

TRANSDISCIPLINARY APPROACH FOR SYSTEMIC RISK REDUCTION AND SUSTAINABLE RESILIENCE IN MALAYSIA



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@ CECAR10 Transdisciplinary Approach for Disaster Risk Reduction by Scientific Knowledge-based Decision-Making, 9-Years of Activity of TC21

CONTENTS



1. Needs and demands **for disaster risk reduction (DRR) agenda at national and local level**
2. Challenges and priorities **for DRR investment & decision-making for climate resilience**
3. **Emerging hazards, systemic risk & compounding disaster:**
Opportunity and Ways Forward

DPPC-MJIIT | 2015-2020-2030

Advancing science and technology for disaster risk reduction and resilience

Vision 2030

A leading disaster risk reduction and management (DRRM) institute in multi-hazards and climate change to strengthen community resilience

“fostering inclusivity, empowering local champion, promoting science & technology, and strengthening societal resilience”



<https://mjiit.utm.my/dppc/>



Focus Area 1
Public-Private-Academic-
Civil Society (PPAPCS)
Platform for DRR



Focus Area 2
Disaster **Risk** Governance,
Communication and
Investment



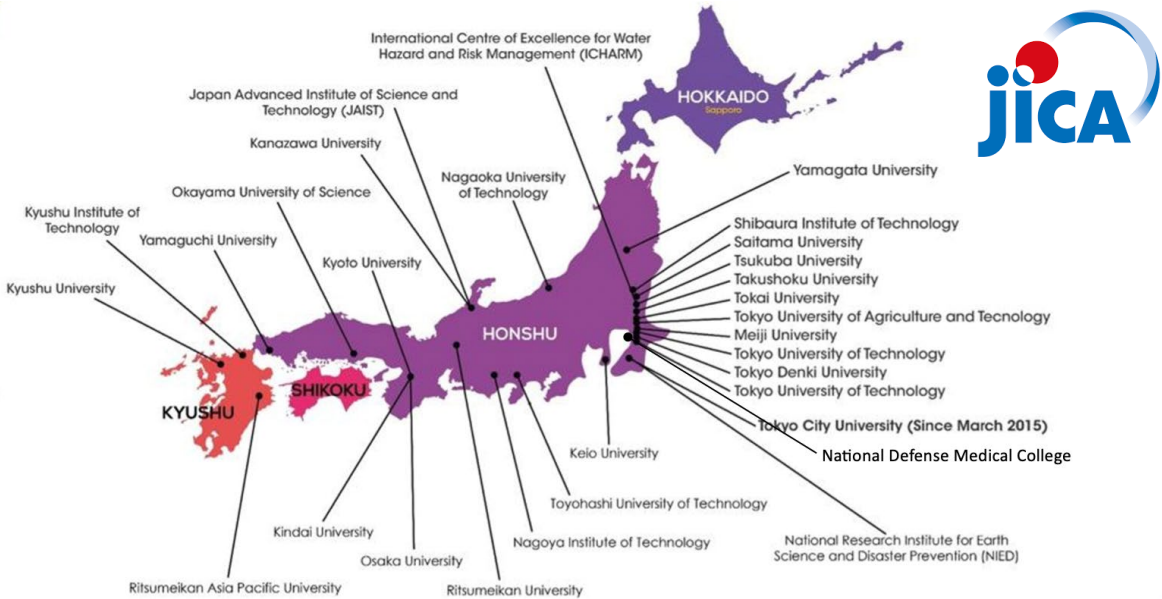
Focus Area 3
Science-Evidence based
Decision Making for
Disaster Risk Reduction



Focus Area 4
Locally-led and nationally-
supported initiatives,
programs and activities



Focus Area 5
Area-based **Action** (Urban,
Rural, Mountainous,
Coastal, Tectonic)



Organised by:



20 YEARS COMMEMORATION WEEK 2004 INDIAN OCEAN EARTHQUAKE AND TSUNAMI IN Banda Aceh, INDONESIA

SUSTAINABLE RESILIENCE AGENDA
25th-26th December 2024 | Time: 1.30pm - 4.00pm (UTC+7)

Venue : The Aceh Tsunami Museum, Banda Aceh, Indonesia



Kindly scan QR Code for more details

Supported by:



International Dialogue & Forum: Sustainable Resilience - Learning from the past and striving for future DRR Agenda 2030 and beyond



<https://mjiit.utm.my/dppc/2024/20th-commemoration-tsunami-aceh/> & <https://www.youtube.com/watch?v=j3tEnbiCEgQ>



School Preparedness and Disaster Education - Community-based Sustainable Resilience (CBSR) – ASEAN Resilience Living Lab – Podcast: Book Review - Sharing Session by DRR Local Champions - 20 Years Tsunami Exhibition & Forum @ The Aceh Tsunami Museum – Book Publication





REFLECTION & COMMITMENTS

50 PER CENT
OF GLOBAL DISASTER FATALITIES
BETWEEN 2004 AND 2014
WERE FROM THE ASEAN
REGION, WITH TOTAL ECONOMIC
LOSS AMOUNTING TO
US\$91 BILLION.

ASEAN (2024)



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& Prevention Centre
(DPPC)

Disaster Intelligence - Community Resilience – Risk Reduction



**ASSOCIATION
OF SOUTHEAST
ASIAN NATIONS**

A COMMUNITY OF
OPPORTUNITIES FOR ALL



**ASEAN
INDONESIA
2023**

ASEAN Leaders' Declaration on Sustainable Resilience

Home | ASEAN Leaders' Declaration on Sustainable Resilience

Home | Statements | ASEAN Leaders' Declaration on Sustainable Resilience

ASEAN Leaders' Declaration on Sustainable Resilience

September 5, 2023



<https://asean.org/asean-leaders-declaration-on-sustainable-resilience/>

ASEAN-ADInet recorded a total of **1,899 disaster events** in the 10 ASEAN Member States from July 2012 to May 2020. These disasters affected more than **147 million people**, displacing **more than 18 million**, resulting in almost **84,000 casualties** (dead, injured, and missing), and amounting to at least **USD 17 billion in damages**.



SUSTAINABLE RESILIENCE
Rejuvenating vulnerable cities
and communities

<https://asean.org/wp-content/uploads/2023/09/ASEAN-Leaders-Declaration-on-Sustainable-Resilience.pdf>



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(DPPC)

Disaster Intelligence - Community Resilience – Risk Reduction

RESILIENCE 2030
DRR @ MALAYSIA

**RISK TO
RESILIENCE**

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COMPOUND DISASTER, SYSTEMIC RISK

Multi-Challenges, local urgency issues and high demands of
extreme weather events & climate-induced disaster



**TRANSDISCIPLINARY APPROACH (TDA)
FOR STRENGTHENING DISASTER RESILIENCE**

13.4 % (44,435 km²)
Total Flooding areas in Malaysia

32 % (10.4 million people)
Population vulnerable to floods

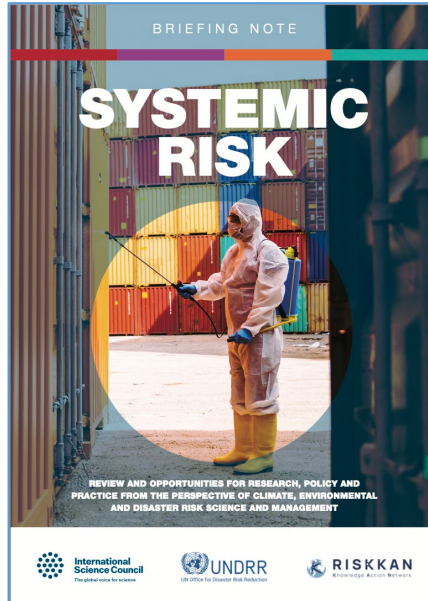
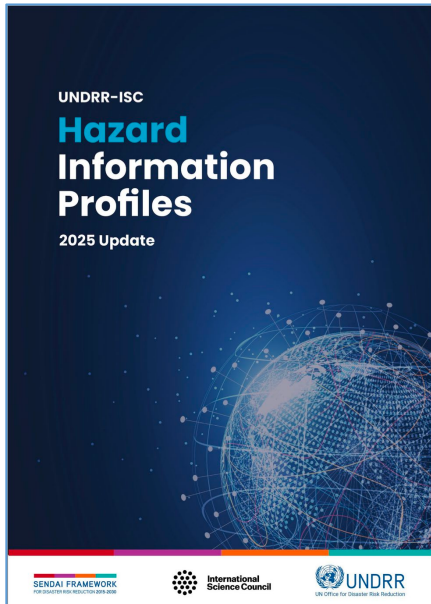
RM 18.1 billion
Annual average damage

*Source: Department of Irrigation and Drainage (DID) Updating of
Conditions of Flooding and Flood Damage Assessment in Malaysia 2023*

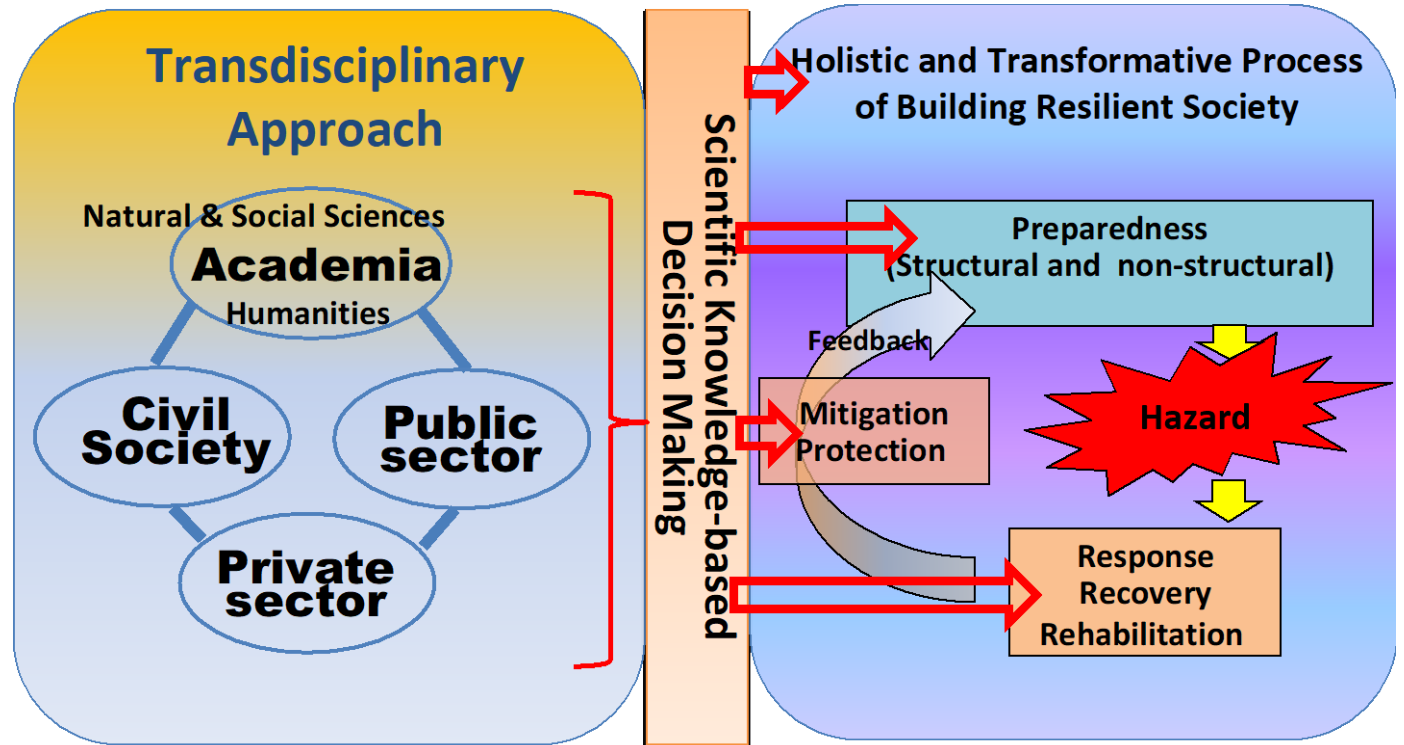


**ISSUES/ CHALLENGES | COST-EFFECTIVE SOLUTIONS & SERVICES
NEEDS & DEMANDS COLLECTIVE & SHARED RESPONSIBILITY**

TDA (transdisciplinary approach) to accelerate local DRR agenda – by working together with various stakeholders (public, private, academia, civil society, media & parliamentary) to go beyond disciplinary and sectoral limit, in making holistic solutions & building societal resilience



<https://pure.iiasa.ac.at/id/eprint/17848/>



Co-Design, Co-Produce, Co-Deliver, and Co-Implement

Source:
TC21 Transdisciplinary Approach for Building Societal Resilience to Disasters, Asian Civil Engineering Coordinating Council (ACECC)



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(DPPC)

"1-in-20-year flood can cost Malaysia up to 4.1 percent of GDP in 2030, in the absence of adaptation efforts"— World Bank, 2024



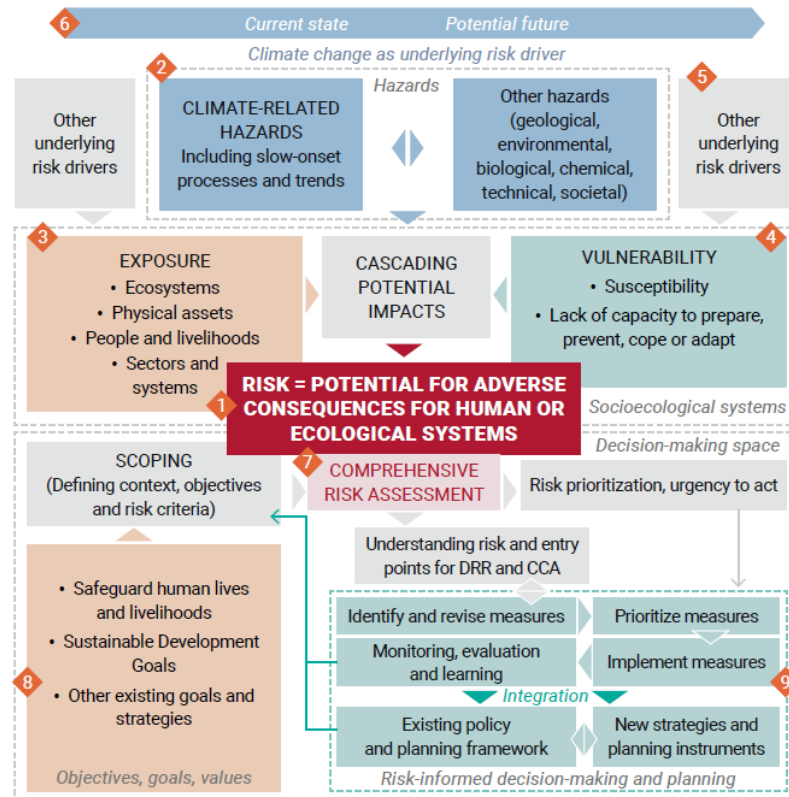
Malaysia has one of the world's highest levels of exposure to flood-related disasters, ranking 12th in the world in terms of the frequency of events but 78th in terms of the average annual damages - World Bank (2024)

Climate change, extreme weather events
>> New, emerging hazards, systemic risk

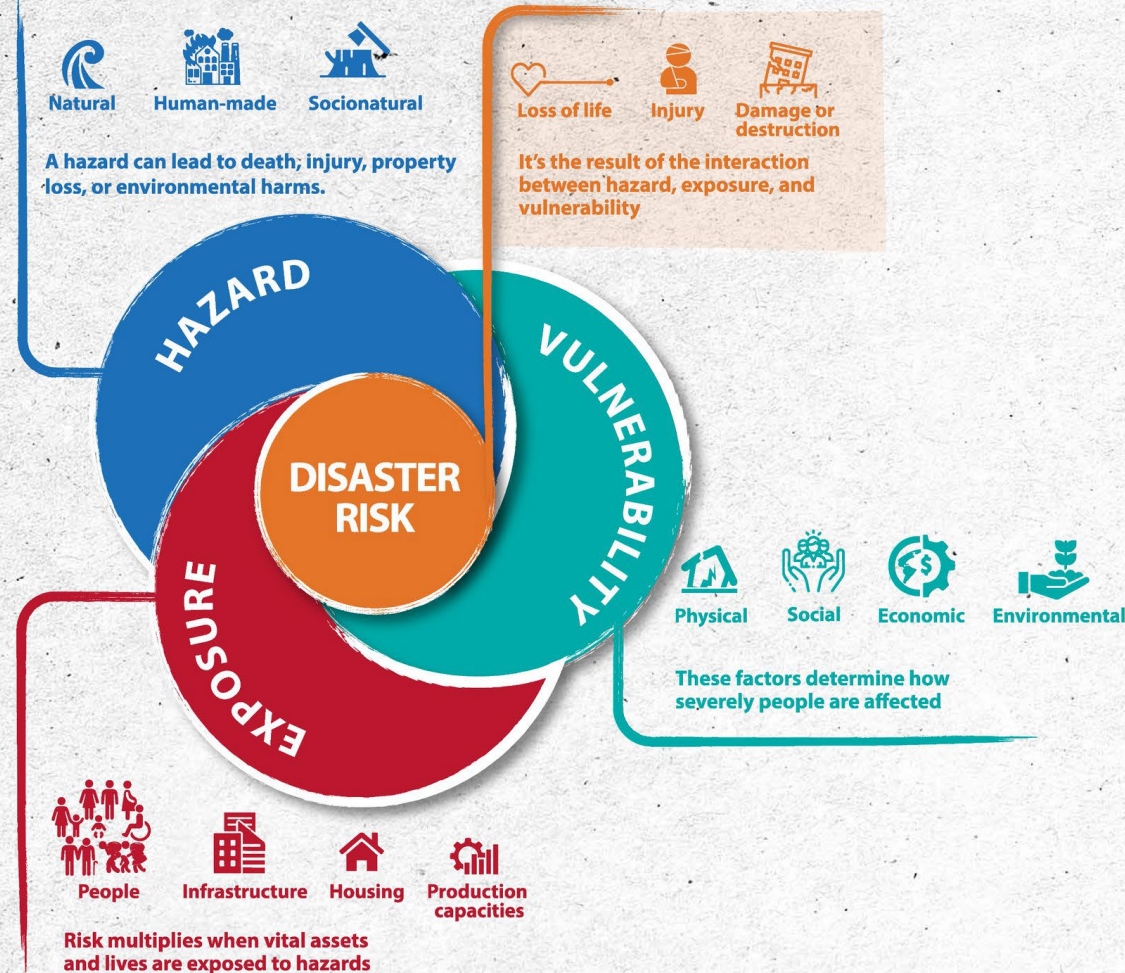
URBAN DISASTER DE-RISK INVESTMENT

High degree of
disaster damages
& economic losses

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The different dimensions of disaster risk

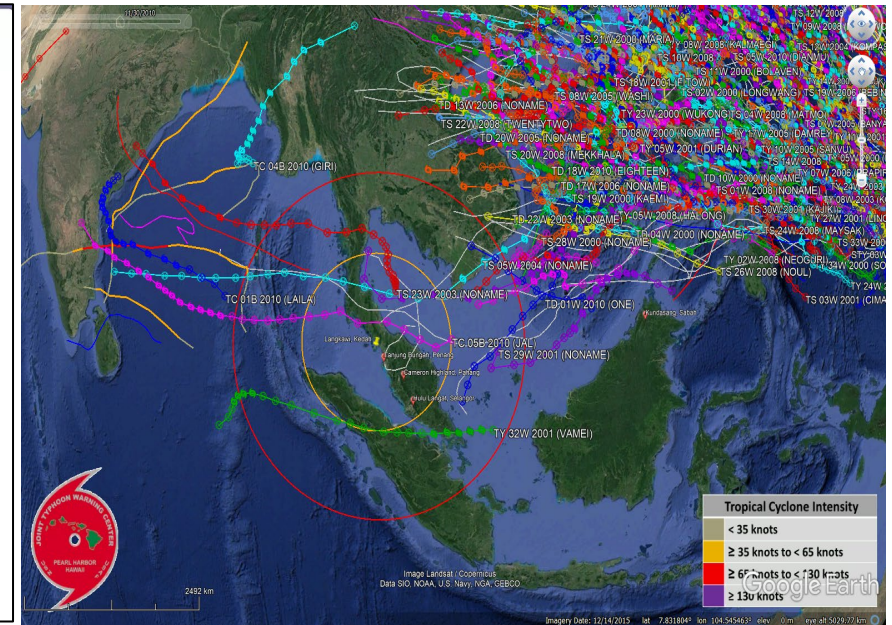
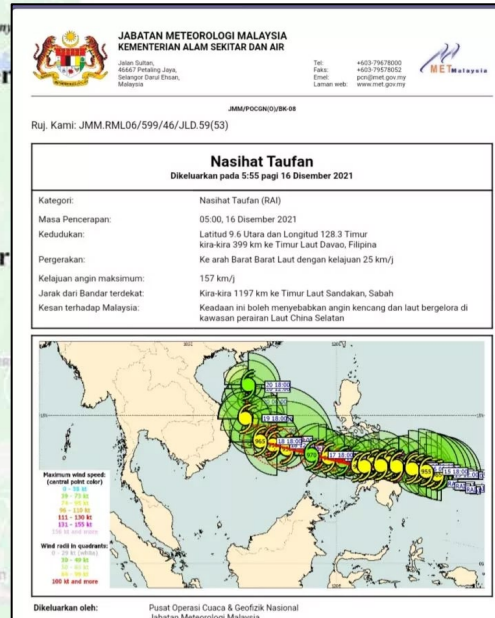


Typhoon-induced, Dam-related, Sediment-related disaster

Emerging Hazard, Systemic Risk and Compound Disaster

Exploring local practices, benchmarking and unique recipe for new and improved solutions towards mainstreaming disaster risk reduction and resilience

Landslide, debris flow, riverine floods, coastal disaster
18-20 December 2021



Selangor: Langat River Pahang: Bentong, Karak, Mentakab, Temerloh, Negeri Sembilan: Jelebu



Jabatan Perancangan Bandar dan Desa
Negeri Selangor
(PLAN)Malaysia Selangor
Perancangan Melangkaui Kelaziman

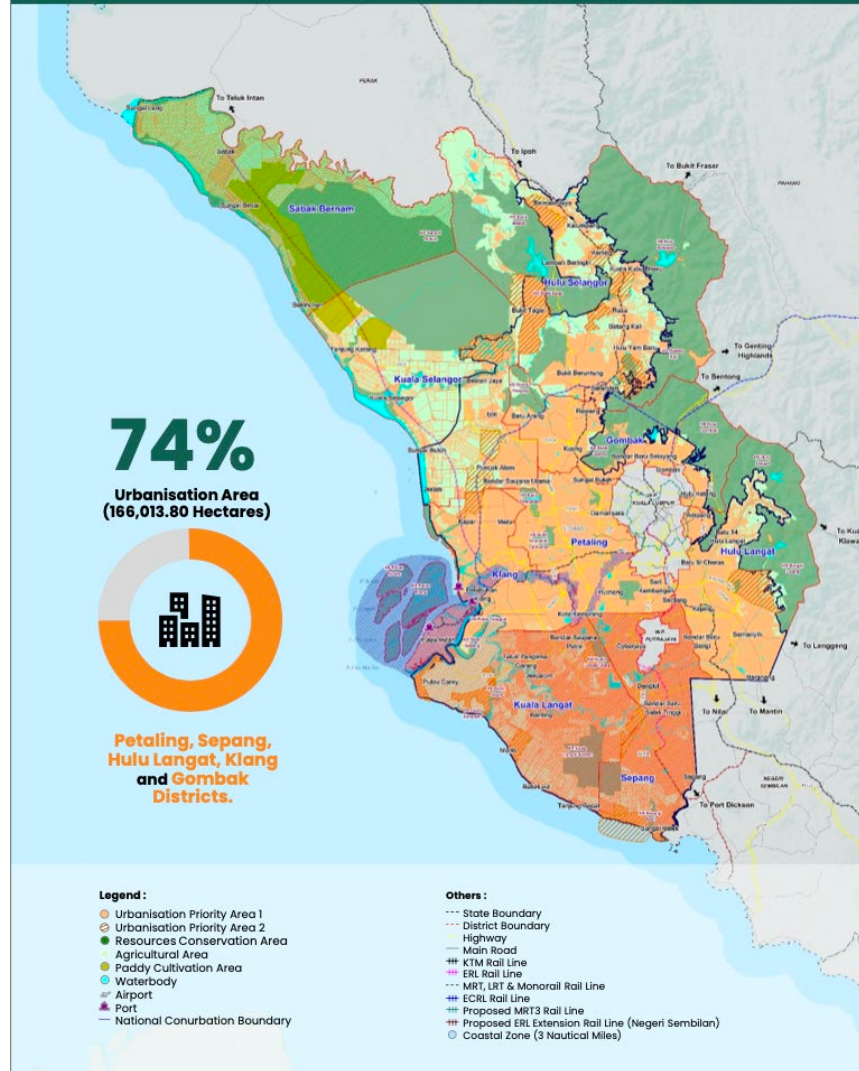
RANCANGAN STRUKTUR NEGERI SELANGOR 2035 (PENGUBAHAN)



Draft STRUCTURE PLAN SELANGOR STATE 2035 [AMENDMENT]

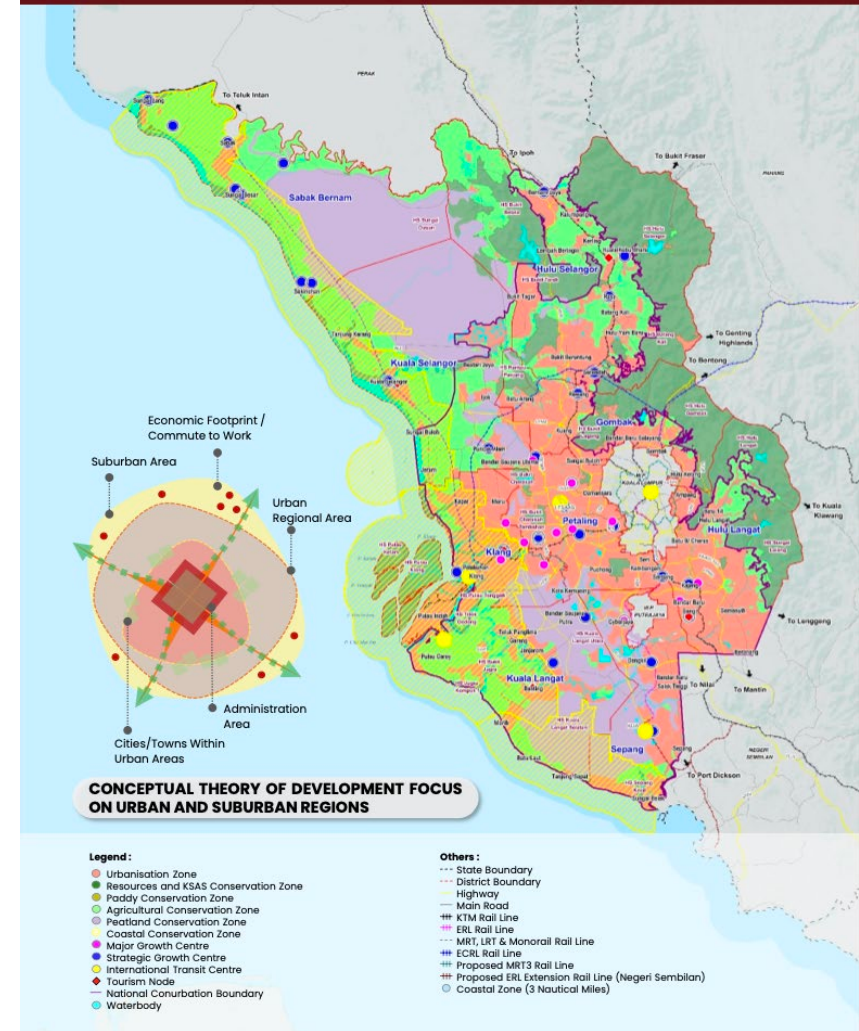
DEVELOPMENT PRIORITY AREAS

URBAN PRIORITY AREAS 1 AND 2



SELANGOR SSP2035 (AMENDMENT)

CONCEPT OF DEVELOPMENT FOCUS ON URBAN AND SUBURBAN REGIONS



Selangor State Land Use Strategic Plan 2035 (Amendment)

RSN
SELANGOR
Scale 1:520,000



DRAFT SELANGOR STATE STRUCTURE
PLAN 2035 (AMENDMENT)

LEGEND :

Main Land Use

Category

- Urbanisation Priority 1
- Urbanisation Priority 2
- Agriculture Area
- Permanent Forest

Types / Main Development Activities

- City State
- Main City
- Local City
- Industry
- Nature Tourism Products
- Heritage Tourism Zones
- Sports, Shopping and MICE

Development Activities / Physical Characteristics with KSAS Status

- Paddy Cultivation Area
- Zon Persisiran Pantai
- Cockle farm
- Waterbody
- Quartz Ridge
- National Leprosy Control Centre
- Central Forest Spine (CFS)

Flagship Project

- Integrated Development Region in South Selangor - IDRIS
- Selangor Maritime Gateway Economic Development Zone - ZPE SMG
- Sabak Bernam Developments Area - SABDA

Infrastructure and Utilities

- Highway
- Main Road
- Transit Rail Line
- KTM Rail Line
- MRT Rail Line
- Rail Freight
- ECRL Rail Line
- BRT Line
- Airport
- Port
- Major Transit Centre
- Electric Power Station

Others

- State Boundary
- District Boundary
- Coastal Zone (3 Nautical Miles)
- Proposed ERL Extension Rail Line (Negeri Sembilan)
- Proposed Klang - Sabak Bernam Rail Line

POLICY

MP1, MP2, MP3, MP5, MP7
MP1
MP12, MP13, MP14, MP15
MP17, MP18

MP5

BM4, BM5, BM6, MP8

BM7, BM8, MP23

MP12, MP13
MP20
MP12
MP21, MP26, MP27
MP18
MP17

BM1, BM4, BM5, BM10

MM15, MM16, MM17, MM18, BM10

Straits of Malacca

PUBLIC TRANSPORT PROPOSAL

- 1. Proposed Reactivation of Commuter Rail Rawang - Coal
- 2. Proposed North Integrated Terminal (TBU) Elmina
- 3. LRT proposal: Sungai Buloh - Shah Alam - Puchong - Cyberjaya - Putrajaya - Bangi New Town
- 4. Port Klang - Seremban Bypass Railway Track
- 5. Proposed LRT Puchong - Serdang - Kajang

KEY PLAN

NOTE :
The built-up area shown is indicative. Lot based land use planning issued is subject to the Local Plan (RT)

SOURCES :
Kajian Rancangan Struktur Negeri Selangor, 2035 (Pembetulan)
Rancangan Fizikal Negara Ke-4, 2020

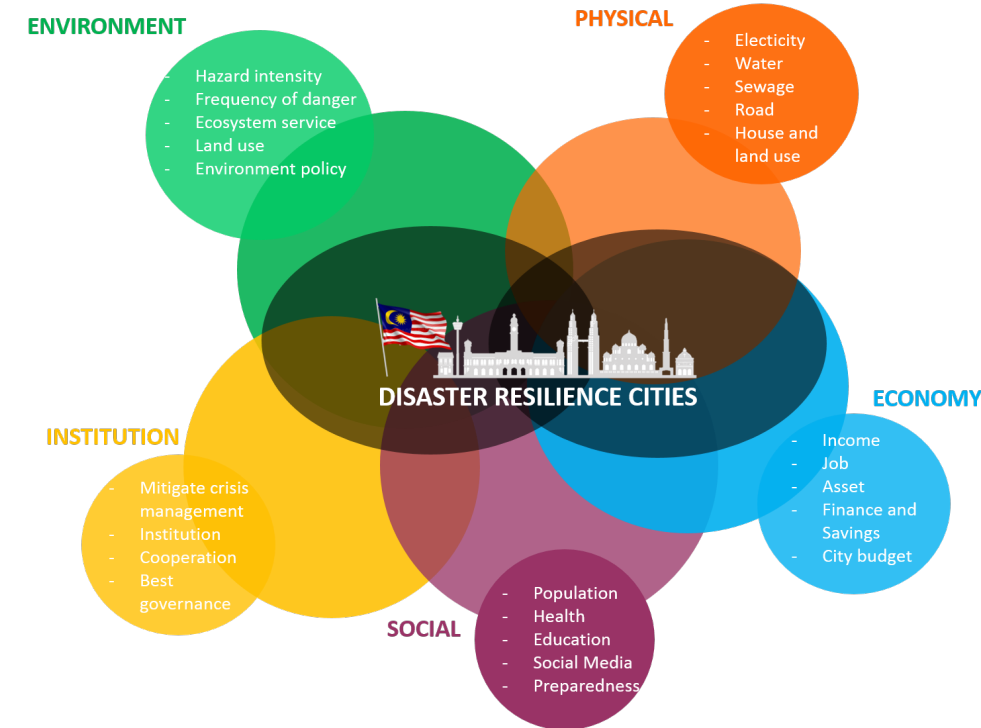
EMERGING
HAZARD
(BAHAYA BARU
MUNCUL)
&
SYSTEMIC
RISK
(RISIKO SISTEMIK)
&
COMPOUNDING
DISASTER
(BENCANA
BERGANDA)

MCR
2030

Making our Cities more Resilient | Promoting risk-informed urban development in a changing climate



NATIONAL GUIDELINE Development Planning for Disaster Resilient Cities, 2019



Technology Enhanced Stakeholder Collaboration for Supporting Risk-Sensitive Urban Development (TRANSCEND)

MULTI-SCALE DISASTER RISK AND RESILIENCE MODEL: ANTICIPATORY ACTION FOR LOCAL CLIMATE CRISIS

To address emerging hazards, systemic risks and climate resilience, this study aims to promote a transdisciplinary approach for building societal resilience and **de-risk strategy** towards **preventing future climate-induced disaster losses** in Malaysia



One of study areas located in Kenyir Geopark, Hulu Terengganu
(photo captured over Kenyir Hydroelectric dam in February 2025)





**40% of large dams are at high risk
12% are aging dams (> 50 years)**

Photo by BERNAMA, 27 February 2022

Extreme weather event & climate-induced disaster risk @ large hydro dam

Power Generation & Critical Infrastructure Disruption | Business Continuity

Massive evacuation | Impact-based Early warning system | Complex decision-making

Systemic risk & emerging disaster | Local DRR Resilience Strategy



4 people stranded, disrupted operations, possible dam-break
No communication, no road access, no bridge, no resources
Complicated due major disaster at a district level

RISK COMMUNICATION FRAMEWORK ON DEBRIS FLOW FOR DISASTER RISK MANAGEMENT AND COMMUNITY RESILIENCE AT JERAI GEOPARK

Liyana Hayatun Syamila Binti Ramlee, Disaster Preparedness and Prevention Center (DPPC) Malaysia-Japan International Institute of Technology (MJIIT) UTM

This study aims to use the knowledge of multi-discipline; geoscience and disaster risk management to develop a comprehensive and integrated framework of risk communication using people-centric early warning system (EWS).

OBJECTIVES:

1. To assess risk and analyze geological mapping on debris flow and its impact.
2. To produce national integrated risk communication framework on people-centric and end-to-end debris flow early warning system (EWS) for disaster risk management and community resilience.
3. To strategize Disaster Risk Reduction (DRR) local action plan and to produce the Geopark Resilience Model.

METHODOLOGY

CASE STUDY

LITERATURE REVIEW

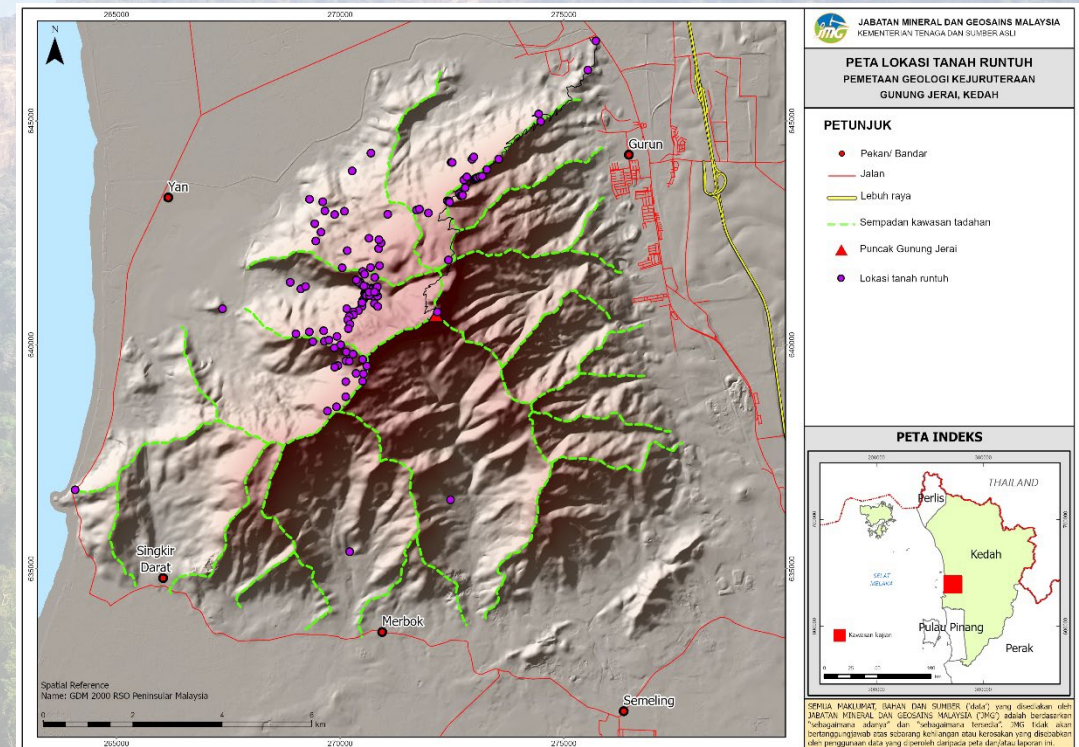
FOCUS GROUP DISCUSSION (FGD) & STAKEHOLDER ENGAGEMENT

QUESTIONNAIRE

Risk Communication Framework

This framework can be beneficial to other Geoparks in Malaysia as an effective guideline, implemented policy into action at the local level

Study Area: Debris Flow at Jerai Geopark on 18 August 2021



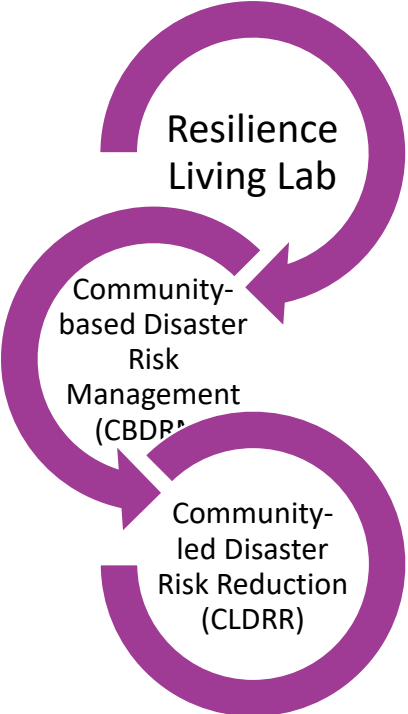
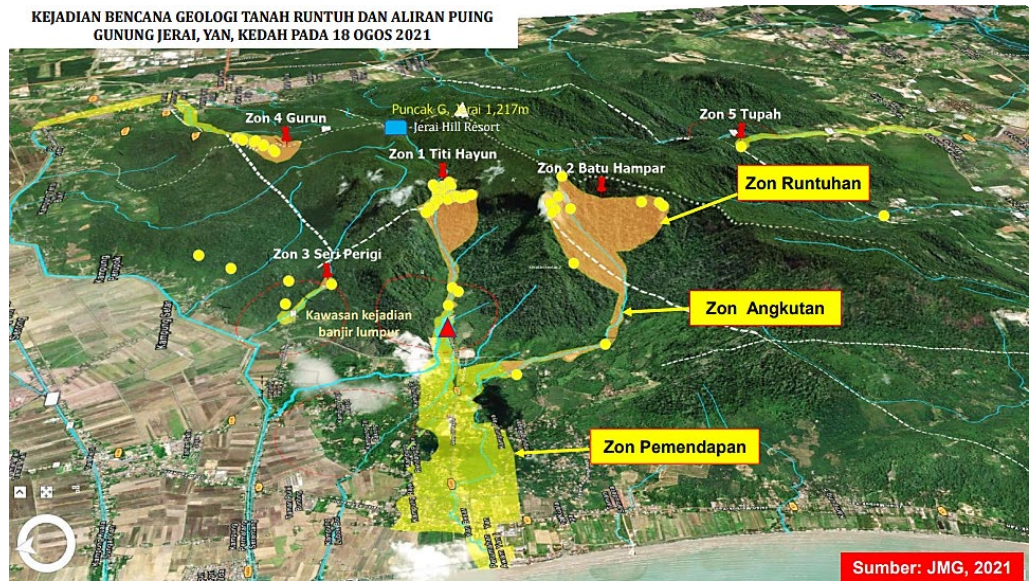
In Malaysia, it is recorded from 1995 that geological disaster debris flow occurred more than 25 times with 442 casualties.

Source: Geological disaster debris flood study report, 2022

Economic losses: RM75 Million
Affected Settlement: 1,732
Affected business premises: 124
Affected chalets: 14

RISK COMMUNICATION FRAMEWORK ON DEBRIS FLOW FOR DISASTER RISK MANAGEMENT AND COMMUNITY RESILIENCE AT JERAI GEOPARK

Study Background:



Capacity Building for Community Resilience:

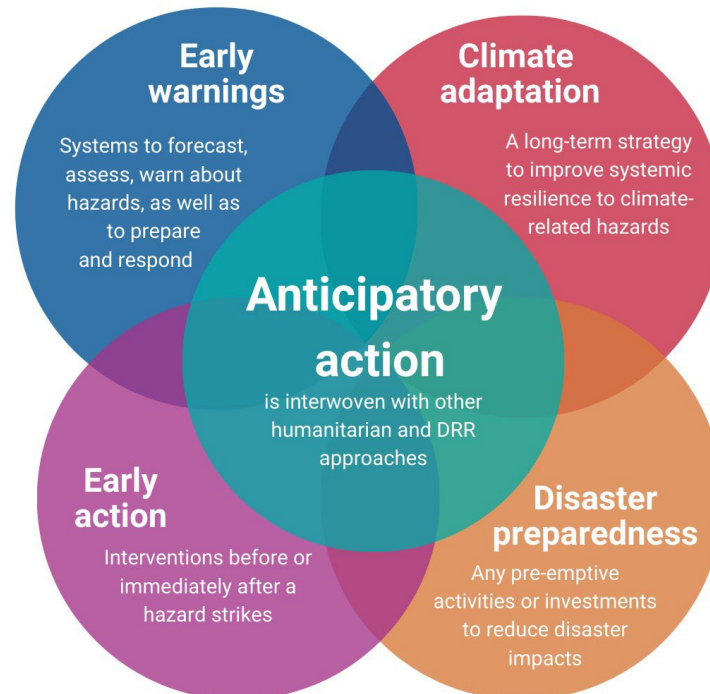


RESILIENCE MALAYSIA 2025-2030

New, emerging hazards,
systemic risk & compounding disaster



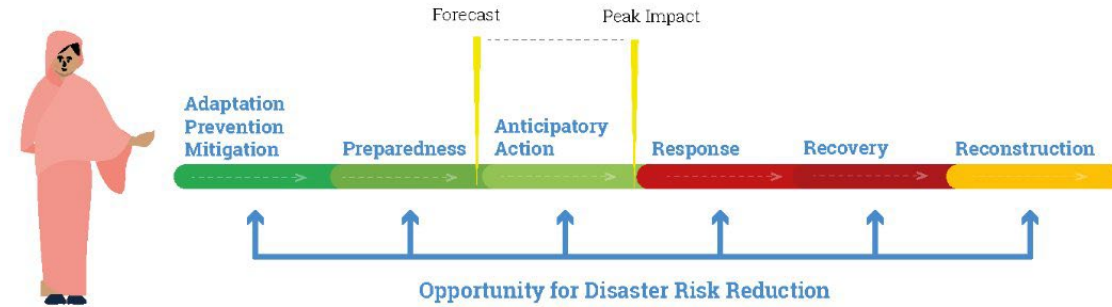
Anticipatory action connects early warnings,
early actions, adaptation and disaster preparedness



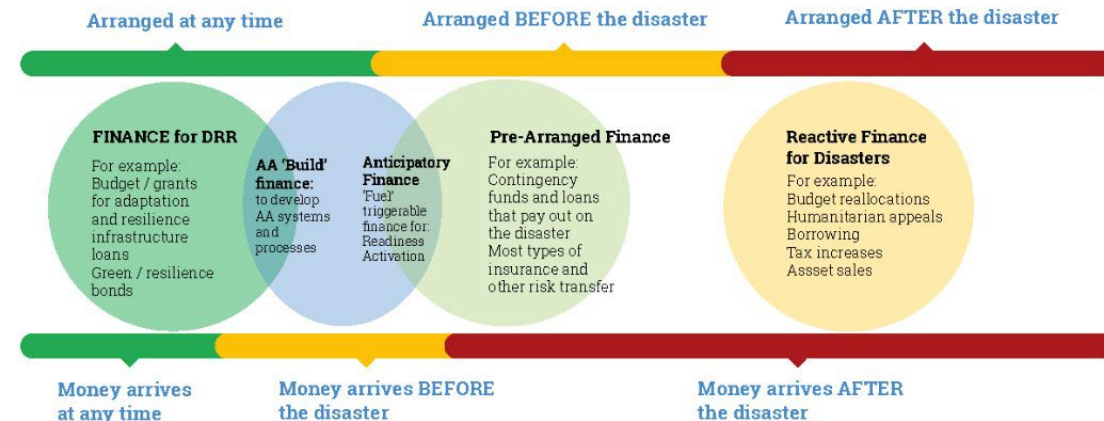
2025-2027-2030

Risk Mapping
Risk Assessment
Risk Governance
Risk Communication
Risk Investment
Risk Reduction

Anticipatory action allows
humanitarian interventions ahead of a disaster

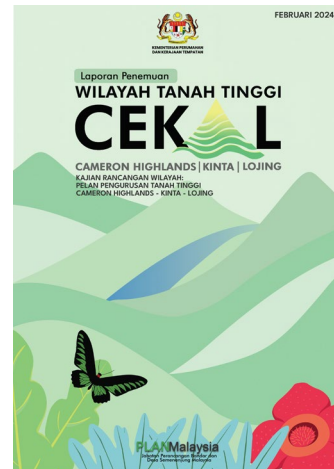


It requires **dedicated finance** that is released
when forecasts meet pre-agreed triggers



Early warning and early action saves lives,
protects livelihoods, and preserves dignity

NEW, UNIQUE STRATEGY: MULTI-SCALE DISASTER RISK REDUCTION (DRR) AGENDA & ACTION



Mainstreaming disaster risk reduction (DRR) action into development planning and control



Investing into risk-sensitive urban and regional development strategies for societal resilience

Town and Country Planning Act 1976 (Act 172)



DISASTER RISK REDUCTION PRODUCTS AND PROCESSES: KNOWLEDGE SHARING FOR PLACE- AND CONTEXT-SPECIFIC ACTIONS

Authors: Naxhell Ruiz-Rivera (Mexico), Maria Soledad Garcia Ferrari (United Kingdom), Alik Ismail-Zadeh (Germany), Gaili Yang (China), Christopher Garimoi Orach (Uganda), Khamarrul Azahari Razak (Malaysia), Josephine Ngaira (Kenya), Fang Lian (China)
Reviewers: John Handmer (Australia), Allan Lavell (Costa Rica), Virginia Murray (United Kingdom), and Coleen Vogel (South Africa)



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A set of approaches for developing science-based DRR products and processes, highlighting good practices that integrate science and diverse forms of knowledge into actions at local and national levels.

Table 1.
Examples of DRR products and processes that incorporate scientific evidence or methodologies

Inputs	DRR types of actions				
	Understanding and preventing future risk	Reducing current risk	Strengthening response preparedness (readiness)	Responding and rehabilitating	Recovering and reconstructing
Hazard and risk mapping	DRR laws / Land use and zoning maps / Hazard micro-zoning / River engineering tools / Participatory/ crowdsourced geographic information systems	Geographic Information System (GIS) & remote sensing tools / Building codes	Hazard Information Profiles (HIPs) ^[1] / Evacuation maps (including participatory cartography) / Local DRR brochures and flyers	Damages and Losses Assessment (DALA) tool ^[2] / Drones & other UAS	Prospective urban plans (relocation and reconstruction)/ Enhanced hazard and risk maps / Enhanced building codes
Demographic analysis	Prospective urban plans (exposure)	Maps of disaster loss assessments	Civil defense and community level plans	Post-Disaster Needs Assessment (PDNA) tool ^[3]	Post-disaster urban plans (dynamic vulnerability and exposure)
Behavioral psychology models	Training models for various groups of people / Humanitarian standards ^[4]	Nudges ^[5] / Emergency evacuation drills ^[6]	EWS design of public alerts	Emergency communication (e.g., social media, crowdsourcing)	Models for long-term rehabilitation of and recovering from post-disaster trauma
Architectural innovations	Modern building materials / Indigenous DRR technologies ^[7]	Building codes / Insurance packages	Resilient building construction plans	Emergency housing plans	Build Back Better (BBB) guidelines
Artificial Intelligence	Epidemiological trends for health managers	Hazard event forecasting / Risk mapping/ EWS for high-speed trains ^[8]	Evacuation models for local authorities	Rapid damage assessments	Indigenous, sustainable and safer building models



Figure 1. Designing DRR Products and Processes

https://www.irdrinternational.org/knowledge_pool/publications/131



DISASTER RISK REDUCTION PRODUCTS AND PROCESSES: KNOWLEDGE SHARING FOR PLACE- AND CONTEXT- SPECIFIC ACTIONS

Authors: Naxhelli Ruiz-Rivera (Mexico), Maria Soledad Garcia Ferrari (United Kingdom), Alik Ismail-Zadeh (Germany), Saini Yang (China), Christopher Garimoi Orach (Uganda), Khamarrul Azahari Razak (Malaysia), Josephine Ngaira (Kenya), Fang Lian (China)
Reviewers: John Handmer (Australia), Allan Lavell (Costa Rica), Virginia Murray (United Kingdom), and Coleen Vogel (South Africa)



POLICY RECOMMENDATIONS

We urge the science academies, funders, and governments across sectors to embrace context-specific, diverse, and plural knowledge as a crucial step toward strengthening evidence-based decision-making processes and accelerating DRR action, particularly at the local level. This effort can be

supported by co-produced DRR processes grounded in dialogue, incorporating local knowledge and community-based mechanisms along with available technologies to support evidence synthesis and ensure that scientific research is relevant to policy questions. A way to achieve this is:

Recommendation 1

To encourage place- and context-specific development of DRR processes, products, and approaches that enable impactful risk reduction actions and support collaboration between research, data, and local policymaking communities. It is essential to embed specific users, including local communities and practitioners, in the co-design and co-production of these approaches and products.

Recommendation 2

To promote the adoption of local science advisory mechanisms that help make science useful, relevant, and credible by integrating diverse forms of knowledge into DRR products. By leveraging new technologies, these mechanisms can support the identification, analysis, and dissemination of evidence for policy development and evaluation, bridging technical capabilities with the diverse expertise and needs of real-world users.



RISK-INFORMED DEVELOPMENT @ ASEAN

This brief is intended to guide sub-national and local authorities, as well as research and academic institutions.

The policy recommendations acknowledge the need for the proposed local and regional actions to work within a corrective and prospective overall national policy framework for DRR management.

CONCLUSION

1. Investing new knowledge, technology, and solutions based on Transdisciplinary Approach (**TDA**)
2. Addressing the **creation of new risk** and its impact at a basin scale
3. Understanding systemic risk, **compounding and cascading** hazards in the urban setting



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- ² Scientific Committee, Integrated Research on Disaster Risk (IRDR), **International Science Council (ISC)**
- ³ Former Science and Technology Expert Panel for Disaster Risk Reduction (STEP for DRR) National Disaster Management Agency (NADMA), **Prime Minister's Department Malaysia**
- ⁴ Former Co-Chair, Working Group on Climate Change & Disaster Risk Reduction, **Global Young Academy, Germany** @ <https://globalyoungacademy.net>
- ⁵ Technical Committee, **Asian Civil Engineering Coordinating Council (ACECC) Japan**, TC21: Transdisciplinary Approach for Building Societal Resilience to Disasters, Japan
- ⁶ Member of **ASEAN Science Diplomats, the Philippines**
- ⁷ Executive Council Member of **MERCY Malaysia**

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