaining national resilience against unforeseen environmental threats. In 2023, Malaysia experienced approximately RM0.8 billion in losses due to severe floods, affecting residential, commercial, and infrastructural sectors. This study aims to evaluate the effectiveness of Malaysia's current DRR strategies and environmental-based policies, particularly in terms of practical implementation and alignment with international frameworks. Using a mixed-method approach, the research incorporated a literature review and questionnaires distributed to over 80 respondents, including students from the International Islamic University Malaysia (IIUM) and members of the public. The findings indicate strong public support for more robust early warning systems and improved communication among stakeholders. Respondents expressed concern over the current reliance on post-disaster compensation and highlighted the importance of proactive, preventive measures to reduce risk. The study also uncovered gaps in awareness and policy coherence, especially for vulnerable groups. These insights support the need for reform in governance structures to build inclusive, sustainable, and resilient cities, aligned with Goal 11 of the Sustainable Development Goals (SDGs). Furthermore, the research underscores Malaysia's role in upholding its international environmental obligations, including commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. Ultimately, while disasters cannot be fully prevented, their risks can be significantly reduced through coordinated, forward-thinking policies that empower communities and strengthen disaster preparedness across all sectors.

Keywords: Disaster risk, environmental, sustainability, policies, SDG 2030

ABSTRAK

Setiap negara mengemukakan pelan pengurusan pengurangan risiko bencana yang sistematik bagi memastikan trajektori daya tahan negara dapat dikekalkan walaupun terdapat sebarang keadaan yang tidak dijangka yang mungkin berlaku. Pada tahun 2023, Malaysia dengan beberapa kawasan yang diketahui terdedah kepada banjir telah menghadapi kerosakan ketara kira-kira RM 0.8 bilion yang menjejaskan pelbagai sektor termasuk kawasan perumahan, premis perniagaan dan infrastruktur.Justeru, kajian ini bertujuan untuk menilai tindakan praktikal dalam pelan mitigasi risiko bencana semasa oleh kerajaan dan untuk memerhatikan dasar berasaskan alam sekitar sedia ada Malaysia yang membantu dalam mengurangkan kesan bencana.Kaedah penyelidikan melibatkan kajian kesusasteraan dan soal selidik yang diedarkan kepada lebih 100 responden, yang terdiri daripada pelajar Universiti Islam Antarabangsa Malaysia (UIAM) dan orang awam,untuk menentukan kebolehlaksanaan tindakan pengurusan bencana sedia ada di Malaysia. Hasilnya menandakan keperluan sistem amaran yang serba lengkap melalui komunikasi yang betul oleh pihak berkepentingan. Keputusan juga memanggil mekanisme pembetulan awal dan bukannya tindakan pampasan pada musim pasca bencana. Sejajar dengan Matlamat kesebelas Matlamat Pembangunan Mampan (SDG) 2030, cadangan tadbir urus yang betul diperlukan untuk mewujudkan bandar mampan yang inklusif dan berdaya tahan. Kepentingan penting kajian ini menganalisis usaha Malaysia yang koheren dalam mengekalkan kewajipan alam sekitar antarabangsa seperti Konvensyen Rangka Kerja Pertubuhan Bangsa-Bangsa Bersatu mengenai Perubahan Iklim (UNFCCC) dan Perjanjian Paris. Kajian ini menandakan pendirian penting untuk menganalisis kecekapan amalan dasar kami yang boleh memenuhi penyelesaian semasa dan masa depan kerana kami tidak dapat menghalang bencana daripada berlaku, namun kita sentiasa boleh meminimumkan risiko yang mendatang.

Kata kunci: Risiko bencana, alam sekitar, kemampanan, dasar, SDG 2030

INTRODUCTION:

Malaysia's geographical position near the equator and its monsoon seasons make it prone to several natural disasters, primarily floods and landslides during the wet season, as well as occasional haze, droughts, and very rare tsunamis.Malaysia is located in Southeast Asia and is divided into two regions by the South China Sea: Peninsular Malaysia and East Malaysia on the island of Borneo. It is a tropical country situated in the equatorial region that gives a hot and humid climate year-round with temperatures ranging from 26°C to 32°C (n.d.,2023). However,due to climate change, the temperature could vary,to be vigorously high. Moreover, the rainfall downpour pattern will increase drastically, especially in monsoon season.Malaysia experiences two main monsoon seasons; which are the Southwest Monsoon and the Northeast Monsoon, which take place expectedly in May and from November to March respectively. This season brings heavy rainfall, especially to the east coast of Peninsular Malaysia.The most affected areas by floods identified would be the states of Kelantan, Terengganu, and Pahang and East Malaysia, which particularly are Sabah and Sarawak.

Knowing the background of Malaysia in terms of the top frequent natural disaster, which is flooding,a multiple efforts between the relevant stakeholders are needed to be included in sustainable ways.For instance,the non-exhaustive involvement from the Ministry of Environment and Water (KASA), works on water management and sustainable practices to mitigate climate change-related risks, including floods and drought. The other ministries involved include the Ministry of Health (MOH),and the Ministry of Housing and Local Government (KPKT), which oversee local disaster risk reduction initiatives, including community preparedness and urban planning to reduce risks associated with natural disasters.

Agencies,such as the Royal Malaysia Police (PDRM), Malaysian Armed Forces (ATM),Malaysian Meteorological Department (MetMalaysia),Department of Irrigation and Drainage (DID),and Social Welfare Department (JKM) all play vital roles in ensuring the security and safety of flood victims' well-being and in mitigating the risk of potential damages from natural disasters. Notwithstanding that,the alarming situation in the country faces substantial challenges from increasingly intense and unpredictable rainfall patterns, influenced by global climate change. Notably, the December 2021 floods were among the most devastating in recent memory, impacting major states such as Selangor, Pahang, and Kuala Lumpur.

The disaster as reported by (Rosmadi, Ahmed, & Mokhtar, 2023) resulted in the loss of 54 lives, displaced over 71,000 individuals, and caused approximately RM 6 billion in damages to homes, infrastructure, and businesses. This is an important call to evaluate the existing effectiveness of our disaster risk management,and to incorporate the sustainability value to ensure our country,Malaysia, to be a resilient country. Flooding in Malaysia results in significant physical, psychological, and economic impacts on affected populations. The severity of these effects underscores the need for robust disaster preparedness, comprehensive emergency response mechanisms, and long-term rehabilitation programs. Mental health support, economic assistance, and the reconstruction of critical infrastructure are essential to fostering resilience and aiding recovery for individuals and communities devastated by these recurring natural disasters(Wang, Z., and Wang, F., 2022).

Besides the disaster risk concept, the sustainability practices in Malaysia have been thoroughly advanced to meet the required environmental stewardship that will help the region advance to a better level in preserving the country's needs. The elements of sustainability in our disaster risk management are measured through the four different Sustainable Development Goals (SDG) 2030,with an aim to be aligned with the international environmental obligation.

The main key goals are:

i. Sustainable Development Goal 11, also known as sustainable cities and communities, aims to provide a sustainable framework to develop cities that are inclusive, resilient, safe and sustainable.
ii. Sustainable Development Goal 3, also known as good health and well-being, aims to ensure healthy lives and promote well-being at all ages.
iii. Sustainable Development Goal 9, also known as sustainable industry, innovation and infrastructure, aims to develop quality, reliable, sustainable and resilient infrastructure.
iv. Sustainable Development Goal 15, also known as sustainable like on land, aims to promote the implementation of sustainable management of all types of forests as a form of natural barrier to mitigate flood impact.

Disaster risk reduction is a concept and practice of reducing disaster through systematic effort and analysis.The sustainability of the reduction management has been executed through various initiatives by

global organizations such as the United Nation and its branches.For instance,the United Nations Educational, Scientific and Cultural Organization (UNESCO),one of the biggest organizations, supports holistic disaster risk management in each state through 8 major things, which are as follows:

i. Post-Disaster Response,
ii. Risk Governance and Social Resilience
iii. The Built Environment
iv. Education School Safety
v. Early Warning Systems
vi. Environment & Ecosystem-Based Disaster Risk Reduction
vii. Science, Technology and Innovation for Resilience
viii. Disaster Risk Reduction for Culture & Sites

There are also different types of disaster risk reduction, which includes prospective,corrective,co mpensatory,community-based, local and indigenous people's approaches to disaster risk management.The prospective activities address and seek to avoid the development of new or increased disaster risks that may develop in the future. The corrective disaster risk management aims to reduce disaster risks that are already present.

The compensatory disaster risk management activities strengthen the social and economic resilience of individuals and societies in the face of residual risk that cannot be effectively reduced. They include preparedness, response and recovery activities, but also a mix of different financing instruments and social safety nets (DREF,2022).

Moreover, community-based disaster risk management promotes the involvement of potentially affected communities in disaster risk management at the local level. This includes community assessments of hazards, vulnerabilities and capacities, and their involvement in planning, implementation, monitoring and evaluation of local action for disaster risk reduction. Lastly, the local and indigenous people's approach to disaster risk management is the recognition and use of tradition to complement scientific knowledge in disaster risk assessments.

This study also incorporate authentic case studies whereby the author had visited Sendai,in bringing through the learning from the Sendai Framework for Disaster Risk Reduction 2015–2030 framework, which has been adopted by the United Nation, and the exclusive learning from Tohoku Gakuin University,Japan as a form of model examples to upgrade our disaster risk management.The study of environmental stewardship will also be discussed throughout the invocation of a site visit in Singapore based on the incorporation of their country in integrating sustainability despite urbanization taking place.

OBJECTIVES:

This study is guided by the central research question as to what extent is Malaysia's disaster risk management, across pre-disaster, during, and post-disaster phases to effectively build resilient communities and cities against flood-related impacts, and how it can be enhanced through sustainable and internationally-aligned practices. In line with this, the study aims to evaluate the effectiveness of Malaysia's current disaster risk management strategies across all phases of disaster response. Next, it also analyzes Malaysia's adherence to international obligations such as the Sustainable Development Goals (SDG) 2030. This study also formulated context-sensitive recommendations for sustainable disaster management by comparing relevant international case studies and incorporating feedback from public surveys. The ultimate objective is to contribute to practical reforms that strengthen national mitigation frameworks and reduce both pecuniary and non-pecuniary harm caused by natural disasters.

METHODOLOGY

This study adopts a mixed-method research design, integrating both quantitative and qualitative approaches to provide a comprehensive analysis of disaster risk management practices in Malaysia. The methods employed include structured questionnaires, literature review, and observational case studies through on-site visits. This combination allows for triangulation of data sources, enhancing the validity and depth of the findings.

For the quantitative component, structured questionnaires were distributed to a total of 100 respondents, comprising students and staff at the International Islamic University Malaysia (IIUM) as well as members of the general public across different regions of Malaysia. The questionnaire was divided into four main sections, each corresponding to relevant Sustainable Development Goals (SDGs). A five-point Likert scale (ranging from Strongly Disagree to Strongly Agree) was used to assess respondents' awareness, attitudes, and perceptions towards disaster risk management and sustainability. To ensure the

validity of the instrument, the questionnaire was reviewed by academic experts in disaster studies and piloted with a small group (n=10) to identify and rectify ambiguities. Reliability was tested using Cronbach's alpha, with results above the 0.70 threshold, indicating acceptable internal consistency. The data was analyzed using basic descriptive statistics, including mean and standard deviation, to summarize the survey findings.

TABLE 1. Agree Likert Scale

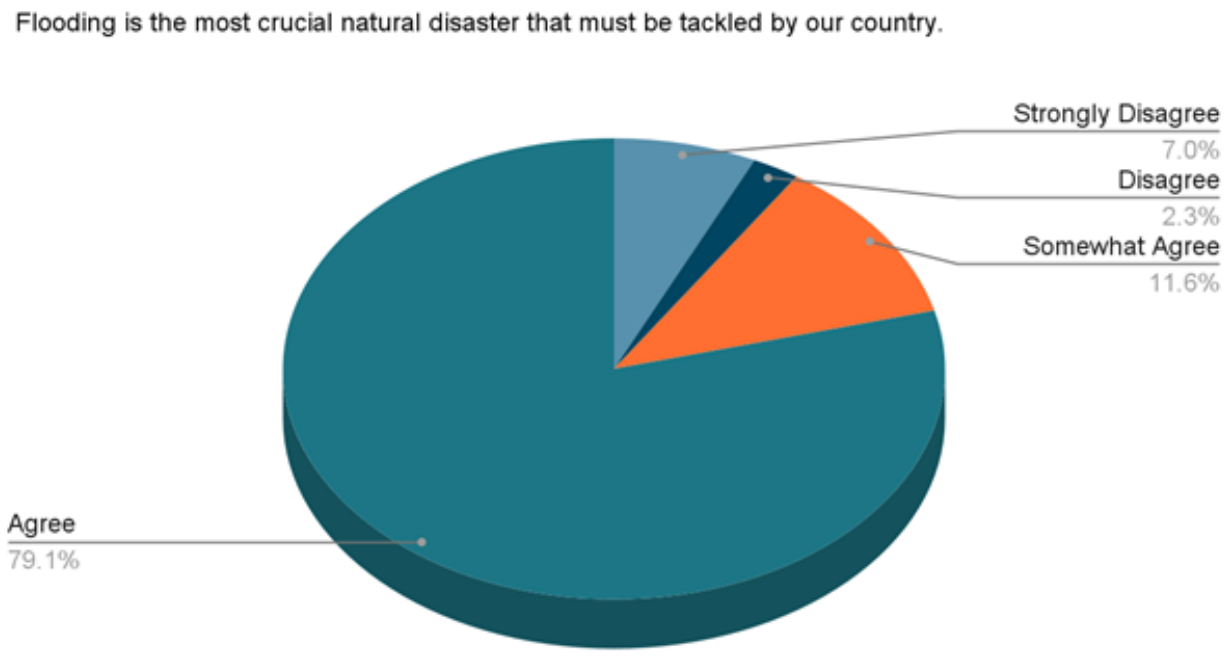
Score	Level of agreement
1	Strongly Disagree
2	Disagree
3	Somewhat Agree
4	Agree
5	Strongly Agree

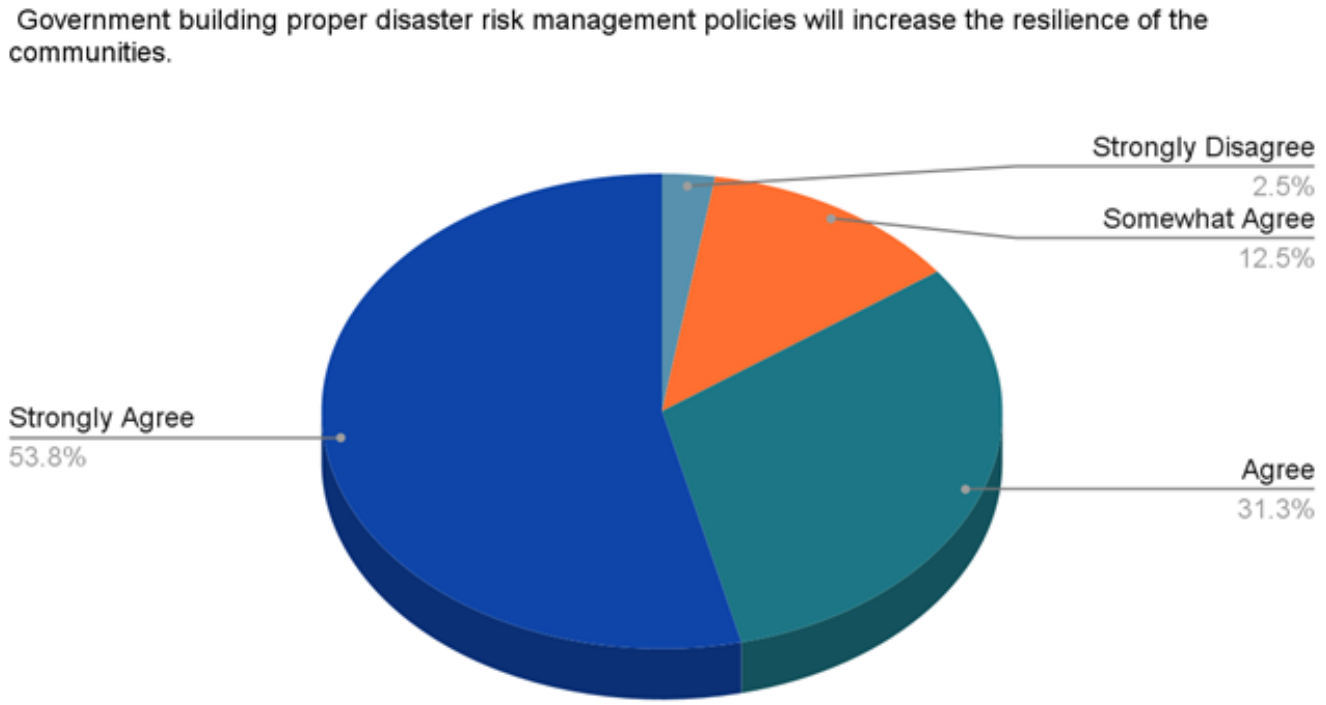
For the qualitative component, archival research and comparative literature analysis were conducted to explore international best practices in disaster management. This was complemented by on-site observational visits to Sendai, Japan renowned for its advanced and community-based disaster resilience and the Cloud Forest in Singapore, recognized for its integration of environmental sustainability into urban design. These locations were purposefully selected based on their relevance and applicability to the Malaysian context. A thematic analysis guided by principles of grounded theory was employed to analyze qualitative data, allowing for the identification of recurring themes and policy implications.

By integrating data from surveys, literature, and field observations, the study achieves methodological triangulation, which enhances the credibility and robustness of the findings. Additional references and supporting data were obtained from official government portals, international organizations, and academic databases to ensure that the analysis remains current, contextual, and evidence-based.

TABLE AND GRAPH

There were 80 people who responded to the survey that our group conducted, including both the IIUM Gombak community and the general public. Respondents to the project we're working on filled out surveys beginning on November 10 and continuing until November 25, 2022. These responses obtain trustworthy information by paying attention to thoughts of the majority,in order for us to achieve the aims of the study.





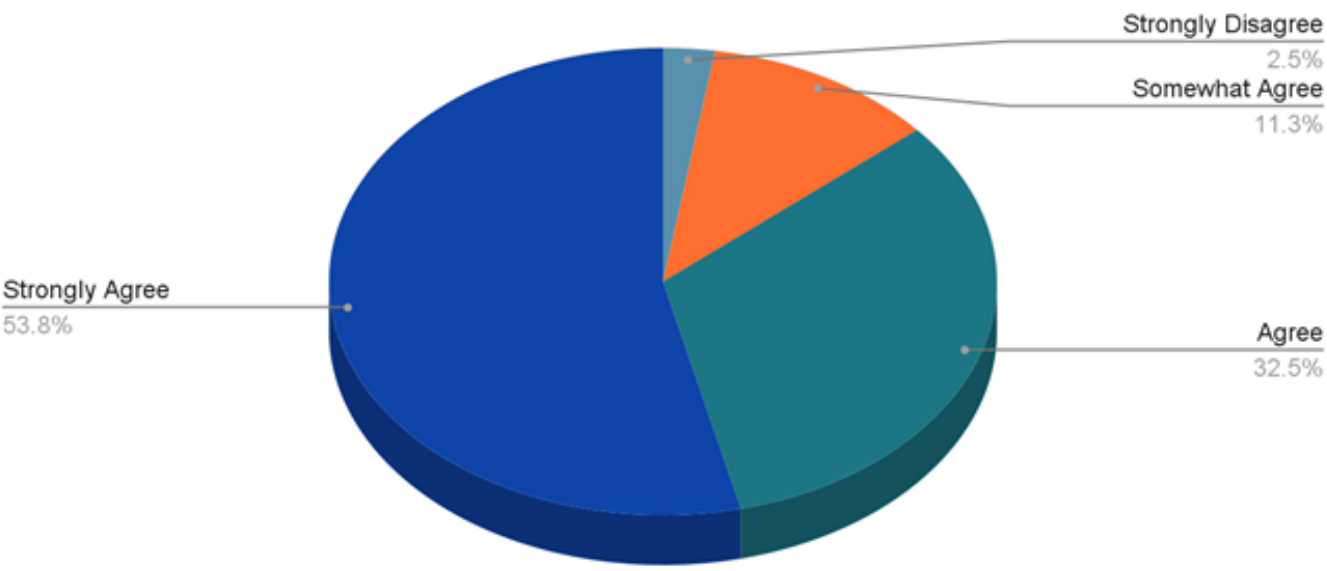


FIGURE 1. Data related to sustainable cities and communities

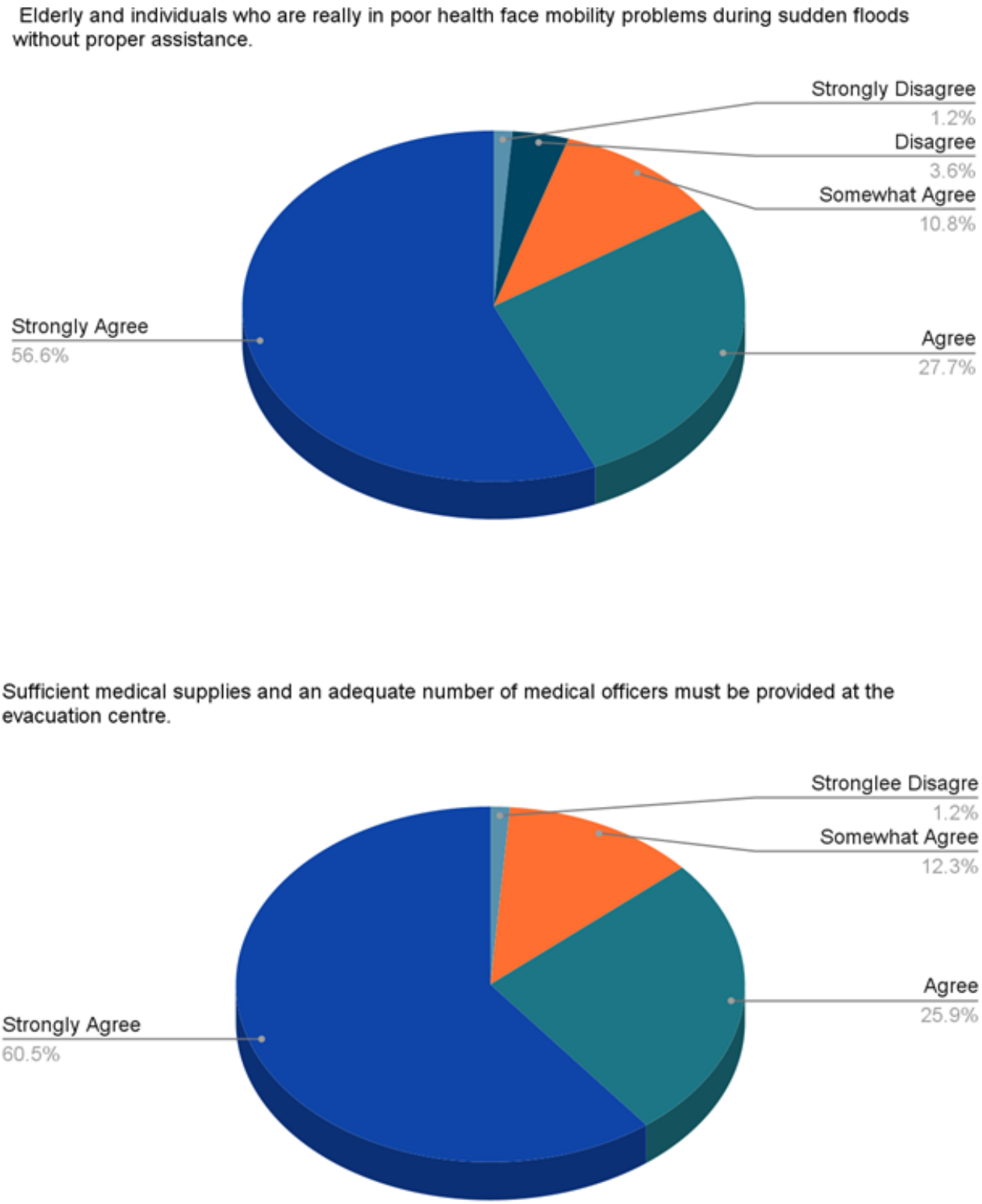


FIGURE 2. Data related to good health and well-being

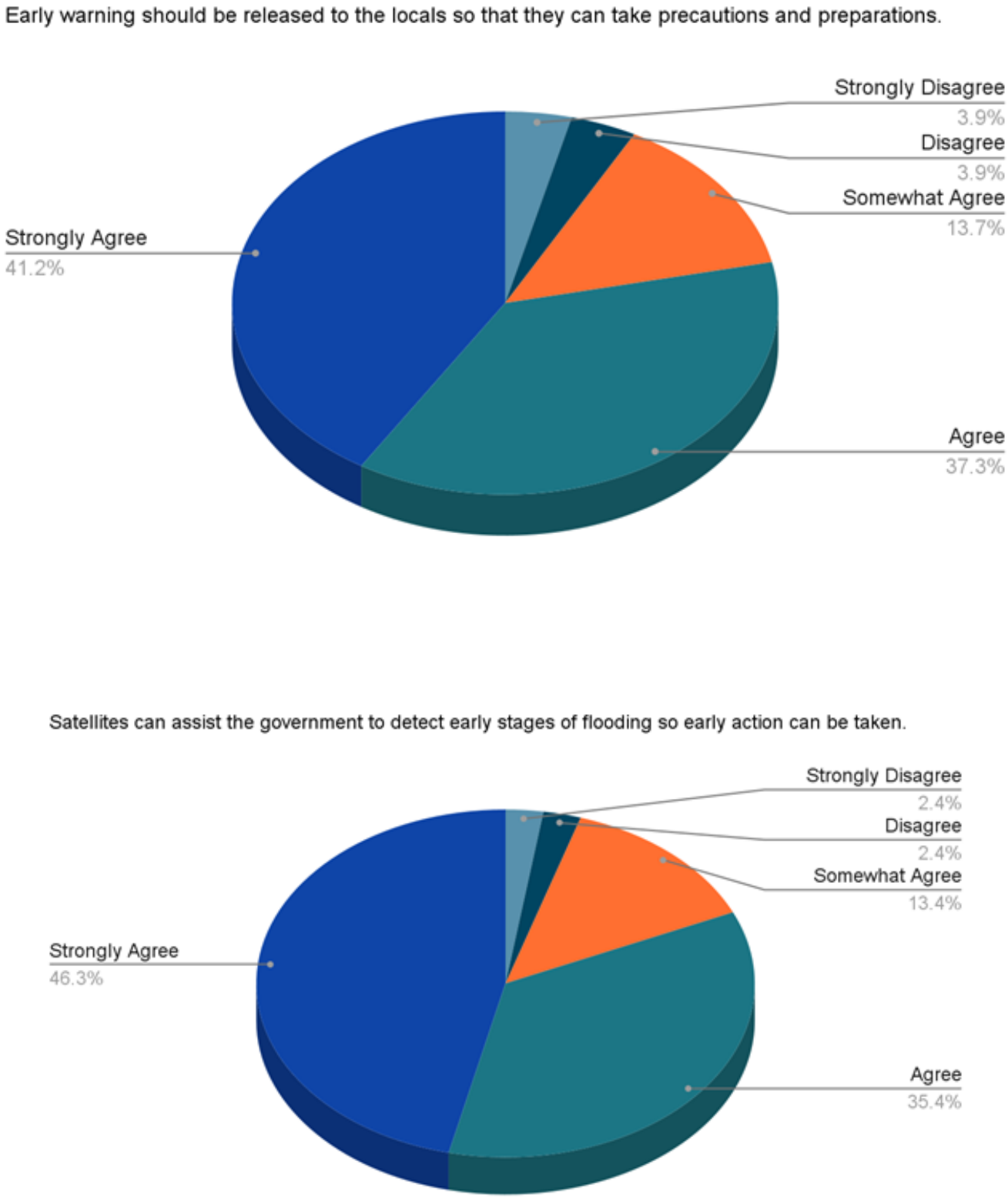


FIGURE 3. Data related to industry, innovation and infrastructure

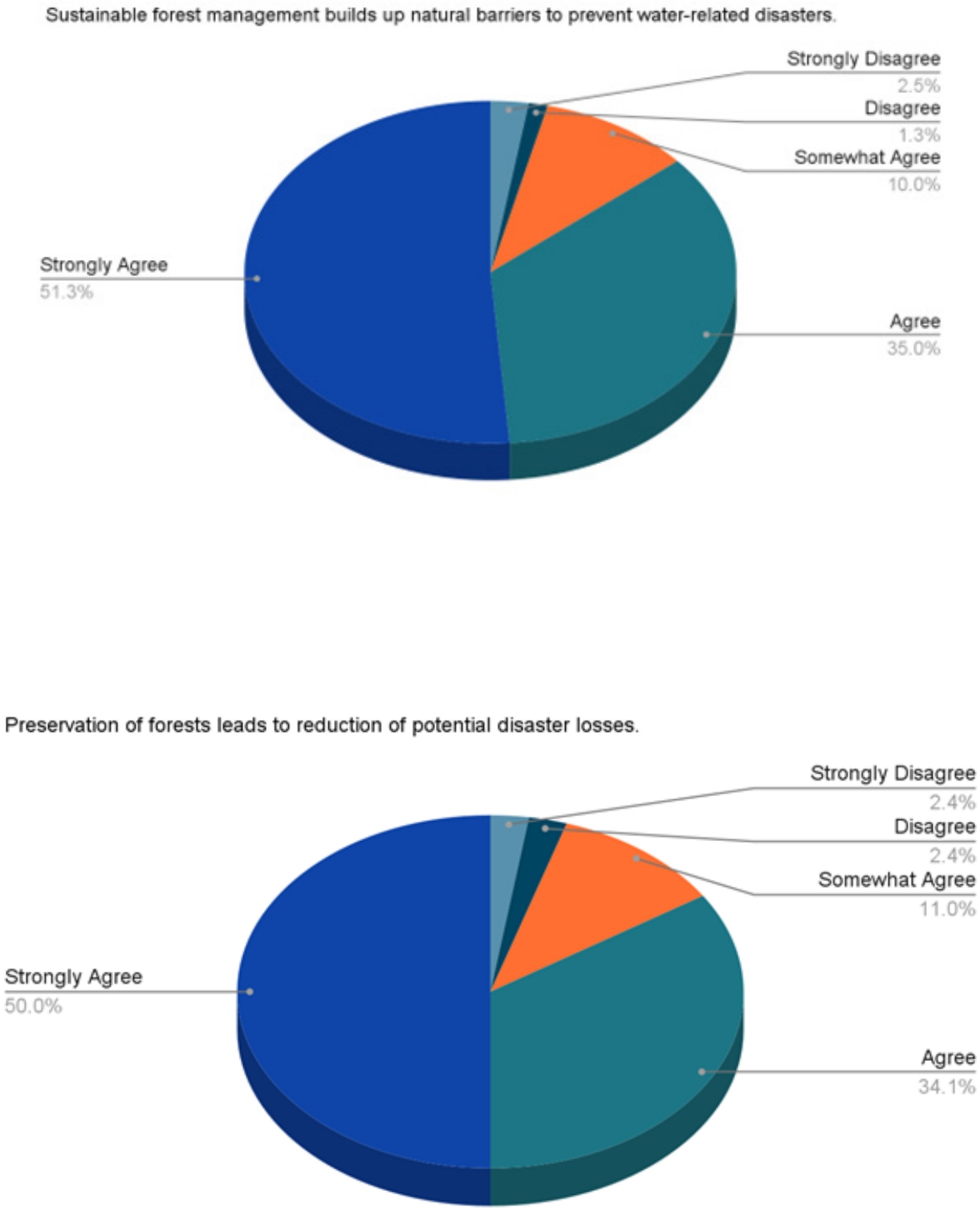


FIGURE 4. Data related to life on land; Forest Management

RESULTS AND DISCUSSIONS:

The findings from the survey reveal several key themes aligned with the study's objectives and the Sustainable Development Goals (SDGs), particularly Goals 3, 9, 11, and 15. These themes include public awareness of flood risks, perceived governmental preparedness, infrastructural readiness, and the value of environmental stewardship.

i. Community Perception of Flood Risk (Goal 11- Sustainable Cities and Communities): An overwhelming majority of respondents (over 90%) recognized flooding as the most urgent natural disaster threatening their communities. This strong consensus supports the study's objective to assess public awareness and the perceived severity of disaster threats. Only a small minority (7%) expressed disagreement, highlighting a relatively unified concern over flooding as a national priority. This data underscores the urgency for more resilient urban planning and targeted risk reduction strategies in Malaysian cities.

ii. Vulnerable Populations and Health Concerns (Goal 3 -Good Health and Well-Being): A significant 85% of respondents agreed that elderly individuals and those with health conditions face critical mobility issues during flood events. Furthermore, 60.5% strongly agreed and an additional 25.9% agreed that adequate medical supplies and trained officers are essential in evacuation centers. These results directly address the study's aim to understand vulnerabilities and advocate for inclusive disaster management frameworks. The very low disagreement (below 4%) reflects a clear public consensus on the need to prioritize health in disaster response planning.

iii. Early Warning Systems and Technological Support (Goal 9-Industry, Innovation and Infrastructure): Nearly 92% of respondents agreed that early warning systems are vital in helping locals prepare for disasters. Complementing this, around 95% supported the use of satellite technologies for early flood detection. These findings indicate public endorsement of proactive, technology-driven solutions. They also reinforce the study's comparative component, which explores best practices from other countries like Japan and Singapore, where such systems are already in place.

iv. Environmental Stewardship (Goal 15 - Life on Land): Over 85% of respondents acknowledged the importance of sustainable forest management in disaster risk reduction. This supports the view that natural ecosystems play a crucial role in buffering communities from flood impacts. The minimal disagreement (between 2–5%) further validates the potential for integrating environmental strategies into Malaysia's disaster framework.

Past Studies Quotation:

The sustainability journal traces by (Muzamil et al., 2022) back newspaper articles and experts' feedback from five years ago to determine the key problems behind the ongoing high impact of damage incurred by Malaysia. The study particularly focused on Sarawak,which detailed out among the primary challenges were poor drainage systems, rapid development in water catchment areas,lack of awareness and training on flood disaster risk, and poor coordination in executing the disaster management cycle among agencies.The late response from the government called upon the proactiveness of all stakeholders to mitigate and ensure the preparation stage before facing the disasters is well-equipped.For instance, the government consolidated fund could be contributed to the development of immersive infrastructure that is resilience to the local housing.Moreover,the early preparation and warning system should be installed in all flood-prone areas with clear guidelines for the locals to follow.Besides that, the stage of understanding the Disaster Risk Reduction extends to three layers, which are understanding, strengthening the governance and lastly, investing in financial funds to have the ability to fully support the building Malaysia's resilience(Nehren et al., 2014, p. 45).

Quoting different past studies based on a master's module titled the Disasters, Ecosystems and Risk Reduction made by the United Nations Environment Programme (UNEP).The past analysis in Indonesia,also suggested same as our findings, which are to strengthen the organizational framework for disaster,and better infrastructure through river and drainage system.The studies are difference from our findings,as they suggested nature-based solutions such as the rehabilitation of mangrove ecosystems to protect the coastal area from flooding,whereas our findings focus more on humanistic and technological solutions.

Moreover,past studies in the Netherlands' disaster risk management have shown the public and administrative consultation being held to deal with all stakeholders.This supports our findings in enhancing

the collaboration and better governance to solve disaster problems.Case studies in Guatemala and Mexico also supported local community organizations and national ministries' initiatives to enable faster communication and organization of donor coordination. Overall,most of the past studies including in the United States of America refer to the cost-benefit analysis.These efficient approaches made through legislation, technology, human approaches and natural ecosystem have been used for disaster risk reduction(Global Facility for Disaster Reduction and Recovery [GFDRR], 2023).

In addition, a past study made during the International Conference on Environment and study by (Chong, Wang, & Zhai, 2020) viewed that it has been agreed that the involvement of disaster risk management should not only involve the government at large, but we also must train our local community so they will be ready when disaster happens.The effective participation of community leaders will enable better decision-making in implementing the existing policies successfully during an emergency time.

However there is another difference between our study with (Current Sociology, 2013), which emphasizes insurance as an essential tool to help the recovery process during the post disaster. These insurances will cover the damages faced by the victims in terms of property, vehicles, and loss of life.

In fact, Malaysia has a structured and multi-agency approach to Disaster Risk Reduction (DRR), with an emphasis on preparedness, mitigation, and response strategies across different levels of government. The key policies, agencies involved, and stakeholders are organized within a cohesive national framework.Malaysia's disaster risk reduction strategy is primarily guided by national policies aligned with global frameworks such as the Sendai Framework for Disaster Risk Reduction (2015-2030). The country's National Policy on Climate Change (2009) and the National Security Council (NSC) Directive No. 20 serve as the main guidelines for managing disasters and ensuring a coordinated approach to disaster preparedness, response, and recovery (Government of Malaysia, 2023).

The NSC Directive No. 20 provides comprehensive instructions on how disaster management should be coordinated across federal, state, and local levels. It emphasizes the roles and responsibilities of various agencies and stakeholders in handling disasters, focusing on areas such as early warning systems, risk assessments, public education, and post-disaster recovery.

Importantly, the National Disaster Management Agency (NADMA) is the primary body responsible for coordinating disaster risk reduction and management efforts at the national level in Malaysia. It was established in 2015 under the Prime Minister's Department and is tasked with coordinating all disaster management activities, including planning, preparation, response, recovery, and mitigation. NADMA works in collaboration with various ministries, agencies, state authorities, and non-governmental organizations. Among NADMA's key functions are the implementation of early warning systems and coordination of disaster response and recovery efforts.In order to oversee post-disaster rehabilitation and reconstruction projects, a multi-agency effort with several key ministries and agencies taking specific roles are mandated (National Disaster Management Agency (NADMA), 2023).

Among others, the Ministry of Environment and Water (KASA) is responsible for environmental sustainability and managing climate change-related risks, including floods and droughts. KASA works on water management and sustainable practices to mitigate environmental disasters.Moreover, the Ministry of Health (KKM) also plays a vital role in providing medical assistance and public health interventions to remain functional during disasters. The Ministry of Housing and Local Government (KPKT) aims to oversee local disaster risk reduction initiatives, including community preparedness and urban planning to reduce risks associated with natural disasters.

Beside the ministries, agencies such as the Royal Malaysia Police (PDRM) and the Malaysian Armed Forces (ATM) provide security, rescue, and relief operations during disasters. They are also involved in coordinating evacuations and maintaining order in disaster-stricken areas. The Malaysian Meteorological Department (MetMalaysia) is also involved in the process of weather forecasting and issuing early warnings related to extreme weather events, such as floods and storms.In fact,the effectiveness of this department plays important remarks in community preparedness and in mitigating the harm that might be incurred. Next, the Department of Irrigation and Drainage (DID) plays a crucial role in flood management through its expertise in water resource management, river basin planning, and flood mitigation projects. Last but importantly, the Social Welfare Department (JKM) is obliged to provide welfare services and manages temporary shelters for displaced people during and after disasters.A proper evacuation center will enable the society to be vigilant in tracking their health and well-being, ensuring Malaysia being a resilient country despite the natural disaster that might happen.

The coordination at the national level enables NADMA to act as the primary coordinating

agency, working with national ministries, such as KASA,MOH,KPKT and the Ministry of Finance, which is involved in budgeting and resource allocation. Meanwhile,at the state level, the State Disaster Management Committee (SDMC) coordinates disaster risk reduction and response activities within the state. The SDMC works closely with NADMA and federal agencies. At the district level,the management is calibrated to relevant local agencies such as Municipal Councils, local police, and fire and rescue services to implement disaster preparedness measures and manage disaster response operations.However,despite these collaborative efforts, oftentimes the public or specifically any non-governmental organizations (NGOs), are way steadfast in helping and managing the impact of the natural disaster by themselves. While they are contributing to the recovery efforts to provide immediate relief and long-term support for communities affected by disasters, the government and local agencies must be well aware of and implement the role in sustainable disaster risk management way exclusively (Government of Malaysia, 2023).

Malaysia's disaster risk reduction framework is a coordinated effort that involves multiple government agencies, NGOs, and private stakeholders. NADMA serves as the central authority, working closely with ministries such as KASA, MOH, and KPKT, as well as state and local governments, to ensure an integrated approach to disaster management. The involvement of these stakeholders across all levels ensures that Malaysia is better equipped to reduce disaster risks, manage disaster impacts, and foster resilient communities.

To make Malaysia’s disaster management framework more efficient, adopting best practices from other countries that have demonstrated success in disaster risk reduction (DRR) can offer valuable insights. Many nations have developed advanced strategies, especially regarding mitigation, early warning systems, and resilience-building measures. Here are some exemplary countries and their practices that Malaysia could consider adopting.

Sendai,Japan Site Visit : Comprehensive Disaster Mitigation and Preparedness:

Japan is widely regarded as a global leader in disaster risk management, especially in the context of natural disasters. Its advanced strategies and frameworks are underpinned by both national experience and international partnerships. Japan's disaster preparedness is frequently cited as exemplary, and its practices are studied and emulated worldwide. According to the WorldAtlas report, Japan ranks among the top countries in reducing disaster risks, particularly under the Hyogo Framework for Action. It has earned a high score of 4.5 in disaster risk reduction, placing it among the best-performing nations in the world. Japan’s credibility in disaster risk management is further solidified by its partnership with the World Bank. The World Bank Tokyo Disaster Risk Management (DRM) Hub, established in 2014, promotes disaster risk reduction (DRR) in developing countries using Japanese expertise. This program supports over 270 projects in more than 110 countries. Japan’s global leadership in DRM is also reflected in its significant contribution to the Global Facility for Disaster Reduction and Recovery (GFDRR), where it helps nations institutionalize DRR as a national priority (WorldAtlas, 2023).

The index highlights Japan’s proactive disaster planning, resilient infrastructure, and innovative use of technology to mitigate risks. These recognitions, supported by robust frameworks like the Sendai Framework for Disaster Risk Reduction, demonstrate Japan's commitment to fostering resilience and providing a strong example for other countries to follow in the area of disaster risk management.

The site visit at Sendai,Japan; a city located in the northern area of Japan,which is prone to strong winds or typhoons and earthquakes, had facilitated themselves to be proactive in taking all disaster-reduction measures in case of any forecasted natural disasters.The durability of their infrastructures is made up of wood that can withstand high-pressure winds.The ability of the meteorological department to collaborate with all the local municipalities and local agencies by having the best technology and reading up the current temperature through satellites installed in one room.

Exclusively, the visit to Tohoku Gakuin University had showcases how the university students could collaborate with the local council in order to assist the disaster-impacted victims in evacuation centers.The students are well equipped with volunteer and training courses so that they have good capacity to help the nearby community.The centralized efforts of the government,to work with private entities and educational institutions showcase their partnership for goals effort to ensure every need of the people could be catered equally.

Other measures,such as Community-Based Disaster Management, have shown how Japan emphasizes community engagement through disaster drills and education programs, ensuring that citizens know how to respond to emergencies. Annual disaster preparedness drills, such as the "Disaster Prevention Day" on September 1, are conducted across the country to train citizens (Cabinet Office, Government of Japan,

2023).

The drilling system enables the proper simulation on where and how the potential victims should react in any case of disaster.The simple analogy on how we train schools to do fire drills, the disaster drill is even more important and could allow the government to detect any weaknesses that could be improved in the nearest time.Consequently,the behavioral pattern of the public could be improved as regular updates are made to the public on disaster risks. Disaster simulations, interactive apps, and public campaigns are regularly conducted to ensure preparedness at all levels of society.

Hence, Malaysia could improve its disaster preparedness by enhancing early warning systems for floods, landslides, and monsoon-related disasters. Public education and regular nationwide drills could be introduced to strengthen community-level preparedness, similar to Japan's model.

The early warning system could also be realized by collaborating with the meteorological department in Malaysia to ensure the detection through satellites could be well communicated,and evacuation processes could be done cohesively.Acknowledging that certain problems,might arise at the evacuation center itself, such as electrical shortages, local facilities that might not be usable, potential mental health and well-being of the victims might be impacted.Thus, this is the time for the establishment of a holistic support system model,incorporating the attributes studied in Japan.The evacuation center in Malaysia could be well linked with all the agencies,local food supply or manufacturers, energy stations such as Tenaga Nasional Berhad and by establishing local initiatives in building up Disaster Volunteer Station in the local area.This Station consists of university students that could help in facilitating flood victims and sustaining their mental health and well-being as to become the support system just as the training plan gained from Tohoku University.These university students are in fact,well trained with relevant skills required after attending volunteer courses,and training courses in their respective communities.These students linked up with communities and local councils enable these three stakeholders to contribute to the flood victims in order to ensure a sustainable disaster risk management could be sustained.

Site Visit to Sustainability Spot in Cloud Forest,Singapore:

Given Singapore’s vulnerability to climate change impacts like rising sea levels and extreme weather, climate adaptation is central to the DRR framework. The government invests heavily in sustainable infrastructure, climate resilience measures, and green technologies.By incorporating cloud forest principles and sustainability into urban planning and disaster preparedness strategies, Singapore can better address and mitigate potential risks associated with climate change and other environmental challenges.

Firstly, cloud forests help regulate the local climate by maintaining high humidity and cooler temperatures. In Singapore, this can contribute to better management of heat and humidity, potentially mitigating the effects of extreme weather events.Secondly, the biodiversity protection of the Cloud Forest ensures the preservation of diverse ecosystems that can offer natural solutions to disaster preparedness. For instance, diverse plant and animal species can contribute to soil stabilization and water regulation, reducing the risk of landslides and floods.

Next, cloud forests also sequester carbon, helping to combat climate change. Reducing carbon emissions and mitigating climate change impacts can help Singapore prepare for and reduce the severity of climate-related disasters, such as heatwaves and heavy storms.Eventually, the resilience building that integrates sustainable practices inspired by cloud forests creates green spaces and promotes urban biodiversity. This can eventually enhance the resilience of urban environments against disasters. These practices can help in managing urban heat islands and improving overall disaster readiness.

Other countries analysis:

Other countries such as New Zealand provide Risk Mapping and Hazard Zoning,whereby the New Zealand government has developed extensive hazard maps, identifying high-risk areas where development is restricted. These maps are continuously updated based on the latest scientific research, and urban planners use them to make informed decisions (Government of New Zealand, 2023). Malaysia could also mitigate the impact of disasters through collaborative efforts in developing the hazard maps and making them accessible to the public. Hazard mapping and zoning policies could be strengthened to avoid development in flood-prone or landslide-prone areas.The involvement of private sector stakeholders in resilience-building could also enhance the country’s resilience.

Apart from that,in long-term future management,an analysis of South Korea’s technological-based solutions has developed an efficient disaster management system that integrates technology, rapid response, and national coordination.For instance, the Integrated National Disaster Management Information

System (NDMIS) whereby South Korea's NDMIS centralizes disaster information in real time, enabling coordinated responses from various agencies. The system collects data from weather agencies, local governments, and emergency services, providing a comprehensive overview of disaster risks and responses (Government of South Korea, 2023). Eventually, Malaysia could also enhance its disaster management by adopting a centralized information system like South Korea's NDMIS. Expanding the use of technology, particularly mobile-based early warning systems and data-driven predictive tools, could improve response times and public engagement.

CONCLUSION

This study examined Malaysia's disaster risk reduction (DRR) strategies through the lens of four key Sustainable Development Goals (SDGs): Goal 3 (Good Health and Well-Being), Goal 9 (Industry, Innovation and Infrastructure), Goal 11 (Sustainable Cities and Communities), and Goal 15 (Life on Land). The findings highlighted the public's strong awareness of flood risks, support for early warning systems, concerns over the safety of vulnerable groups, and the importance of sustainable forest management. These insights reinforce the urgent need for a more inclusive, technologically adaptive, and environmentally conscious DRR policy framework in Malaysia.

To build more resilient communities and cities, disaster risk management must move beyond reactive responses and adopt a holistic and anticipatory approach, integrating public health readiness, infrastructure innovation, and ecological preservation. Government agencies should prioritize early warning systems, invest in disaster-resilient infrastructure (especially in flood-prone areas), and ensure that evacuation and health services are accessible, especially to the elderly and disabled. These reforms should be guided by national policy alignment with SDG 2030 goals, and also benefit from regional collaboration within ASEAN and globally, including technology transfer and expert exchange.

To strengthen the sustainability of disaster risk reduction (DRR) efforts in Malaysia, future reforms should prioritize youth participation and grassroots community empowerment as central pillars of national and local strategies. Drawing from international models such as the European Union's National Risk Assessment frameworks, Malaysia can adopt a multi-stakeholder, bottom-up approach that integrates local knowledge, youth innovation, and inclusive governance.Young people, especially in educational institutions and civic organizations, should be given opportunities to co-design early warning systems, lead awareness campaigns, and participate in community preparedness planning. These initiatives can be further supported through capacity-building programs, DRR education in schools and universities, and digital platforms for youth engagement in climate and disaster governance.

This grassroots-driven model must be backed by collaborative support from government agencies, private sectors, NGOs, and academic institutions, each playing a role in funding, technical support, and policy facilitation. Aligning these reforms with the Sustainable Development Goals (SDGs), especially Goals 11, 13, and 17, will ensure an integrated, future-proof DRR framework. By empowering local communities and youth as active agents of change, Malaysia can foster resilient societies that are better equipped to face both current and emerging disaster risks.

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APPENDIX

FIGURE 5. Site visit in Sendai Disaster Risk Reduction Institution

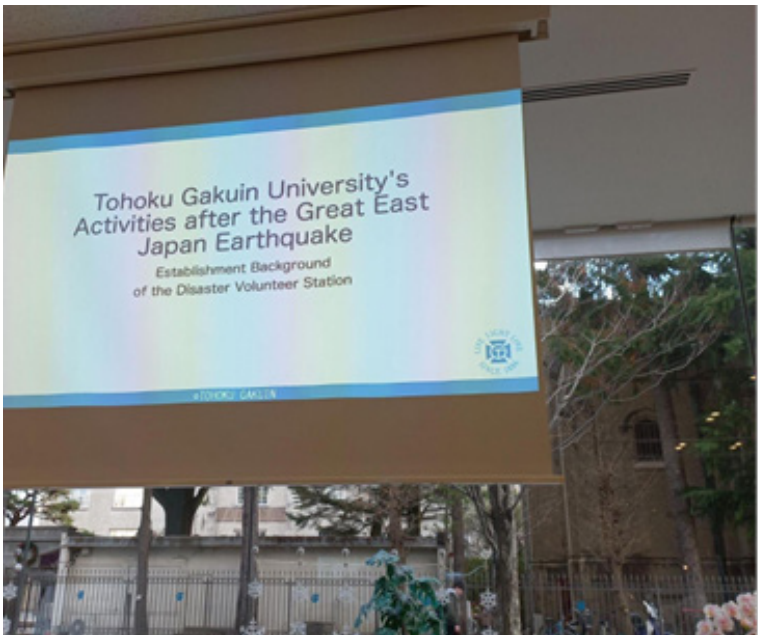

FIGURE 6. Learning session in Tohoku Gakuin University

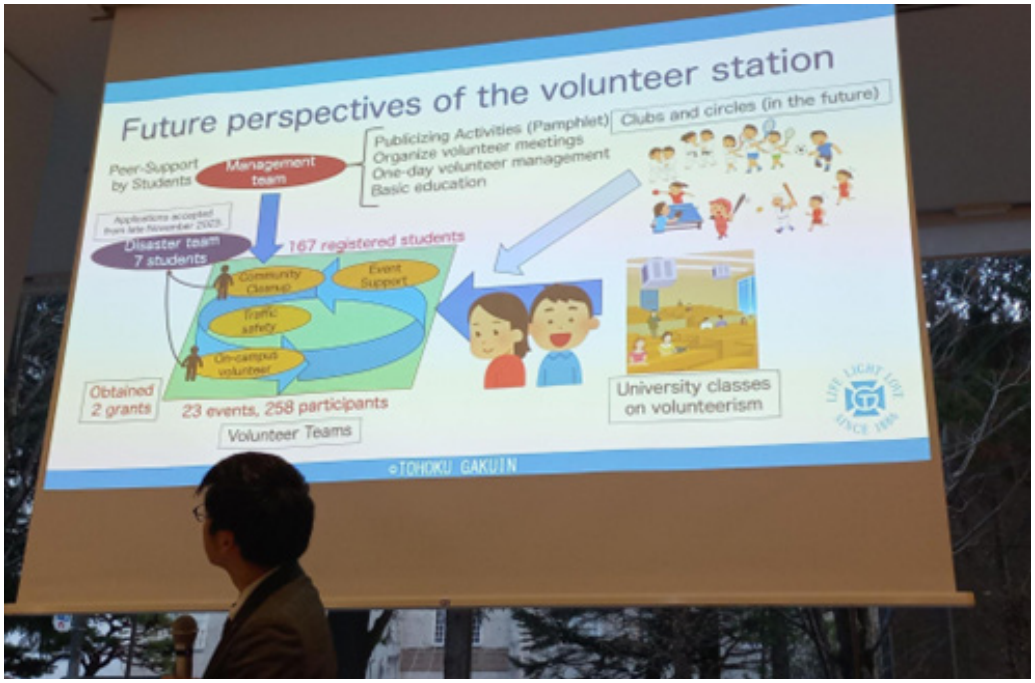

FIGURE 7. The Disaster Risk Management Plan in Tohoku Gakuin

FIGURE 8. Visit to Cloud Forest in Singapore

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