JABATAN PERDANA MENTERI
AGENSI PENGURUSAN BENCANA NEGARA

NATIONAL RISK REGISTER

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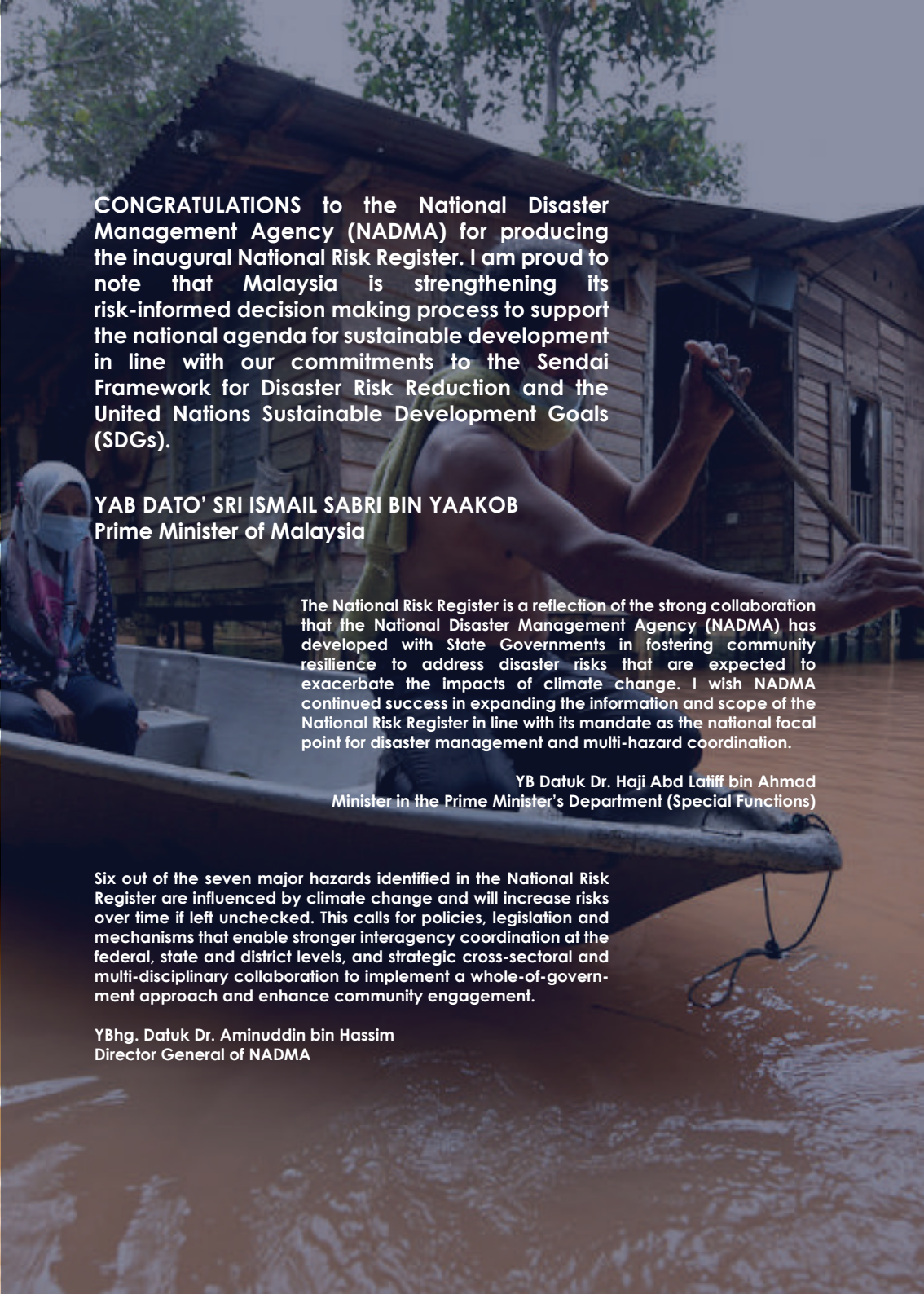

CONGRATULATIONS to the National Disaster Management Agency (NADMA) for producing the inaugural National Risk Register. I am proud to note that Malaysia is strengthening its risk-informed decision making process to support the national agenda for sustainable development in line with our commitments to the Sendai Framework for Disaster Risk Reduction and the United Nations Sustainable Development Goals (SDGs).

YAB DATO' SRI ISMAIL SABRI BIN YAAKOB
Prime Minister of Malaysia

The National Risk Register is a reflection of the strong collaboration that the National Disaster Management Agency (NADMA) has developed with State Governments in fostering community resilience to address disaster risks that are expected to exacerbate the impacts of climate change. I wish NADMA continued success in expanding the information and scope of the National Risk Register in line with its mandate as the national focal point for disaster management and multi-hazard coordination.

YB Datuk Dr. Haji Abd Latiff bin Ahmad
Minister in the Prime Minister's Department (Special Functions)

Six out of the seven major hazards identified in the National Risk Register are influenced by climate change and will increase risks over time if left unchecked. This calls for policies, legislation and mechanisms that enable stronger interagency coordination at the federal, state and district levels, and strategic cross-sectoral and multi-disciplinary collaboration to implement a whole-of-government approach and enhance community engagement.

YBhg. Datuk Dr. Aminuddin bin Hassim
Director General of NADMA

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BOXES

Overview

The National Disaster Management Agency (NADMA) Malaysia was established in 2015 as the national focal point for disaster management, undertaking responsibilities formerly held by the National Security Council of Malaysia. In 2020, NADMA completed the inaugural National Risk Register (NRR) for Malaysia. The NRR has been developed based on data from multiple sources and engagement with various government agencies. The information that was previously distributed in various departments is now collated under a single agency to strengthen disaster resilience and future planning.

This document is based on information from the NRR where the initial scope is on natural hazards. It is being shared with the public to foster local disaster risk reduction strategies through risk profiling and formulation of disaster resilience plans. It is also meant to promote better understanding and communication of risks to enhance actions that build up the resilience of critical infrastructure and basic services. The scientific values espoused in the NRR are documented in the Kuala Lumpur Consensus on Science and Technology for Disaster Risk Reduction (2020)[1].

The first section of this document provides background information on NADMA; highlighting key roles and activities as well as an overview of the NRR. The second section presents key findings on hazards and disasters in Malaysia including its classification according to likelihood and impact. The third section is devoted to provision of further information on hazards that occur in the country. Sources of the information including websites that are accessible to the public are provided here.

The inaugural NRR records Malaysia as being subjected to seven hazards. Ranked according to the risk matrix, these are floods, tsunami, earthquakes, landslides, storms, dry spells (drought), and wildfires. Future work will be undertaken to expand the coverage of disaster risks in line with the Sendai Framework on Disaster Risk Reduction. State and local authorities are encouraged to determine risk assessments for their respective jurisdictions. The risk profile at these levels is expected to be different due to variations of physical and geological susceptibility, exposure to hazards and level of vulnerability.

1 The Kuala Lumpur Consensus on Science and Technology for Disaster Risk Reduction documents the commitment of stakeholders from across the Asia Pacific, who participated in the 2020 Asia Pacific Science and Technology Conference for Disaster Risk Reduction. It was convened on 10 October 2020 under the aegis of the United Nations Office for Disaster Risk Reduction, NADMA and partners, to provide evidence-based information to inform the recovery process in the context and aftermath of COVID-19 to ensure long-term disaster resilience (https://www.ukm.my/apstcdrr/programme/).

Section 1: Introduction

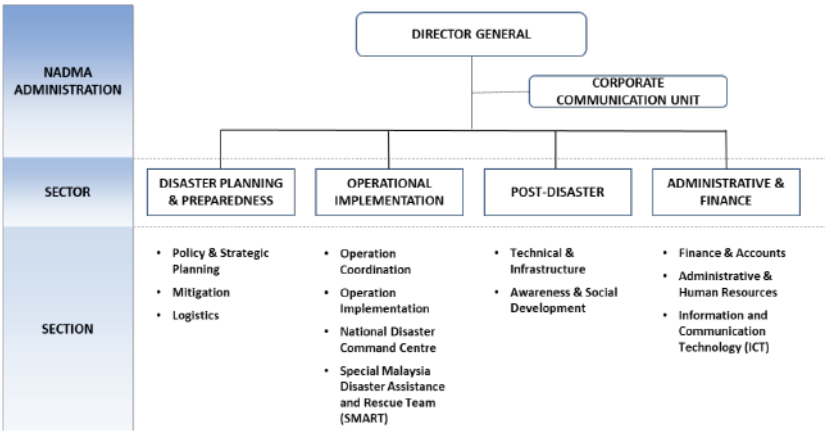
Flooded paddy field in Rompin, Pahang, 2020

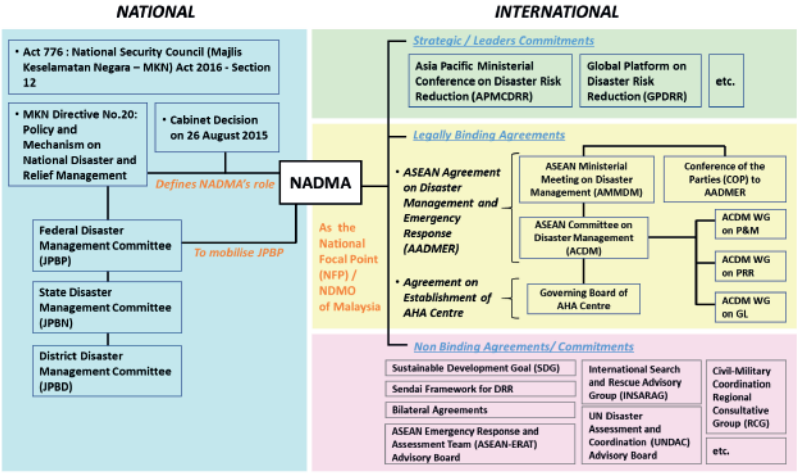
1.1 NADMA Malaysia – The National Focal Point for Disaster Management

Malaysia faced its worst ever monsoon floods in December 2014. This led to the establishment of the National Disaster Management Agency (NADMA) on 1 October 2015 through a Cabinet decision on 26 August 2015. Placed under the purview of the Prime Minister's Department (PMD), NADMA assumed control of responsibilities pertaining to disaster management formerly held by the National Security Council (NSC). The establishment of NADMA saw the amalgamation of three entities: Disaster Management Division of the NSC; Post-Flood Recovery Unit of the PMD; and Special Malaysia Disaster Assistance and Rescue Team (SMART). As the national focal point for disaster management, NADMA is responsible for formulating policies and mechanisms on disaster management with the support of its divisions.

At the national level, NADMA serves as the Secretariat for the National Disaster Management Committee, overseeing the implementation of policies and coordination of initiatives in line with the disaster management cycle. NADMA also oversees public awareness programmes and advocates strategic research for disaster risk reduction. The backbone in coordinating all major disasters in the country, NADMA manages the National Disaster Relief Trust Fund, directs deployment of the SMART Team and leads international humanitarian assistance for disasters. NADMA collaborates with technical agencies at the federal, state and district levels, including disaster management secretariats and relief committees, as well as other organizations at the regional and global platforms on disaster risk reduction (Box 1). As the national disaster management agency, NADMA oversees multi-hazard management transcending natural, biological and technological hazards, including battling the COVID-19 pandemic (Box 2).

Box 1. The organization of NADMA and its institutional linkages





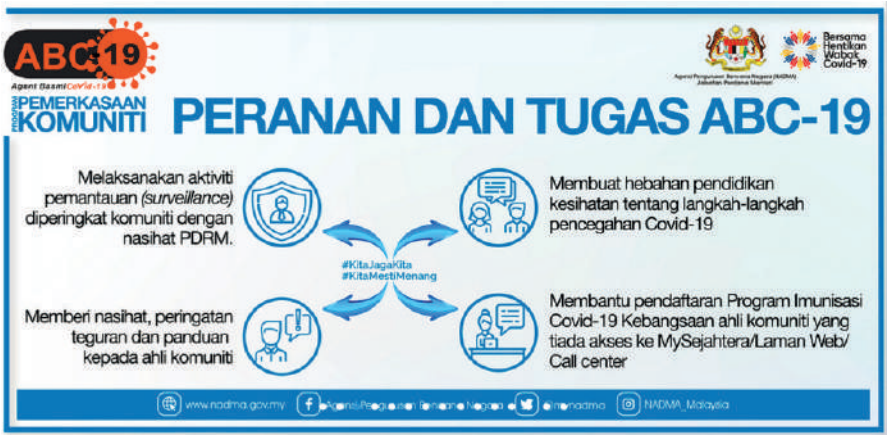
NADMA consists of four divisions that are dedicated to mobilize its strategic and operational roles across all phases of disaster management (top). As the disaster management focal point for the country, NADMA works with organizations at the global, regional, national and sub-national levels on disaster risk management, humanitarian assistance and disaster response (bottom). Within the country, NADMA coordinates disaster management at the national, state and district levels, which is critical for ensuring effective response and relief operations as well as risk reduction, in conjunction with other government agencies and stakeholders.

Box 2. Snapshot of NADMA in action

NADMA as the focal point for multi-hazard management: Battling the COVID-19 pandemic

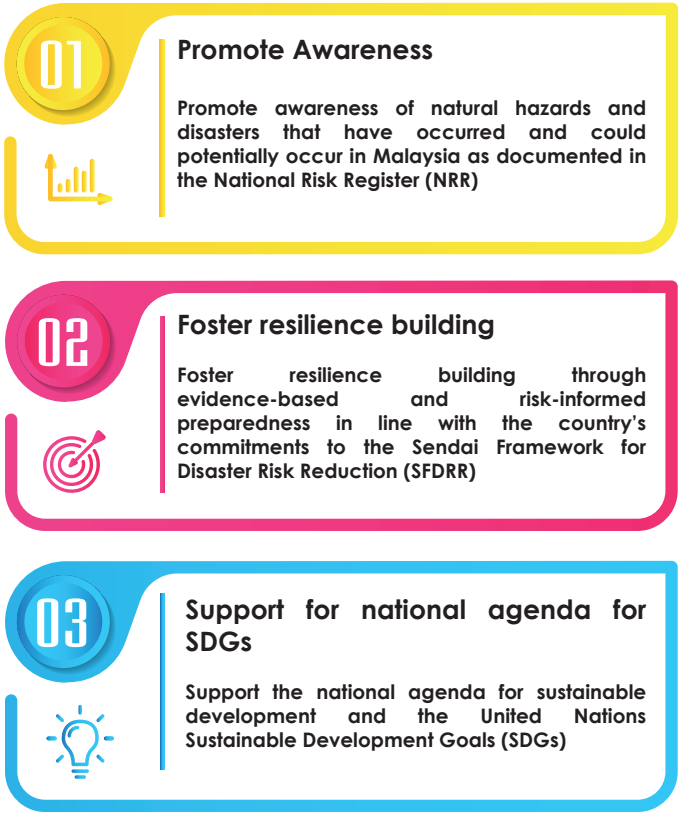
NADMA Malaysia has contributed significantly to support the Ministry of Health and the National Security Council in battling the COVID-19 pandemic. NADMA led the effort to prepare special guidelines to ensure the highest level of preparedness. The agency also played an instrumental role in establishing a fund to assist frontliners and victims of COVID-19. In conjunction with various stakeholders, NADMA contributed to assess the impacts of COVID-19 on national development priorities, vulnerable groups as well as small and medium enterprises, to strategically build continuity between immediate measures and longer-term recovery. More critically, the lessons learnt are being documented for better crisis preparedness and planning in the future. Specific tasks led by NADMA include the following:

- COVID-19 Special Assistance to Malaysian citizens who lost their source of income;
- Management of COVID-19 in flood evacuation centres;
- Entry and quarantine processing of persons under surveillance arriving from abroad.



The ABC-19 programme of NADMA takes a whole-of-society approach to educating and promoting awareness at the community level in the COVID-19 pandemic. The acronym ABC-19 stands for Agen Basmi COVID-19 in the Malay Language, meaning the agent to prevent COVID-19. The programme includes community surveillance, guidance and information dissemination on prevention measures, and registration for immunisation for groups without access to the internet.

1.2 Scope and Purpose



The scope of the inaugural NRR is on natural hazards. Further expansion to cover the full range of hazards in the Sendai Framework for Disaster Risk Reduction including Natural Hazards Triggering Technological Disasters (Natech) is under consideration. The information in this document is drawn primarily from the NRR. It is being shared with the public to foster local disaster risk reduction strategies through risk profiling and formulation of disaster resilience plans. It is also meant to promote better understanding and communication of risks to enhance actions that build up the resilience of critical infrastructure and basic services. The scientific values espoused in the NRR are documented in the Kuala Lumpur Consensus on Science and Technology for Disaster Risk Reduction (2020).

National Risk Register

The National Risk Register (NRR) captures a range of potential impacts of hazards and their cascading risks that may directly or indirectly affect Malaysia in the coming years.

The National Risk Register has been developed based on data from multiple sources, engagement with various technical agencies and ministries, and information from NADMA on disaster management and risk reduction initiatives. The information that was previously distributed in various government agencies is now collated under a single agency to strengthen disaster resilience and future planning.

The NRR will leverage existing legal instruments that provide for the collection, consolidation, analysis and sharing of information critical to an effective governance system for disaster risk reduction. It is intended to support the role of NADMA as the focal point for multi-hazard disaster management and coordinator of disaster events in the country through its National Disaster Command Centre (NDCC).

It was developed by NADMA after the completion of the inaugural national level disaster risk assessment conducted in 2020 under the Eleventh Malaysia Plan. The information is useful to support the decision-making process and allocation of resources for the phases of disaster management. There are five phases in disaster management or disaster management cycle, namely: disaster prevention, mitigation, preparedness, response and recovery (Box 3). It would also benefit federal, state and local authorities as well as individuals, families and businesses in promoting a culture of safety and strengthening disaster resilience.

Further Information

Further information on NADMA and key agencies that are involved in the management of hazards and disasters in Malaysia can be obtained from:

- NADMA website: http://www.nadma.gov.my/
- NDCC portal: http://portalbencana.nadma.gov.my/
- Department of Environment, JAS: https://www.doe.gov.my/
- Department of Irrigation and Drainage, DID: https://www.water.gov.my/
- Department of Mineral and Geoscience, JMG: https://jmg.gov.my/
- Department of Social Welfare Malaysia, JKM: https://www.jkm.gov.my/
- Malaysia Civil Defence Force, APM: https://www.civildefence.gov.my/
- Malaysian Meteorological Department, MetMalaysia: https://www.met.gov.my/
- Malaysian Space Agency, MYSA: https://www.mysa.gov.my/
- Public Works Department Malaysia, JKR: https://www.jkr.gov.my/
- District and Local Council Offices

Box 3. Disaster management phases

Disaster Management Cycle

The disaster management cycle in Malaysia is adapted to support existing legislative directives, promote consistent practices and accommodate practitioners from multidisciplinary backgrounds. The cycle comprises five phases: prevention, mitigation, preparedness, response and recovery. Disaster risk reduction (DRR) is part of each phase.

Disaster Prevention *(Pencegahan Bencana)* focuses on long-term measures for reducing or eliminating risk. Such measures include mainstreaming disaster risk reduction, legislation, land-use regulations, standards, guidelines and insurance as well as measures to reduce underlying risk factors. Aspects of prevention include delineation of disaster prone areas and vulnerable populations, early warning tools, communication of risks to policy and decision makers as well as the public, engaging stakeholders and providing regulations on evacuation. Prevention is the most cost-efficient method for reducing the impact of hazards.

Disaster Mitigation *(Mitigasi Bencana)* aims to prevent hazards from developing into disasters altogether or to reduce the effects of disasters through physical construction. Mitigation measures encompass both engineering and nature-based structures through the use of technological and innovative solutions.

Disaster Preparedness *(Kesiapsiagaan Bencana)* essentially involves informing the public about disaster risks and what to do in the event of a disaster. Information of this kind can be incorporated into the education system, starting from early childhood learning. In the preparedness phase, emergency managers develop plans of action to manage disasters and take action to build the necessary capabilities. Common preparedness measures include communication plans, proper equipment maintenance, training of emergency response teams, testing of early warning methods, and development of trained volunteers among civilians.

Disaster Response *(Tindakbalas Bencana)* includes mobilizing the necessary emergency services and first responders such as fire fighters, police and ambulance crews in the disaster area. These will be supported by secondary emergency services, such as specialist rescue teams. A well-rehearsed emergency plan developed as part of the preparedness phase enables efficient coordination of rescue.

Disaster Recovery *(Pemulihan Bencana)* essentially focuses on restoring an area affected by disaster to its previous state. Recovery efforts are concerned with issues and decisions that must be made after immediate needs are addressed. Actions include rebuilding destroyed property, re-employment, and the repair of other essential infrastructure. Efforts should be made to "build back safer", aiming to reduce the pre-disaster risks inherent in the community and infrastructure. Effective recovery efforts take advantage of a 'window of opportunity' to implement prevention and mitigation measures that might otherwise be unpopular while the impact of the disaster is fresh in the memory of its victims.

Section 2: Hazards and Disaster Risks in Malaysia

Eroded river bank near Jerantut, Pahang, 2020

2.1 What are disasters and hazards?

DISASTERS

Disasters are defined by the National Security Council of Malaysia Directive 20 as disruptions to socio-economic activities and official duties of the government involving loss of life, damage to properties, economic loss and destruction of natural habitat, which exceeds the coping capability of citizens and requires extensive resources for action. The management of disasters or any hazardous event that has the potential to become a disaster is clearly spelt out in Directive 20, depending on the scale, magnitude and coping capacity at the district and state levels.

DISASTER RISK

Disaster risk is the potential loss of life, injury, or destruction or damage to assets, which could occur to a system, society, or community in a specific period of time, determined as a function of hazard, exposure, vulnerability and capacity.

HAZARDS

A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socio-natural in origin.

The United Nations Office for Disaster Risk Reduction (UNDRR) has provided terminologies and concepts to better explain hazards and disasters. The terminologies and concepts are useful for promoting better understanding across multiple disciplines and sectors. The terminologies used in Malaysia have been contextualised to suit national circumstances where necessary (Boxes 4 and 5).

Box 4. Hazards and related terminologies

Hazards

A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socio-natural in origin.

Natural hazards are naturally occurring physical phenomena caused either by rapid or slow onset processes. Natural hazards can be classified into geophysical hazards (i.e. earthquakes, landslides, tsunamis, volcanic activity, etc.), hydrological hazards (i.e. avalanches, floods, etc.), climatological hazards (i.e. extreme temperatures, droughts, wildfires, etc.) and meteorological hazards (i.e. cyclones, storms, wave surges, etc.). Hydrometeorological hazards are of atmospheric, hydrological or oceanographic origin. Climatic hazards include all types of natural hazards influenced by climate and weather.

Biological hazards comprise biological substances such as a micro-organism, virus or toxin that pose a threat to the health of living organisms, primarily humans. This includes substances that are harmful to animals.

Technological hazards encompass industrial pollution, nuclear radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires, and chemical spills, among others.

Natech refers to technological hazards that arise due to the impact of a natural hazard event.

Multi-hazard means (1) the selection of multiple major hazards that the country faces, and (2) the specific contexts where hazardous events may occur simultaneously, cascadingly or cumulatively over time, and taking into account the potential interrelated effects.

Box 5. Disasters and related terminologies

Disasters

Disasters are defined by the National Security Council of Malaysia Directive 20 as disruptions to socio-economic activities and official duties of the government involving loss of life, damage to properties, economic loss and destruction of natural habitat, which exceeds the coping capability of citizens and requires extensive resources for action. The management of disasters or any hazardous event that has the potential to become a disaster is clearly spelt out in Directive 20, depending on the scale, magnitude and coping capacity at the district and state levels.

Resources will be mobilized when the scale of potential disaster expands beyond the coping capacity and resources available at the state level, or a disaster transcends state boundaries, or if there is a request for assistance by the state. During a disaster event, the National Disaster Management Agency (NADMA) through its National Disaster Control Centre (NDCC) as well as federal and technical agencies work closely with the National Disaster Management Committee and the State Disaster Management Committee or its equivalent at the state level.

At the international level, the United Nations Office for Disaster Risk Reduction (UNDRR) defines disasters as a disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceed the ability of the affected community or society to cope with using its resources.

Disaster Risk

Disaster risk is the potential loss of life, injury, or destruction or damage to assets, which could occur to a system, society, or community in a specific period, determined as a function of hazard, exposure, vulnerability and capacity.

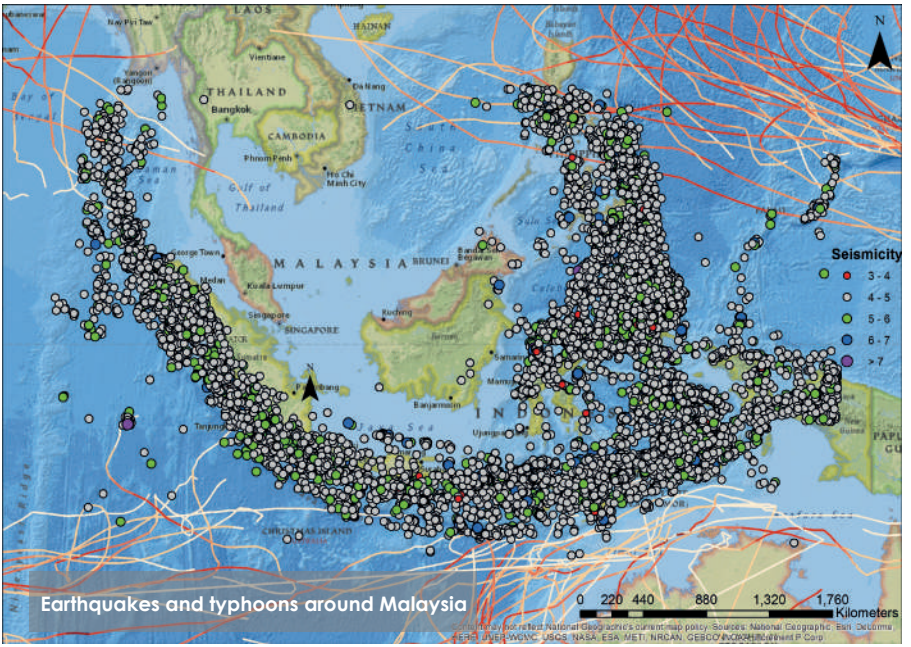
The UNDRR definition of disaster risk reflects the concept of hazardous events and disasters as the outcome of continuously present risk conditions. Disaster risk comprises different types of potential losses that are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be generally assessed and mapped.

2.2 Overview of Disasters

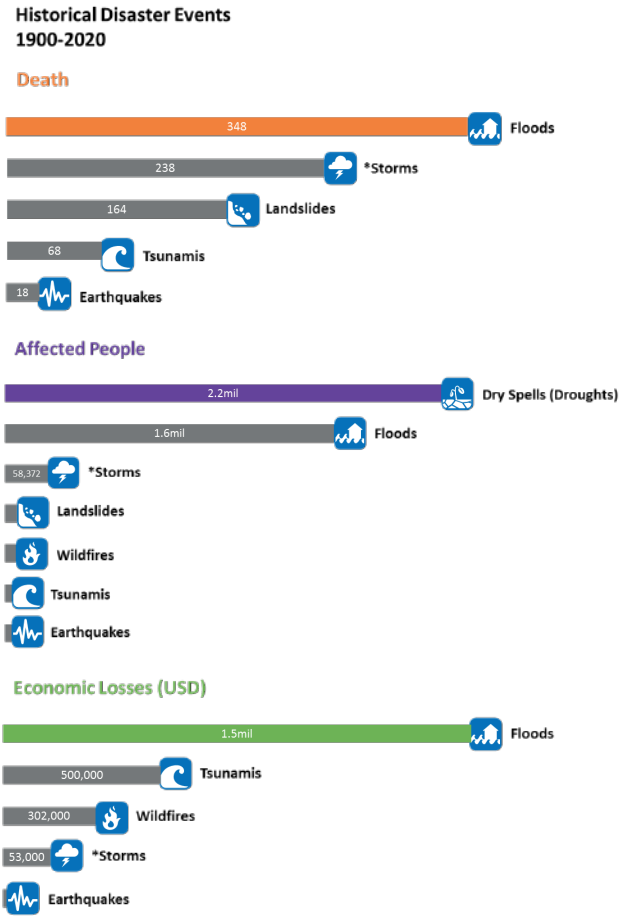
Floods and landslides are the most common types of disasters in Malaysia. Natural hazard events over the past 120 years (1900 - 2020) have caused the most deaths. Deaths are associated with storms when they trigger landslides and floods (Box 6). Historically, many cities in the country have evolved from settlements located in the lowlands adjacent to rivers. With rapid urbanization, some densely populated cities expanded to the highlands with steep slopes. This situation contributes to the high incidences of floods and landslides in the country. Extreme weather and emerging climatic hazards are expected to lead to increased exposure of cities and settlements to impacts such as floods, landslides, water stress and coastal inundation.

Malaysia is not located within the "Pacific Rim of Fire" thus major natural hazard events such as earthquakes and tsunami are not common. However, the occurrence of such disasters in the country cannot be totally excluded. Earthquakes of light to moderate seismicity have been detected in the country, especially in Sabah and Sarawak.

Storms in Malaysia are mainly localised strong wind events. Although not common, a few rare events from the tail effect of tropical cyclones have resulted in intense rainfall. Wildfire from peat and forest fires from local sources and transboundary sources have contributed to haze in the country.



Box 6. Historical disaster events (1900-2020)

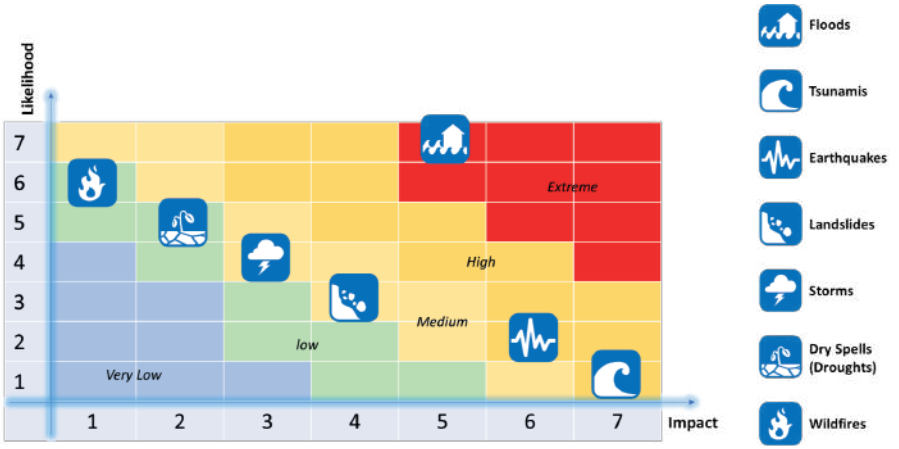


* Includes storm induced landslides and floods

Source: Adapted from EM-DAT

2.3 National Risk Profile

The risk profile developed for Malaysia in the inaugural NRR draws on information from past disaster events. The country's risk profile is represented by floods (flash floods and monsoon floods), tsunami and earthquakes, landslides, storms, dry spells or droughts, and wildfire (including haze). A risk matrix has also been developed based on the likelihood and potential impact of various risks that may directly or indirectly affect the country over the next five years.



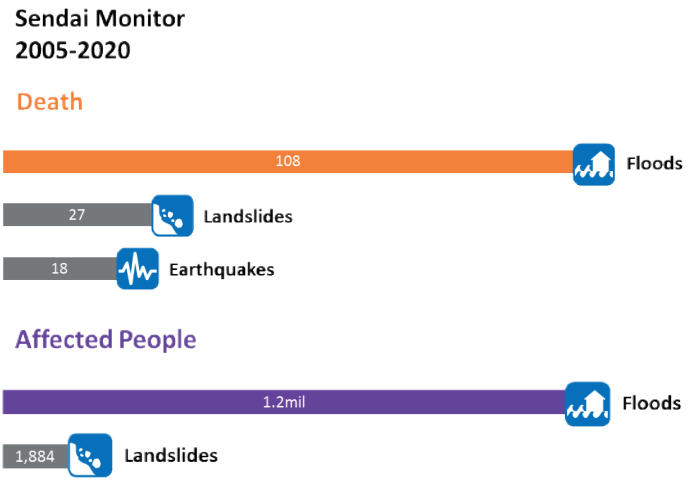
The risk matrix classifies hazards according to its likelihood and impact for Malaysia

The National Risk Register records Malaysia as being subjected to seven hazards. Ranked according to the risk matrix, these are floods, tsunamis, earthquakes, landslides, storms, dry spells (drought), and wildfires. The risk matrix was developed by classifying a hazard according to its likelihood and impact. The classification was based on a hybrid approach of combining information from open sources, technical departments and national reporting to the UN Sendai Framework Monitor (Box 7) as well as the expert opinion of government agencies. Tsunami and earthquake risks were emphasized during the expert engagement sessions. The risk matrix is expected to change with time due to availability of data, evolution in type and magnitude of hazards as well as alteration of exposure and vulnerability in susceptible areas.

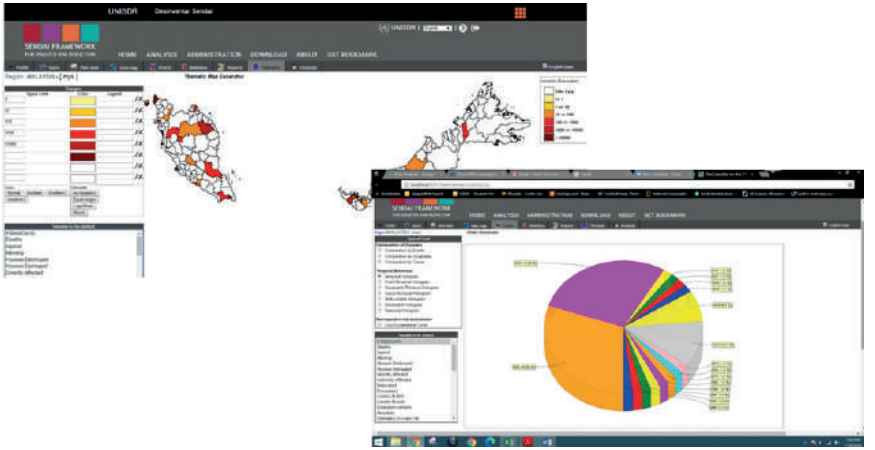
The risk profile at the state and local levels is expected to be different due to variations of physical and geological susceptibility, exposure to hazards and level of vulnerability. State and local authorities are encouraged to carry out risk assessments at the local scale with the collaboration of federal technical agencies to determine their respective risk profiles.

A comprehensive repository of annual disaster events that occurred in Malaysia over the past 15 years (2005–2020) is now available in NADMA. The data is stored in the DesInventar system adapted from the UNDRR (Box 8). Information on major historical disaster events that occurred in the country prior to this period was also considered in building the National Risk Register. NADMA augments its disaster database on a regular basis with information from open sources including the newspapers, after screening for accuracy and redundancy. NADMA NDCC also monitors the social media for hazard and emergencies events.

Box 7. Past Natural Hazard Events (2005-2020)



Box 8. DesInventar for managing disaster information



DesInventar is a Disaster Information Management System promoted by the United Nations Development Programme (UNDP) and United Nations Office for Disaster Risk Reduction (UNDRR) for the systematic collection, documentation and analysis of data about disaster events and losses due to natural hazards. The system is used for the generation of national disaster inventories and the construction of databases of damage, losses and the effects of disasters at various scales. DesInventar Sendai is a software that seamlessly plots all the indicators and data required for monitoring Targets A to D of the Sendai Framework for Disaster Risk Reduction, which corresponds to the indicators of Sustainable Development Goals (SDGs) including poverty eradication (Goal 1), sustainable cities and communities (Goal 11) and climate action (Goal 13).

Malaysia has been using DesInventar since 2020 and the data template has been adapted to suit existing disaster loss data collection systems in the country. DesInventar was used to develop the national risk register and it is also being utilized for national reporting to the UNDRR Sendai Monitor. NADMA is currently encouraging the use of the DesInventar by state and local agencies. This is to facilitate data sharing between national and sub-national levels and implement seamless online reporting of disaster impacts including loss and damage after an event.

2.4 Plausible Futures

Over the coming years, Malaysia is expected to experience more climate-related hazards. With increasing sea levels, extreme temperatures and intense rainfall, the impacts are anticipated to be severe on local communities. The change in weather patterns with more frequent and intense rainfall and longer dry spells are manifestations of climate change. Other challenges would include dealing with heat stress if global warming proceeds unabated. Reduced food crop yields and regional instability could also negatively impact the economy and give rise to security issues.

Flood mitigation works at Sungai Bertam, Cameron Highlands, 2016

Flooding is expected to worsen, taking different forms depending on the locality. The three main types of flooding are fluvial, pluvial and coastal. Thus, flood risk management programmes should be strengthened with proper monitoring and forecasting systems, as well as early warning and risk communication at the local level. Capacity building is critical to ensure effective preparedness and response during emergencies. Measures are also required to ensure that water resources are managed sustainably, with plans to explore alternative sources of water supply. Examples of such measures include promoting Integrated Water Resources Management (IWRM) and Integrated River Basin Management (IRBM).

The Twelfth Malaysia Plan has a major strategy for increasing resilience against climate change and disasters. The emphasis is on four major areas:

- Implementing evidence-based and risk-informed actions;
- Adopting integrated approaches for climate adaptation and disaster risk reduction;
- Enhancing early warning systems and disaster response; and
- Enhancing disaster preparedness and recovery

Among the initiatives that have been proposed include the formulation of a National Policy on Disaster Risk Reduction. This will serve to guide the nation in seeking solutions to address future impacts of climate extremes and climate change through effective community engagement, partnerships, understanding of risks and risk financing, among others.

2.5 Can Risks Change Over Time?

The threat of geophysical hazards appears to be minimal. Nevertheless, their impact is equal and in some cases even greater than hydrological hazards. Historical records indicate that landslides are the deadliest events in the country. With the expected change in rainfall patterns, it is necessary to mobilize resources to prevent, mitigate and prepare for potential disasters and their cascading effects. There also appears to be increasing tremors in Sabah and Sarawak, which requires more detailed investigations.

Debris flow search and rescue in Batu Hampar, Yan, Kedah, 2021

Development activities are mostly concentrated in cities and towns, and their expansion into new areas alters the risk landscape. Natural hazards vary depending on context and geographical setting. For example, Sabah is the most seismically active region in Malaysia, where mild earthquakes occur occasionally, but the threat is minimal. The impact of tsunami was observed in the north-western region of Peninsular Malaysia. However, floods occur throughout the nation, particularly during the monsoon season. Thus, proper planning and discussion are required between the regional authorities and technical agencies at the local level, prior to the approval of any development projects to minimize future risks.

Climate change is expected to result in increased risks over time if left unabated. Malaysia is anticipated to experience a rise in climatic hazards. The frequency and intensity of these hazards are likely to escalate as global warming proceeds to 1.5 degree Celsius. With rising sea levels and extreme temperatures, disaster risks will surge, especially for coastal communities. Hydrological hazards will remain a major issue in the country. The risk of flooding and landslides and its cascading effects are expected to escalate with a shifting climate. Emerging hazards associated with Natech, pollutant mobilization and climate related diseases among others, need to be better understood to prevent disasters.

2.6 National Preparation for Emergencies

Flood monitoring systems have been established to provide forecasting and early warning of flooding events during the monsoon season. The Department of Irrigation and Drainage (DID) has developed a river basin flood forecasting and warning system. The National Flood Forecasting and Warning System (NAFFWS) also known as *Program Ramalan dan Amaran Banjir* (PRAB) by DID will be able to provide robust and effective flood forecasting and warning service to the public, giving the public sufficient time to get prepared and protect against the threat and minimize social and economic impact (Box 9).

Floods in Pasir Mas, Kelantan, 2019

The Malaysian Meteorological Department (MetMalaysia) has maintained a weather monitoring and forecasting system for rainfall. Seasonal forecasting systems are in place to predict severe rainfalls especially during the monsoon season. Government agencies also encourage local communities to prepare prior to the northeast monsoon, which usually takes place from November to March. This includes monitoring the latest updates that are provided from official sources. Efforts are also underway to enhance public engagement with local emergency responders, agencies, and other communities. Pluvial flood risk management has to be improved at the city level. MetMalaysia has been involved in a demonstration project that forecasts multi-hazards, which is now operational in Kuala Lumpur. The replication of this project requires the collaboration of local, state, and federal agencies as it involves developing contingency plans to address flood risk in cities, which is expected to worsen. MetMalaysia is also maintaining an earthquake monitoring system for the country. After the 2004 Tsunami, a national tsunami early warning system was developed to monitor tsunami threats around our country. With the implementation of this system, government agencies such as MetMalaysia are able to disseminate early warning information to the public using sirens in coastal communities, messaging systems and media announcements.

The Department of Mineral and Geoscience (JMG) leads several national programmes to reduce the risk of landslides in the country. This includes terrain mapping that has been conducted in the highland areas of Perak, Pahang, Sabah and Sarawak, among others. In conjunction with the Public Works Department (JKR), a national slope master plan has been developed for better slope management in the country. The Department also works closely with MetMalaysia in providing technical support for mapping of earthquake and tsunami hazards. The operational capacity of the JMG is being strengthened to address issues related to groundwater hazards in coastal areas due to sea level rise, subsurface geological hazards and climate resilient groundwater aquifers to augment water supply during dryspells.

Earthquake-induced landslides at Mount Kinabalu, Sabah, 2015

The Ministry of Environment and Water (KASA) in collaboration with the Malaysian Green Technology and Climate Change Centre (MGTC) have been actively addressing climate change by promoting programmes in cities to reduce carbon emission. Such programmes include the implementation of the Low Carbon Cities Framework (LCCF), Low Carbon Cities Master Plan (LCCMP) and Low Carbon Mobility Blueprint (LCMB). Climate change mitigation is a disaster prevention measure to reduce risks due to global warming and intensification of extreme weather, sea level rise and other climatic hazards. However, these programmes have to be expanded to include measures for disaster risk reduction in the immediate term and climate change adaptation in the long term. Awareness campaigns targeting local communities as well as capacity building of technical agencies are being planned to ensure that the country is well prepared to handle emerging climatic risks.

2.7 Local Preparation for Emergencies

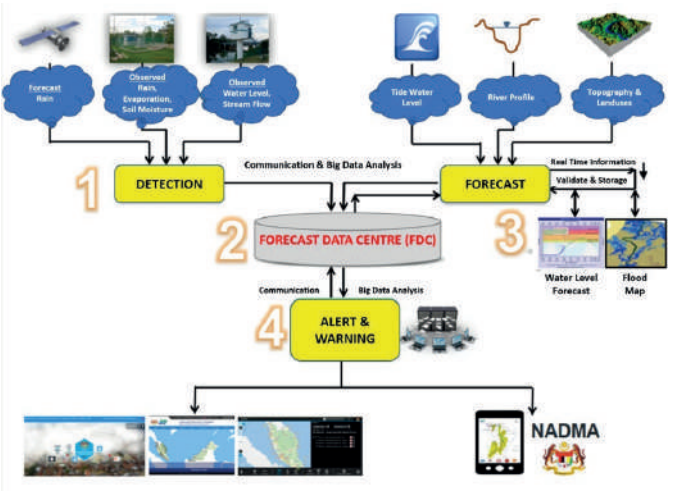
As the focal point for disaster management in Malaysia, NADMA collaborates with various parties to enhance community awareness and promote community-based disaster management programmes. The NDCC of NADMA is the national disaster management coordination centre that communicates with the Disaster Management Secretariat at the state and district levels (Box 10). The NDCC also collaborates with government agencies such as MetMalaysia, Ministry of Health (MOH), DID and JKR, among others in handling major national disasters.

Emergency rescue operations in Titi Hayun, Yan, Kedah, 2021

Crisis-response centres have been established at the Disaster Management Secretariat at the state and district levels to prepare local communities in responding to disaster events. Disaster resilience at the local level has also been strengthened with more cities establishing dedicated crisis-response centres to handle small but frequent disaster events. Cities such as Kuala Lumpur have set the benchmark in developing a forecasting system for multi-hazards, which is now operational at the emergency response centre (Box 11).

In addition, the government has also established a disaster relief fund to support impacted communities. The primary focus is on engaging with local communities to build awareness and preparedness for floods and landslides. Disaster drills are actively conducted in areas that were heavily impacted by the 2004 tsunami. Most of the coastal communities in northwest Peninsular Malaysia have been trained to react accordingly in disaster emergencies.

Box 9. PRAB programme for flood forecasting



The National Flood Forecasting and Warning Program (NWFFWP/ PRAB) has four key objectives:

• Develop a system that can forecast monsoon floods 7 days earlier based on weather forecast data from the Malaysia Meteorological Department.

• Increase the capacity of the existing system for warning and dissemination of monsoon floods from 6 hours to 2 days earlier for the benefit of related agencies and the population affected by the flood.

• Increase the accuracy of flood forecasting by reducing the difference between forecast and observed data from 1 meter water level to less than 0.5 meters.

• Develop a system that is capable of forecasting and disseminating flash flood warning to the public from 1 to 3 hours earlier, based on weather forecast data from MetMsia.

Further information is available at
https://publicinfobanjir.water.gov.my/mengenai-kami/prab/?lang=en

Box 10. NDCC for monitoring and coordinating disaster response

The National Disaster Command Centre and Disaster Management Coordination Centre (NDCC) of NADMA monitors and coordinates disaster response including early warning to the public. It also manages the Disaster Information Management Systems (MYDIMS) and hosts the web portal (Portal Bencana) that disseminates information on hazards and disasters to the public.

Further information is available at http://portalbencana.nadma.gov.my

Box 11. Kuala Lumpur MHP for multi-hazard forecasting

The Multi-Hazard Platform (MHP) is a forecasting system for weather and early warning of geophysical and atmospheric hazards at the city level. Initiated as a pilot funded by the Newton Ungku Omar Fund, the Kuala Lumpur MHP displays meteorological forecasts up to three days in advance at the street level. It also displays areas susceptible to geophysical hazards (floods, landslides, sinkholes) and atmospheric hazards (rain, strong winds, temperature, air quality) to graphically communicate risk to city managers and first responders in the city. The MHP is currently operational in Kuala Lumpur with support from MetMsia and Universiti Kebangsaan Malaysia.

Further information on development of the MHP is available at http://ancst.org/nuof

2.8 Improving the National Risk Register

The development of the inaugural National Risk Register is a positive step for disaster management in Malaysia. It is an indication that the country is very serious about protecting its infrastructure and the assets of investors in the country. The National Risk Register will be periodically improved to take into account the following:

• Establishing and enriching disaster repositories at agencies, states and cities to improve data provision to the public, i.e. via EM-DAT. https://www.emdat.be/

• Recording and assessing loss and damage for disaster events, including direct and indirect costs for property damages, casualties, etc. in line with the Sendai Framework Indicators. https://www.preventionweb.net/sendai-framework/sendai-framework-monitor/indicators

• Implementation of the DesInventar template at the sub-national level for online data submission on disaster loss. https://www.desinventar.net/

• Exploring risk financing options for mitigating disaster loss, including insurance products for floods, landslides, earthquakes etc.

• Systematically mapping and assessing disaster risk for specific and multi-hazards at national and sub-national scales, in line with current approaches. https://www.undrr.org/publication/words-action-guidelines-national-disaster-risk-assessment

• Encouraging states and cities to carry out disaster risk assessment at the local level and considering a disaster resilience scorecard system and action planning. https://www.unisdr.org/campaign/resilientcities/toolkit/article/lessons-learned-from-the-disaster-resilience-scorecard-assessment-and-disaster-risk-reduction-drr-action-planning

Section 3: Addressing Common Disaster Risks

Floods in Kampung Padang Kijang, Tanah Merah, Kelantan, 2019

3.1 Floods

Background

• Generally, floods affect the highest number of people in Malaysia. There are at least four main types of flooding: monsoon/seasonal, fluvial, pluvial flash floods and coastal floods. Monsoon or seasonal floods occur on the largest scale, inundating areas state-wide and affecting several states at once during the almost yearly monsoon season, especially the northeast monsoon season from October to March. Fluvial flooding typically happens around riverine or floodplain (low lying) areas. Pluvial flash floods frequently occur on a smaller scale affecting mainly urban areas. Coastal floods occur near the shore.

• Historically, there were at least 50 significant flooding events in Malaysia. The oldest on record is the "Bah Air Merah" (1926) in Kelantan, followed by the "Kuala Lumpur Flood" (1971). However, the most recent and worst event occurred in 2014, where eight states (Sabah, Kelantan, Pahang, Terengganu, Perak, Johor, Selangor and Perlis) were affected.

• These flood disasters were widespread and recorded in many international and national databases. EM-DAT (International) database sources show that flood disasters have affected Malaysia from 1900 to 2020.

What is being done about the risk?

• Flood prevention and mitigation strategies such as environmental conservation, policy, laws and economic development plans have been emphasized since the First Malaysia Plan (1966 – 1970).

• The installation of early flood warning systems at the community level with aid from local authorities.

What you should do:

• Consult the relevant government agencies to check on flood risk information for your area.

• Since 2000, the Department of Irrigation and Drainage has maintained an online platform to provide updates on the status of floods. Thus, local communities constantly experiencing flood issues should use this website to monitor flood situations.

3.2 Tsunamis

Background

• There is currently no threat of a locally generated tsunami in Malaysia.

• On record, Malaysia has only been impacted by a tsunami once, in 2004, caused by an earthquake in Indonesia. Distant tsunamis generated by earthquakes originating from Indonesia (Indian Ocean) and the Philippines (South China Sea, Sulu and Celebes Seas) pose a threat to certain coastal areas along the northwest coast of Peninsular Malaysia (Langkawi, Kedah, Penang and Perak) and also along the whole coast of Sabah.

• Based on tsunami simulations in the Indian Ocean, several major cities and towns are deemed at risk from tsunamis coming from Indonesia, including Alor Setar, Kuala Kedah, Georgetown, Balik Pulau, Butterworth, Lumut, Seri Manjung, Sitiawan, Sungai Besar. Tsunami simulations in the Sulu Sea further indicate that coastal areas along Kudat, Sandakan and Lahad Datu are also at risk. Tsunami simulations in the Celebes Sea indicate that the coastal areas along Tawau and Semporna are directly exposed to tsunami waves and thus at a higher risk (Box 12).

• Tsunamis generated by large submarine landslides in the South China Sea may put coastal areas along Sabah and Sarawak at risk, although the likelihood of this occurring is unlikely.

• With the impending rise of sea level due to climate change, more inland areas in tsunami risk zones may be exposed and these have to be delineated.

What is being done about the risk?

• The Malaysian Meteorological Department has produced a tsunami risk map to identify high-risk areas due to tsunamis, particularly along the coastline throughout Malaysia.

• Tsunami risk reduction has been carried out by providing public awareness, drills, developing evacuation plans, and conservation of mangrove areas.

• Extra effort and resources have been allocated for high-risk areas in northwest Peninsular Malaysia and southeast Sabah for tsunami disaster risk reduction including preparing detailed evacuation plans, targeted public education and awareness programmes, and protection of mangroves areas.

What you should do:

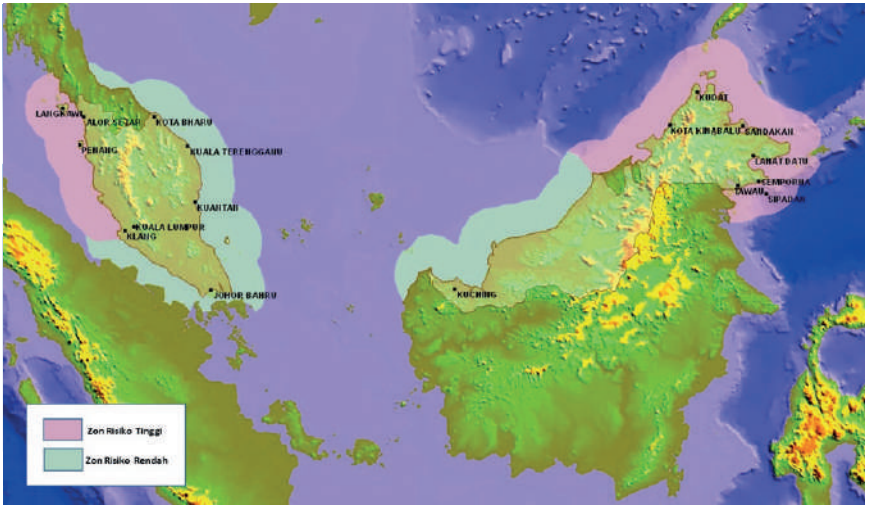
• Consult the relevant government agencies prior to any construction to find out the risk of tsunamis, particularly near exposed coastlines.

• Identify the risk in your area and get more information from local authorities and relevant government agencies.

• If you are a visitor in the areas at risk, look out for high ground or evacuation route signage as a precaution. Follow instructions by the authorities during emergencies.

• Learn about the procedures: What to do Before, During and After a Tsunami from relevant authorities, booklets or websites i.e. MetMalaysia (https://www.met.gov.my/pendidikan/gempabumitsunami/tsunami) or USGS

Box 12. Tsunami hazard zones for coastal areas



Source: MOSTI (2009). Seismic and tsunami hazards and risks study in Malaysia. Summary for policy makers. Kuala Lumpur, Malaysia: Academy of Sciences Malaysia.

A tsunami hazard map has been developed for coastal areas in Malaysia based on known historical tsunamigenic sources in neighbouring regions. High risk zones are coloured in pink and low risk zones are in green.

3.3 Earthquakes

Background

• There is no widespread threat of local earthquakes in Peninsular Malaysia. The future threats in Peninsular Malaysia will come from distant, large earthquakes in Sumatra.

• Significant local earthquake incidents have only been recorded in Sabah. Based on the USGS Earthquake Database, from 1900 to 2020, about 31 moderate (magnitude larger than 5.0 Mw) earthquakes were recorded onshore and offshore Sabah. Out of the 31, four earthquakes of magnitude 6 Mw and above occurred within Sabah. These are the 2015 Ranau earthquake (6.0 Mw), 1976 Lahad Datu earthquake (6.2 Mw), 1951 Kudat earthquake (6.1 Mw) and 1923 Lahad Datu Earthquake (6.3 Mw). The epicentres of the earthquakes were concentrated on the east coast of Sabah, around Lahad Datu-Kunak area, and Kundasang-Ranau area.

• Sabah earthquakes are attributable to the active subduction zone along the trenches of the Philippines, Manila, Negros, Sulu, Cotabato and North Sulawesi.

What is being done about the risk?

•A seismic hazard map of Malaysia was produced by the Department of Mineral and Geoscience (JMG) in 2017, which indicates the probability of an earthquake occurring throughout Malaysia (Box 13).

•Resources have been channelled to earthquake-prone areas, particularly in enhancing public preparedness and awareness, as well as promoting the use of seismic resilient construction standards developed by the Department of Standards Malaysia.

• Public preparedness and awareness of earthquake disasters can reduce the risk and threat, particularly to the community.

•More resources are required for high-risk earthquake areas to undertake prevention and preparedness measures such as targeted public awareness programmes and implementation of the newly developed seismic building code prepared by the Department of Standards Malaysia.

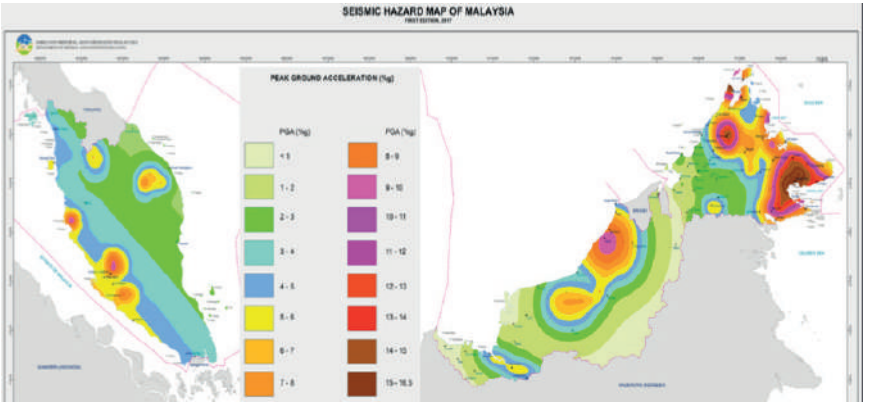
What you should do:

• Consult the relevant government agencies prior to any construction to find out the risk of earthquakes in your area.

• Learn about earthquake hazards and risks in your area.

• Learn about the procedures: What to do Before, During and After an earthquake from booklets issued by relevant authorities or official websites i.e. MetMalaysia (https://www.met.gov.my/pendidikan/gempabumitsunami/gempabumi)

Box 13. Seismic hazard map for earthquakes



Source: Department of Mineral and Geoscience Malaysia in 2017

The Seismic Hazard Map shows peak ground acceleration (PGA) values for areas in Malaysia. This information is included in the Malaysia National Annex MS EN1998-1:2015 Eurocode 8: Design for Structures for Earthquake Resistance – Part 1: General Rules, Seismic Actions and Rules for Buildings.

3.4 Landslides

Background

• Landslides are associated with poor construction practices and inappropriate construction on sloping sites with a history of landslides or problematic disturbed grounds and development in the highlands.

• Landslides that occur close to settlement areas or along public routes could potentially result in loss of life, injuries, property damage or disruption of essential services. For example, the Highland Tower collapsed due to a landslide in 1993, killing 48 people.

What is being done about the risk?

• Early warning system and detection of soil movements are being implemented in high risk areas.

• Landslide inventory maps and slope hazard and risk maps have been produced by the Department of Mineral and Geoscience (Box 14). The Department of Public Works focuses on slope hazards along road corridors (Box 15).

What you should do:

• Consult the relevant government agencies prior to any construction work especially near foothills or landslide-prone areas.

• Be mindful of tell-tale signs of landslides along slopes.

• Perform slope maintenance by keeping good drainage and vegetation or engage professionals for assessment.

Installation of the Global Navigation Satellite System at the landslide area in Kundasang, Sabah, 2021

Box 14. NaTSIS for landslide, terrain and slope management

National Geospatial Terrain and Slope Information System (NaTSIS) is an integrated web-based landslide, terrain and slope management system that is accessible to all government agencies to assist planning and decision making. It was developed under the Slope Hazard and Risk Mapping (PBRC) project to complement the National Slope Master Plan (2009-2023) and provide information on development suitability.

https://www.natsis.jmg.gov.my

Box 15. Slope monitoring along road corridors

The Slope Engineering Branch of the Department of Public Works conducts automatic and continuous monitoring of slopes along selected road corridors that are susceptible to failures. An example is the Robotic Total Station located along the Simpang Pulai Road (Section 44, FT 185), which was installed to provide timely and reliable information for early warning and mitigation actions. Early warning system and real-time monitoring, in conjunction with policy and institutional framework, hazard mapping and assessment and loss assessment constitute major thrusts of the National Slope Master Plan 2009-2023. The Master Plan comprises detailed actions with key performance indicators up to 2023.

3.5 Storms

Background

• Convective and tropical storms have occurred in Malaysia. A convective storm is a type of meteorological hazard generated by the heating of air and the availability of moist and unstable air masses. Convective storms range from localized thunderstorms (with heavy rain and/or hail, lightning, high winds, tornadoes) to meso-scale, multi-day events. Localized storms are characterised by strong winds, sometimes with heavy rain, with a magnitude that could blow away house roofs, but not uproot trees.

• A tropical storm originates over tropical or subtropical waters. It is characterized by a warm-core, non-frontal synoptic-scale cyclone with a low pressure centre, spiral rain bands and strong winds. Depending on their location, tropical cyclones are referred to as hurricanes (Atlantic, Northeast Pacific), typhoons (Northwest Pacific), or cyclones (South Pacific and Indian Ocean). Malaysia generally is outside of the typhoon track. Malaysia has experienced two direct hits, namely Tropical Storm Greg (Dec 1996) and Typhoon Vamei (Dec 2001); and one tail effect of Tropical Storm Hilda (Jan 1999). They cascaded into debris floods, landslides and flood disasters.

What is being done about the risk?

• Models and templates to analyse loss and damage are being developed and implemented.

• Alerts and advisory warnings are routinely disseminated (Box 16).

What you should do:

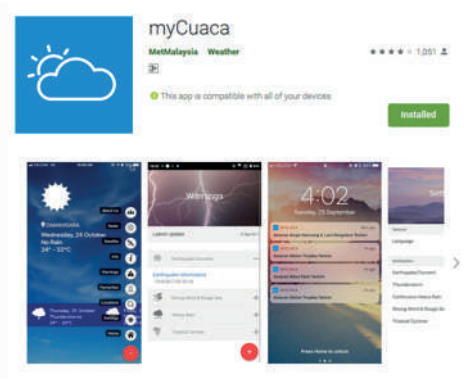
•Monitor weather forecast systems to get the latest update.

• Check advisories released by authorities in public and social media.

•Awareness and education materials:
https://www.met.gov.my/pendidikan/cuaca/fenomenacuaca

Box 16. Weather forecasts on the web and smart phone apps

Online platform for weather forecasting in Malaysia



The Malaysian Meteorological Department (MetMalaysia) has developed a weather forecasting app, which is freely available on Google Play and App Store. The intention is to provide real-time information and a forecast model at no cost. The app serves as a user-friendly tool to disseminate daily weather information for Malaysians. The service includes updates on thunderstorm, continuous heavy rain, strong wind and rough sea and tropical cyclone. It also covers seismological information, weather radar and satellite image. The information can also be accessed via the website of MetMalaysia.

3.6 Dry Spells

Background

• In humid tropical Malaysia, drought is a term referring to a dry spell as opposed to a rainy season. However, irregular dry weather and prolonged lesser rain periods do cause water shortages at times. The demand for daily potable water and commercial use can escalate this situation to crisis level.

• Malaysia is generally endowed with fairly abundant rainfall in the order of 3000 mm annually, of which surface run-off is around 57%. About 60% of rain falls between November and January annually. Seasonal distribution and variation, both temporally and spatially, renders some regions to be occasionally water-stressed. Dry spells also increase the risk for wildfires and major health issues associated with respiratory functions.

• Malaysia experiences water stress primarily due to management factors coupled with the high demand for water supply. Official data reveals that 2014 and 2016 were the two worst years. The international database (EM – DAT) also suggests likewise.

• The challenges in water management are many and diverse, and at times unanticipated. As such, shifts to strengthen existing governance measures remain a priority for the Federal and State governments. This has been reflected in the various Malaysia Plans, the most recent in the Twelfth Malaysia Plan (2021-2025), where a comprehensive Water Sector Transformation Plan has been introduced.

What is being done about the risk?

• Implementation of integrated water resources management (Box 17).

• Augmented or alternative water source from groundwater.

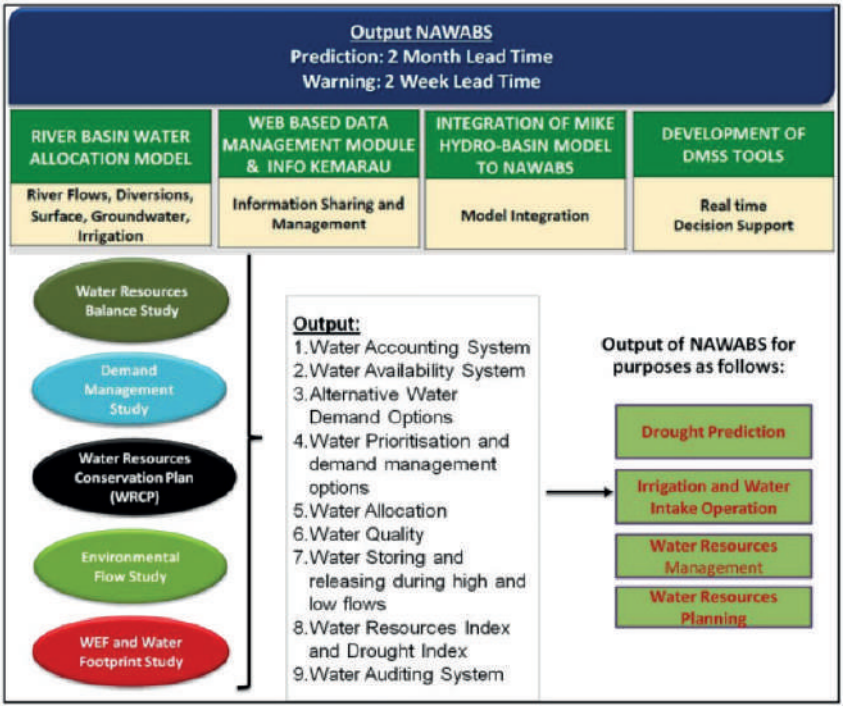
• Enforcement and monitoring to prevent pollution.

What you should do:

• Get updates on water resources status and early warning on potential and current dry-spell status from official online sources.

• Check advisories released by authorities in the public and social media.

Box 17. NAWABS for managing water resources



The National Water Balance Management System (NAWABS) is a robust Decision Management Support System (DMSS) framework to balance water supply and demand via a detailed assessment of future weather patterns. The system incorporates real-time data on rainfall, river levels and flows into a modelling software and ensures that a comprehensive assessment is conducted for forecasting. Information for short-term forecasts is extracted from the Malaysian Meteorological Department. Long-term forecasts such as climate projections require inputs from global models. The overall objective is to ensure water accounting, water availability and water allocation in times of weather extremes such as dry spells.

For more information, please visit http://nawabs.water.gov.my

3.7 Wildfires and Poor Air Quality

Background

• Most of the fires in Malaysia occur in degraded forests or peat swamp forests, both in Peninsular Malaysia and along the coasts of Sabah and Sarawak.

• Wildfires also occur occasionally due to improper forest and peatland management, slash and burn activities and poor water management.

• Wildfire events including peatland fires; and their resultant haze are among the new hazards in the region.

• Transboundary haze is air pollution attributed to seasonal fires that occur in forests and farmlands of neighbouring countries. The pollution crosses the boundary of countries giving rise to issues such as health risks from suspended solid particles in the air and low visibility that disrupt air and sea navigation.

What is being done about the risk?

• Groundwater is used to artificially recharge soil water and keep the peatlands wet during dry spells to prevent the ignition of fires, under the Peat Soil Area Fire Prevention Programme. The programme is a collaboration of the Department of Environment, Fire and Rescue Department, Department of Mineral and Geoscience Malaysia, and Department of Irrigation and Drainage.

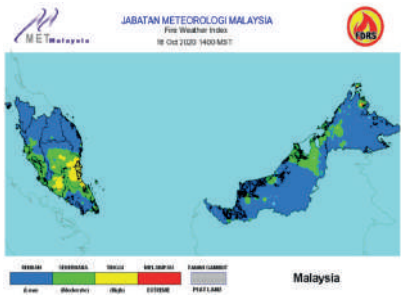
• The ASEAN Agreement on Transboundary Haze Pollution was signed on 10 June 2002 in Kuala Lumpur, Malaysia by all ASEAN Member States. The Agreement includes preventing, monitoring, and mitigating land and forest fires to control transboundary haze pollution through concerted national efforts, regional and international cooperation. The Agreement came into force in 2003 and has been ratified by all ASEAN Member States

What you should do:

• Regularly check fire hotspots and air pollution information on the websites of the Department of Environment (DoE), Malaysian Space Agency (MySA) and MetMalaysia (Box 18).

• Check advisories released by authorities in the public and social media.

Box 18. Fire hotspots and air quality monitoring platforms on the web



Fire Weather Index by MetMalaysia

Forest Fire Information Sistem (ForFIS) by MySA

Air Pollutant Index of Malaysia by DoE

The fire weather index was developed by the Malaysian Meteorological Department (MetMalaysia). This index includes build-up, initial spread, drought code, duff moisture code and fine fuel moisture code. The Forest Fire Information System (ForFIS) was established by the Malaysian Space Agency (MySA). Since the cross-border haze in 1997, MySA took the initiative to develop a Total Forest Fire Management Plan (TFFMP). This includes the detection and monitoring of forest fires in Malaysia and ASEAN countries. The hotspot information is detected through the National Oceanic and Atmospheric Administration (NOAA) and Moderate Resolution Imaging Spectroradiometer (MODIS) satellites. The Air Pollution Index was implemented by the Department of Environment (DoE). The index is developed using data from a network of environmental monitoring stations that has been installed to detect any change in air quality. The index represents the effect of air quality on human health.

3.8 Volcanic Activities

Background

• There are scientifically inaccurate claims of volcanic activity in Malaysia.

• Malaysia is situated some distance away from the Ring of Fire where a series of volcanos are located along major tectonic plates.

• No active volcano is reported within Malaysia. Mud volcanoes are found mainly in Sabah and Sarawak. These must not be mistaken for the actual igneous volcanoes, as they do not produce lava and are not necessarily driven by magmatic activity.

• Several volcanic cones in Sabah of the Holocene age were reviewed and considered not active. There is a 27,000-year-old volcanic cone mountain remnant known as Mount Bombalai in Tawau, Sabah, which is no longer active.

How will it affect us?

• Generally, Malaysia is not affected by volcanic activities in the neighbouring region. Only some cases of disruptions in regional aviation were reported. Historically, dust from volcanic eruptions from Indonesia **of very large but rare events** are known to have reached Malaysia, i.e. Krakatau (1883), Pinatubo (1991), Tambora (1918) and Toba (74,000 years ago). Eruptions of these scales only recur at most every hundred up to thousands of years.

Apas Kiri Hotsprings in Tawau, Sabah

Supporting Agencies

The inaugural NRR was developed by the National Disaster Management Agency (NADMA) Malaysia with technical support from Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM). The support and contribution of the following agencies are much appreciated:

Ministry of Environment and Water
Ministry of Higher Education
Ministry of Communication and Multimedia
Ministry of Works
Ministry of Energy and Natural Resources
Ministry of Transport
Ministry of Tourism, Arts and Culture
Ministry of Health Malaysia
Ministry of Home Affairs
Ministry of Women, Family and Community Development Ministry of Education
Ministry of Plantation Industries and Commodities
Ministry of Rural Development
Ministry of Housing and Local Government
Ministry of Agriculture and Food Industries
Ministry of Youth and Sports
Malaysian Armed Forces
Royal Malaysia Police
Economic Planning Unit, Prime Minister's Department
Public Works Department
Department of Statistics Malaysia
Atomic Energy Licensing Board
Civil Aviation Authority of Malaysia
Department of Irrigation and Drainage
Malaysian Maritime Enforcement Agency
Department of Higher Education, Ministry of Higher Education
Department of Veterinary Services
Fire and Rescue Department of Malaysia
Malaysian Space Agency
Local Government Department, Ministry of Housing and Local Government
National Security Council, Prime Minister's Department
Forestry Department of Peninsular Malaysia
National Youth and Sports Department
Department of National Heritage
Department of Town and Country Planning
Department of Fisheries Malaysia
Department of Women Development
Malaysian Meteorological Department
Department of Environment
Department of Mineral and Geoscience Malaysia
Malaysian Civil Defence Force
Department of Social Welfare
Department of Agriculture
Implementation & Coordination Unit, Prime Minister's Department
Construction Industry Development Board
NADMA Science and Technology Expert Panel for Disaster Risk Reduction (STEP for DRR)

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Appendix: National Risk Register - Methodology

How are risks identified?

The dynamic socio-economic conditions and climate change makes historical evidence insufficient to establish a robust indication of the level of risk in a particular country. Malaysia certainly has a history of disastrous events. However, most calamities have a wide range of probabilities, lack of risk maps for specific hazards at the national scale (except earthquakes and tsunamis), and insufficient long track disaster losses database. This makes it challenging to assess its risk. Thus, for a start, the NRR was constructed from the two main components. Firstly, hazard identification by retrieving information from international and national sources. Secondly, analysis of the nature and likelihood of those events, followed with vulnerability elements, which focuses on the degree of loss and damage (can be accessed from open-source data such as the newspapers). The combined data was discussed with experts from government agencies and other institutions.

How are the likelihoods assessed?

The disaster record in Malaysia was acquired from open-source data (i.e. newspapers), national and international database. A set of templates was utilized by obtaining the required collection parameters from the DesInventar system, a freely available tool to broadcast disaster information. The template was established by incorporating extracted information from newspapers. Subsequently, the frequency of any hazard can be acquired for the likelihood assessments. For example, floods have a higher frequency in comparison to landslides or earthquakes, which implies floods have higher likelihood of occurrence.

How are the impacts assessed?

Impact assessment was based on parameters such as the number of deaths, injury, affected people, economic loss and damage to property. These parameters were utilized to produce a hybrid model as mentioned in the previous section. The information serves as an important basis to understand the scale of damage from certain hazards. For instance, the 2014 Bah Kuning flood caused severe loss of lives and damage to properties; this makes floods highly impactful. Since floods are frequent, they can be easily classified as having high likelihood and impact. On the other hand, the 2015 Sabah earthquake killed 18 people and caused extensive damage, while the 2004 North Sumatera tsunami reached the shores of the country only once. These can be classified as high impact low frequency events; they are rare in Malaysian history. A risk matrix is used to assess the impact and likelihood of natural hazard events for Malaysia.

Types of disasters in Malaysia

Geophysical	Hydrological	Climatological	Meteorological
Earthquake Landslide Tsunami	Flood	Extreme Temperature Water-stressed drought Wildfires	Storm Typhoon

Frequency

Hydrological Hazard	High
Climatological Hazard	High
Meteorological	Moderate
Geophysical Hazard	Low

Impact

Geophysical Hazard	High
Climatological Hazard	High
Hydrological Hazard	Moderate to high
Meteorological	Low to moderate

Loss and damage

Economic damages were assessed based on open-source data (i.e. newspapers) and the National Disaster Relief Fund (KWABBN). The open-source information ranges from 2005 – 2020. Disaster losses in the last 15 years involving floods were enumerated at RM 886 million, while landslides (RM 75 million), earthquakes (RM 94 million) and storms (RM 80 million) were much less. Based on the compiled auditor's and government reports on expenses for disaster response and post-disaster phases, including financial assistance for loss of income, damaged house, livestock and aquaculture damage, agricultural damage, and burial cost for the victims of disasters, flooding has caused the most economic loss, followed by storms, droughts, landslides, tsunamis and others.

JABATAN PERDANA MENTERI
AGENSI PENGURUSAN BENCANA NEGARA