



**PLENARY SESSION 3 THURSDAY 25 APRIL 2019 @ HANOI**

## **Geo-led Horizon Scanning Programme for Disaster Risk Reduction (DRR): A New Insight into 2030 Global Vision**

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# OUTLINES

Disasters at Glance (Global, Asia, ASEAN) | Concept of Horizon Scanning  
Sendai VS SDG | Transdisciplinary Approach | Case Studies | Concluding remarks



Mapping Analysis & Assessment  
(MAA)

Modelling Simulation & Prediction  
(MSP)

Monitoring Surveillance &  
Warning (MSW)



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and Informatics

# MULTI-GEOHAZARD & DISASTER RISK

## A TRANSDISCIPLINARY DISASTER RESEARCH

*Advancing disaster risk reduction in a changing environment*



FLOOD



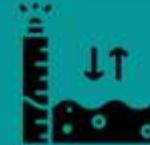
EARTHQUAKE



LANDSLIDE



TSUNAMI



SEA LEVEL RISE



COASTAL

***“Knowing Our Current Risk, Preventing Our Future Risk”***

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## Disaster Risk Reduction and Management

Advancing science and technology for disaster risk reduction and management

Supporting evidence-based decision making for reducing future disaster risk

Promoting Transdisciplinary Approach (TDA) for building societal resilience



JASTIP

Japan - ASEAN  
Science, Technology and  
Innovation Platform



GADRI

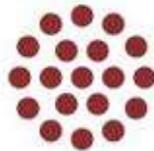
Global Alliance of  
Disaster Research Institutes



AUN/SEED-Net



Transdisciplinary Approach (TDA)  
for Building Societal Resilience to Disasters



International  
Science Council

Regional Office for Asia and  
the Pacific



Global Young Academy

The voice of young scientists around the world



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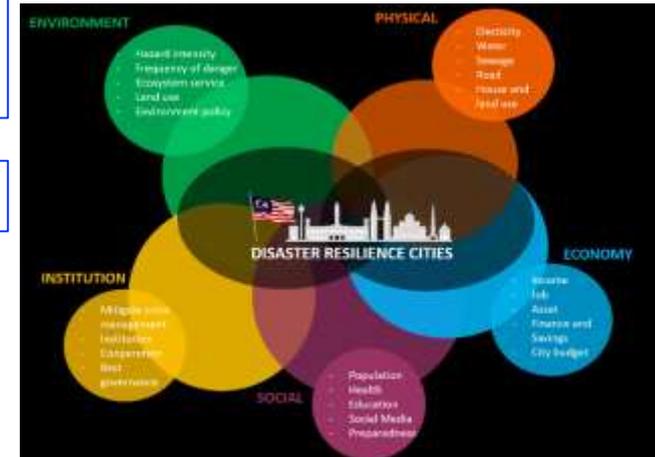
# Disaster Risk Reduction and Management

MULTI-HAZARD RISK ASSESSMENT, MAPPING, MONITORING,  
EARLY WARNING-BASED IMPACT AND PREDICTIVE MODELLING

DATA MANAGEMENT & ANALYTICS

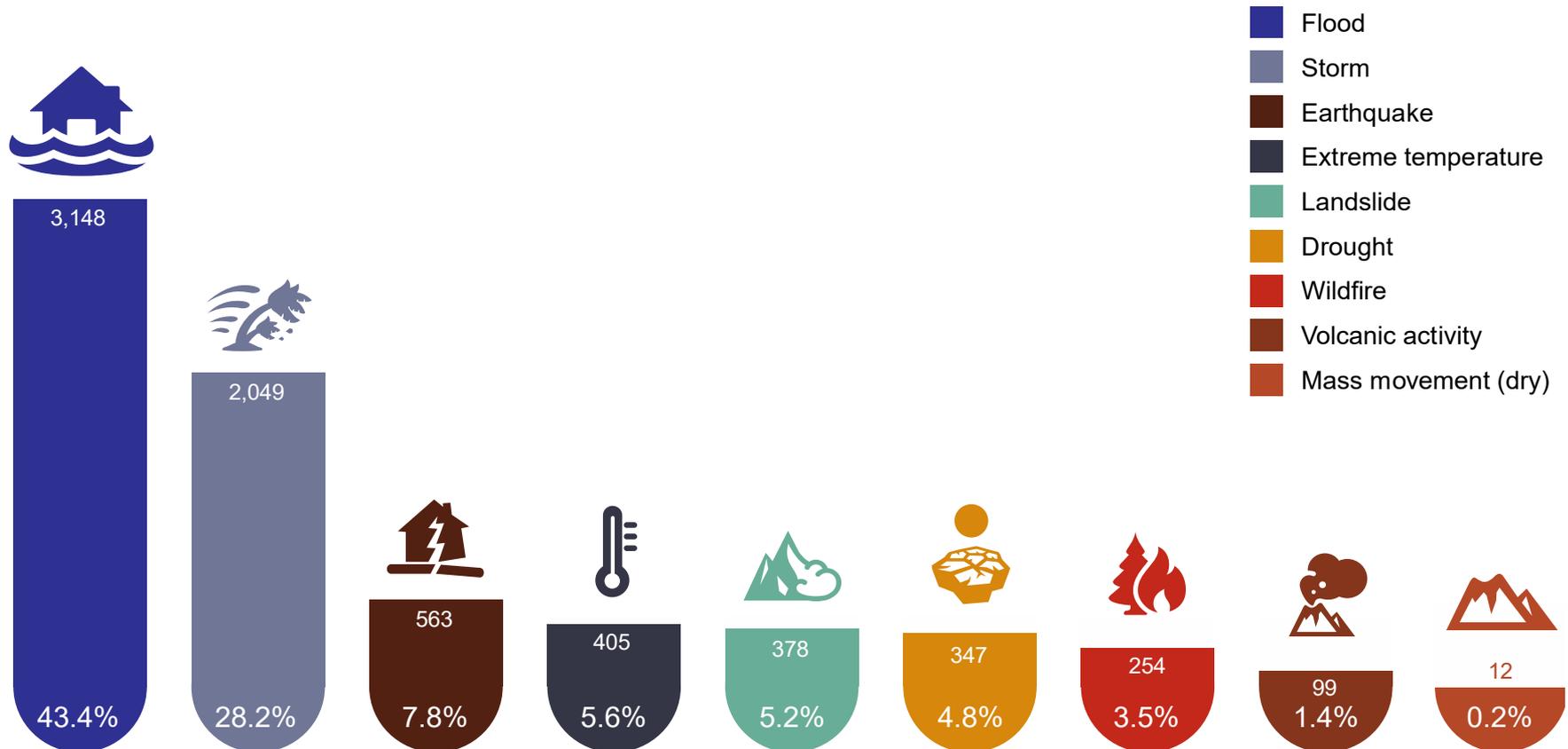
DECISION MAKING

ASEAN Vision 2025 on Disaster Management  
Sendai Framework for Disaster Risk Reduction 2015-2030  
Paris Agreement on Climate Change  
New Urban Agenda  
Agenda 2030 for Sustainable Development



# Numbers of disasters per type, 1998-2017

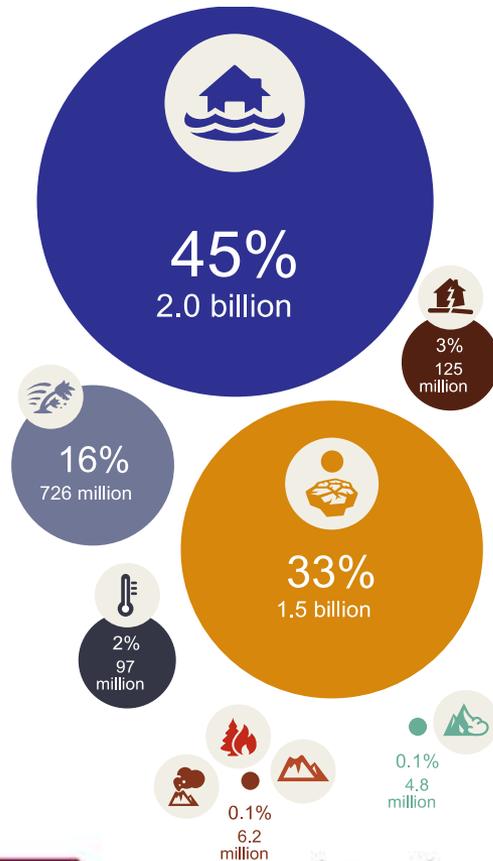
Source: CRED & UNISDR, Economic Losses, Poverty and Disasters 1998-2017



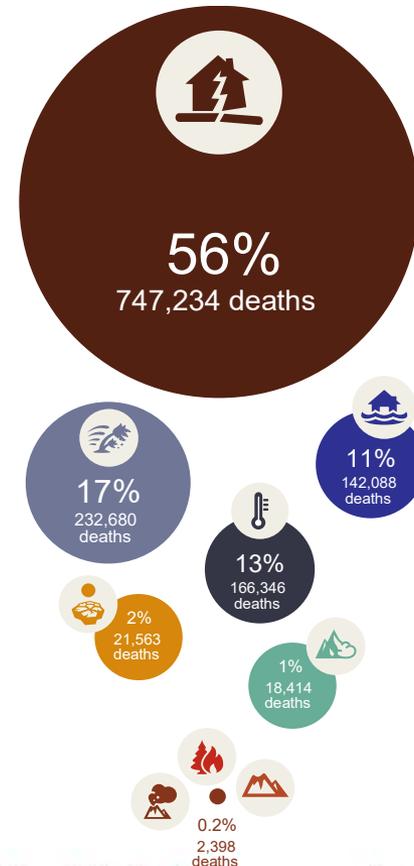
# Number of people affected and numbers of death per disaster type, 1998-2017

Affected people

- Flood
- Storm
- Earthquake
- Extreme temperature
- Landslide
- Drought
- Wildfire
- Volcanic activity
- Mass movement (dry)



Death





International Federation of Surveyors



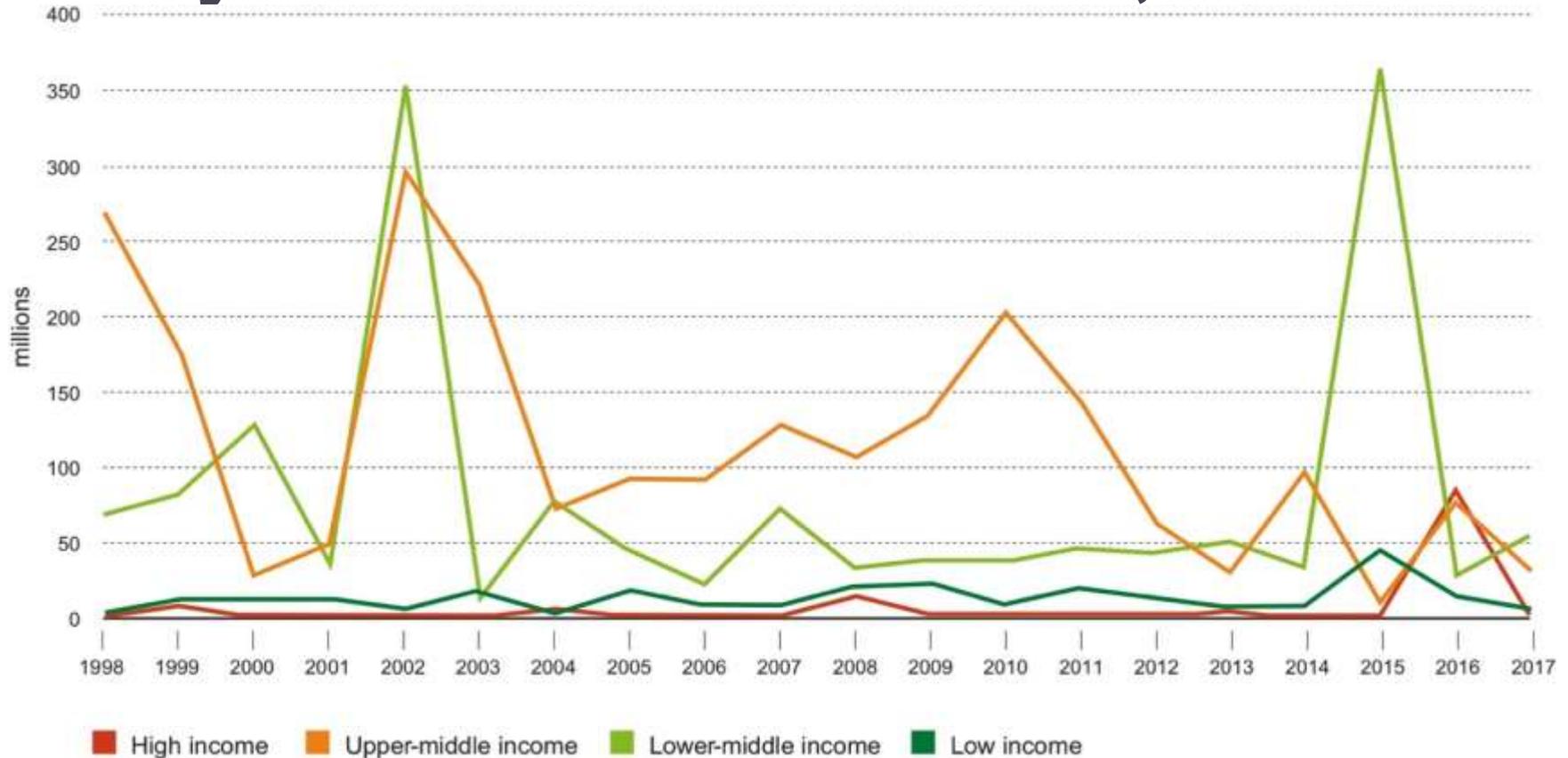
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# Annual affected populations by national income bracket, 1998-2017



Source: CRED & UNISDR, Economic Losses, Poverty and Disasters 1998-2017



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Surveyors



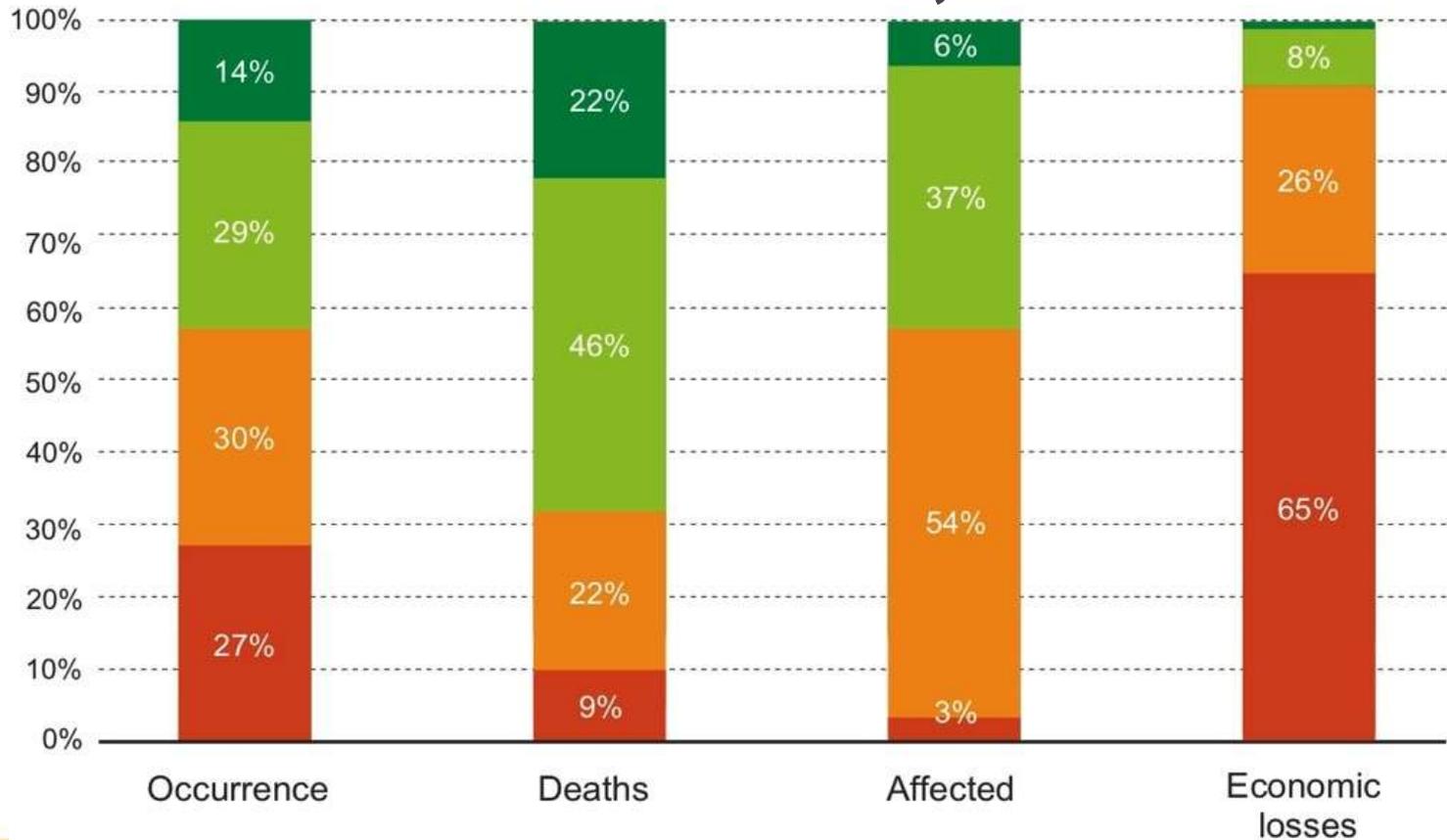
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# Climate-related and geophysical disasters, 1998-2017

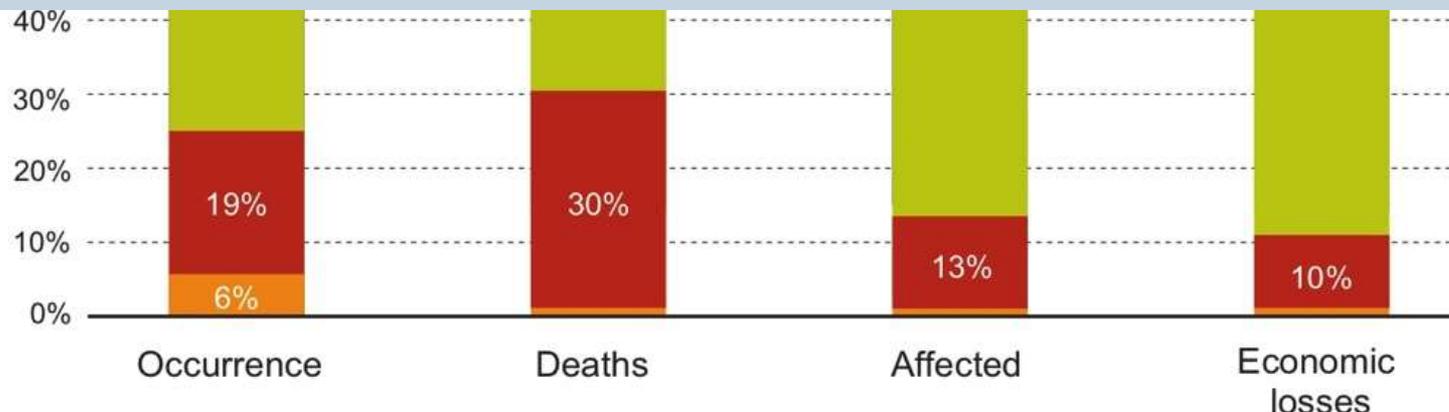


Source: CRED & UNISDR, Economic Losses, Poverty and Disasters 1998-2017

# Human and economic costs of geophysical disasters, 1998-2017



Economic losses to disasters in Asia and the Pacific could exceed **\$160 billion** annually by 2030 (UN ESCAP, 2018)



- Africa
- Americas
- Asia
- Europe
- Oceania

Source: CRED & UNISDR, Economic Losses, Poverty and Disasters 1998-2017



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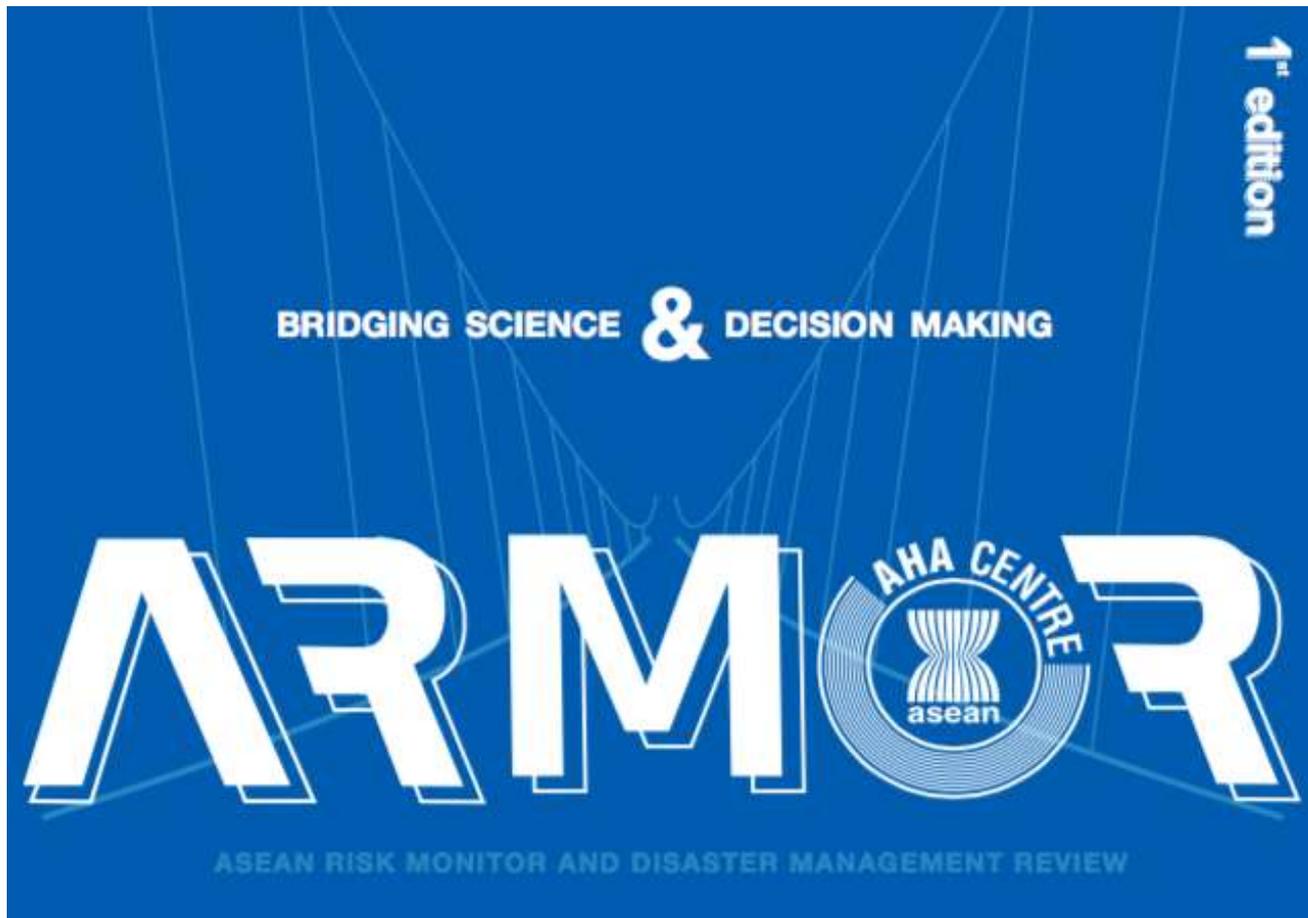
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## Trillion Dollar Multi-Hazard Risk Landscape in Southeast Asia

In 2018, the combined **nominal GDP** of Southeast Asian countries **ranked fifth globally**, amounting to **USD 2.89 trillion**.

However, due to the constant risk of natural hazards, the region's exposed **capital stocks** amount to **USD 8.35 trillion**, or **THREE TIMES OF ITS COMBINED ECONOMY** (Pang & Dimailig, 2019)

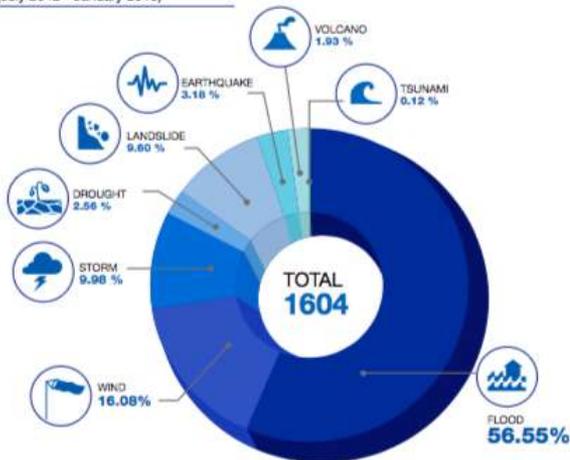
Indonesia (63%) | Philippines (10%)  
The rest (27%)

### Distribution of Disasters in ASEAN (July 2012-January 2019)



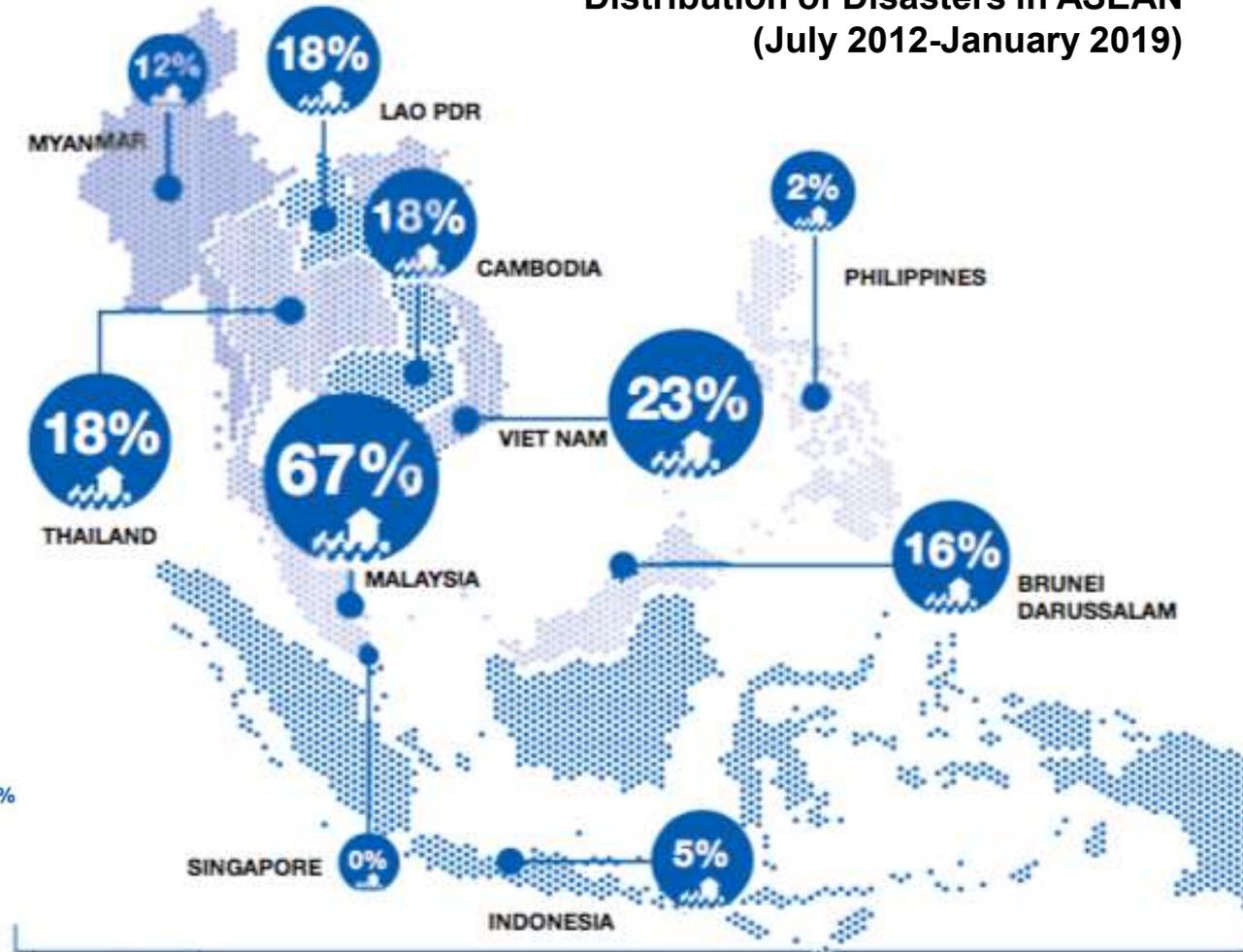
## Percentage of Population Exposed to Floods in ASEAN Member States

Breakdown of Disasters in ASEAN (July 2012 - January 2019)



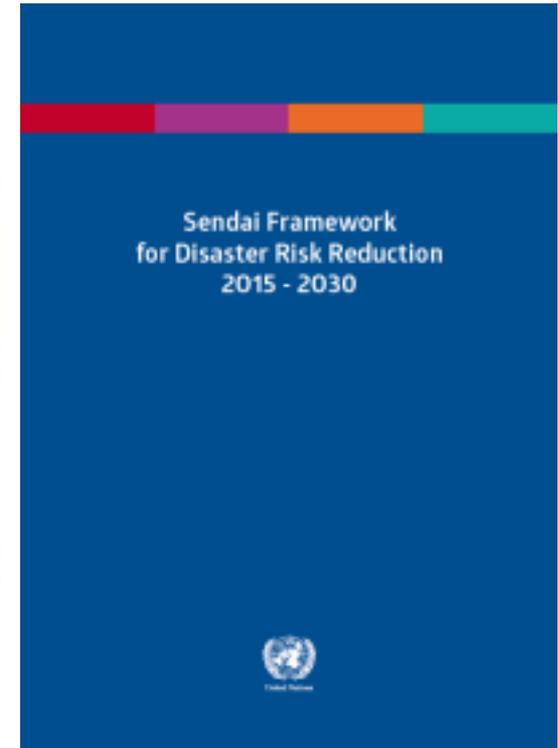
**Flood (56.55%)**

## Distribution of Disasters in ASEAN (July 2012-January 2019)





**SUSTAINABLE DEVELOPMENT GOALS**



As core development strategies, 10 of the 17 SDGs with 25 targets are identified related to disaster risk reduction (DRR). Given extreme climate and rapid urbanization, it is crucial for us to better cope the disaster capacity, assessing our increased exposure to natural hazards and advancing our understanding disaster by science and technology.



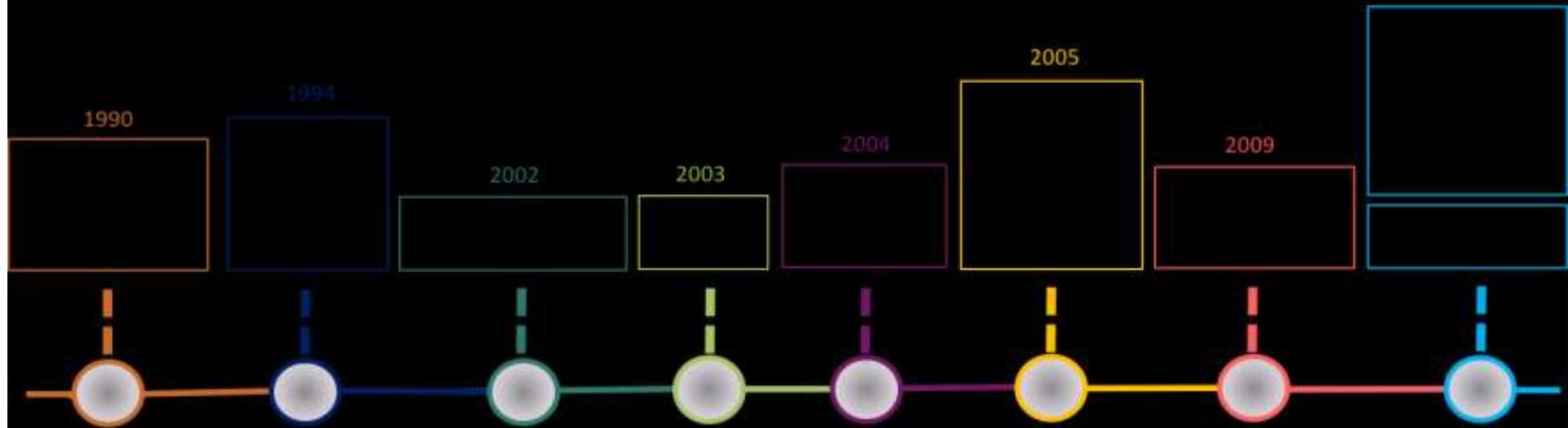
**SUSTAINABLE DEVELOPMENT GOALS**



**Sendai Framework for Disaster Risk Reduction**

**2015 - 2030**

	Reduce	Increase
<b>7 GLOBAL TARGETS</b>	<b>Mortality/ global population</b> 2020-2030 Average << 2000-2015 Average	Countries with national & local DRR strategies 2020 Value << 2015 Value
	<b>Affected people/ global population</b> 2020-2030 Average << 2000-2015 Average	<b>International cooperation</b> to developing countries 2030 Value << 2015 Value
	<b>Economic loss/ global GDP</b> 2030 Ratio << 2015 Ratio	<b>Availability and access</b> to multi-hazard early warning systems & disaster risk information and assessments 2030 Values << 2015 Values
	<b>Damage to critical infrastructure &amp; disruption of basic services</b> 2030 Values << 2015 Values	





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**Horizon scanning** is the intelligence gathering part of strategic foresight, concerned with emerging trends, issues and uncertainties that the future may bring, and assessing their potential impact



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**Horizon Scanning** can be a good technique for people to look at complexity, challenge assumptions and review multiple ways that events could unfurl, in order to increase the resilience and reliability of their organisations.

It is not about trying to predict the future but rather to review options so that evidence-based decisions can be made (Institute of Risk Management, 2017)



Cabinet Office



European Commission  
Joint Research Centre



BETTER POLICIES FOR BETTER LIVES



**Horizon scanning** assesses the information available about future trends and explores the range of potential futures that may result. Using this analysis helps policy makers to get a richer, more informed view about the future, and build that into their plans.

**Current & new disaster risk in future**

**Policy-makers & disaster managers**

**Risk-informed decision making**



## Transdisciplinary Approach (TDA)

Prof. Dr. Emeritus Takeuchi,  
Founding Director, ICHARM  
@ MJIIT, UTM Kuala Lumpur



Scientific knowledge-based decision making  
Co-Design, Co-Produce, Co-Deliver, and Co-Implement  
Societal Transformation is only possible by TDA

“An approach to achieve a common societal goal, by all players and stakeholders at all levels of all related disciplines (natural, social and humanity sciences) and sectors (public, private, academia, and civil) working together, going beyond the limit of disciplinary knowledge and sectoral capacities by creating innovation means, and making holistic and transformative solutions possible”

**Master of Disaster Risk Management (MDRM) <http://mjiit.utm.my/dppc/mdrm-homepage/>**

# Stakeholders

Refugees



- Villagers
- Head of communities
- Children & Youth
- Elders
- People with disabilities
- Teacher
- Public Officers
- Immigrants
- Refugees
- Others



- Local/state agencies
- Federal/central agencies
- Ministry of Health & its agencies
- Ministry of Education & its agencies
- Districts officers
- Police, Fire, Army departments
- Public Healthcare providers- clinic, hospitals

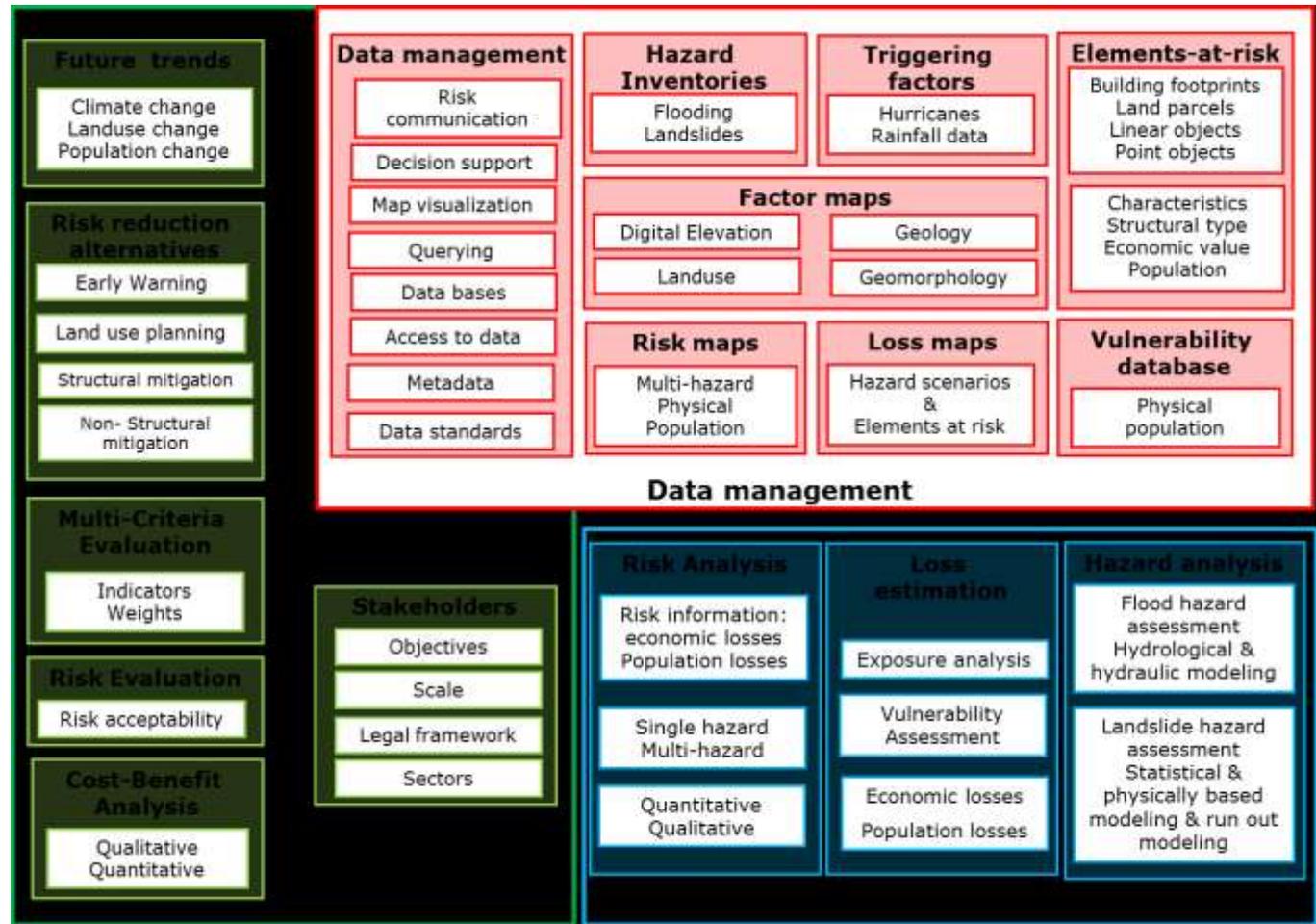


- Small Medium Enterprises
- Government-linked companies (GLCs)
- Financial Institutions
- Public & private early learning centers
- Public & private higher education institutions

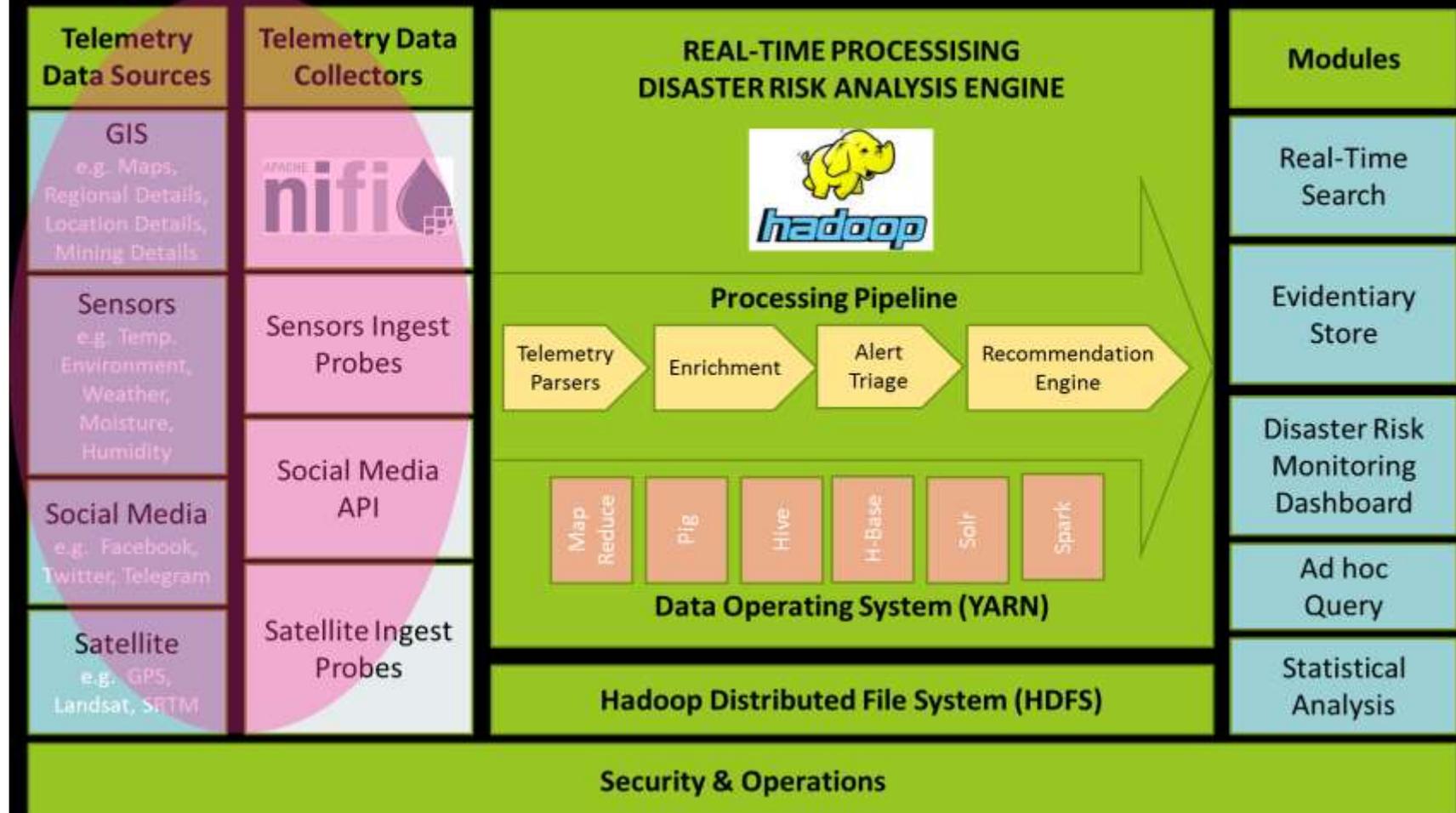
## New Approach : Multi-Hazard & Disaster Risk Management

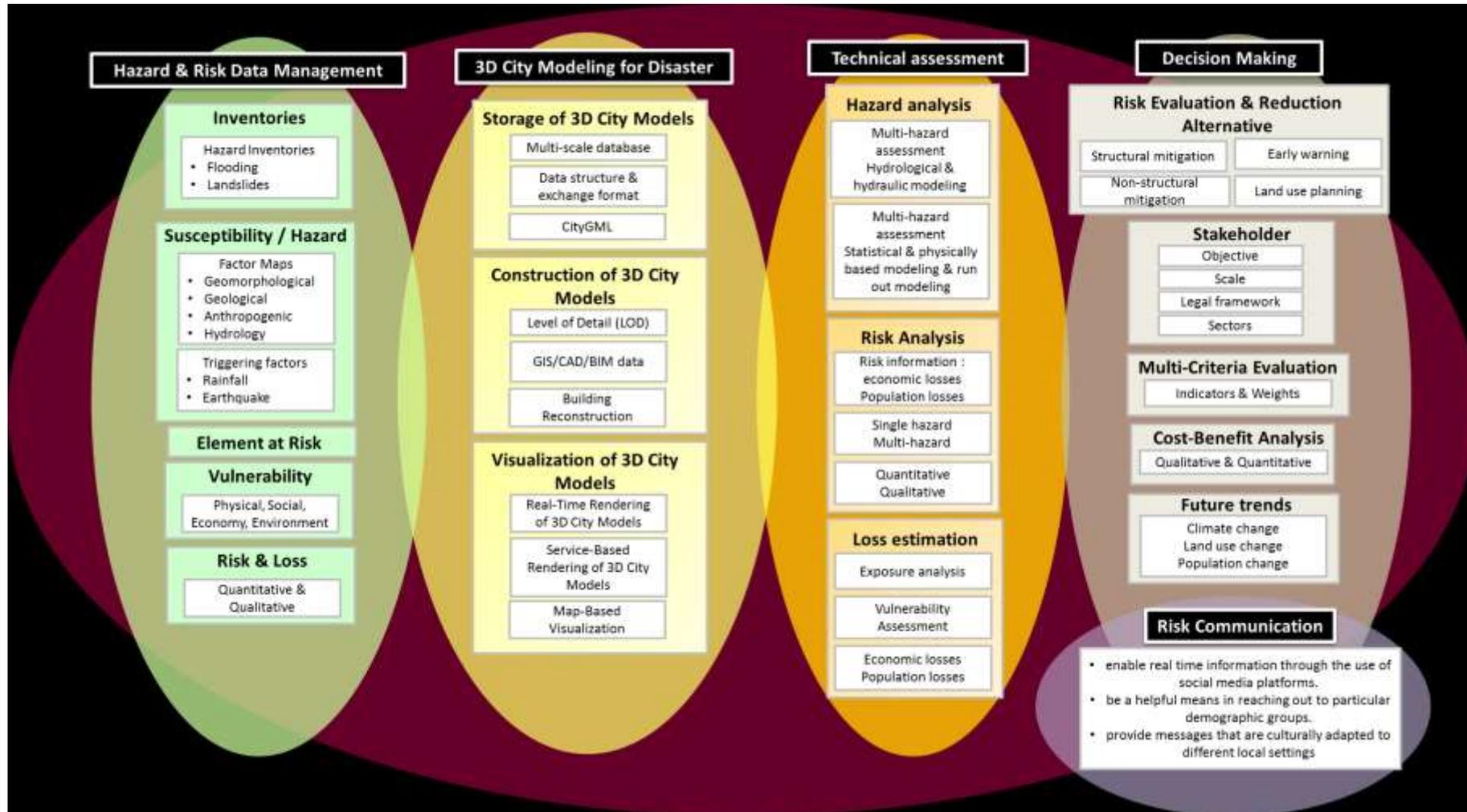
### Three main components:

- 1) Technical assessment (hazard and risk)
- 2) Decision making (use cases)
- 3) Data management



## BIG DATA PLATFORM FOR DISASTER RISK REDUCTION - CONCEPT





**A: Input data**

**B: Susceptibility assessment**

**C: Hazard assessment**

**D: Exposure analysis**

**E: Vulnerability assessment**

**F: Risk assessment**

**G: Quantitative risk**

- Economic risk

- Direct

- Indirect

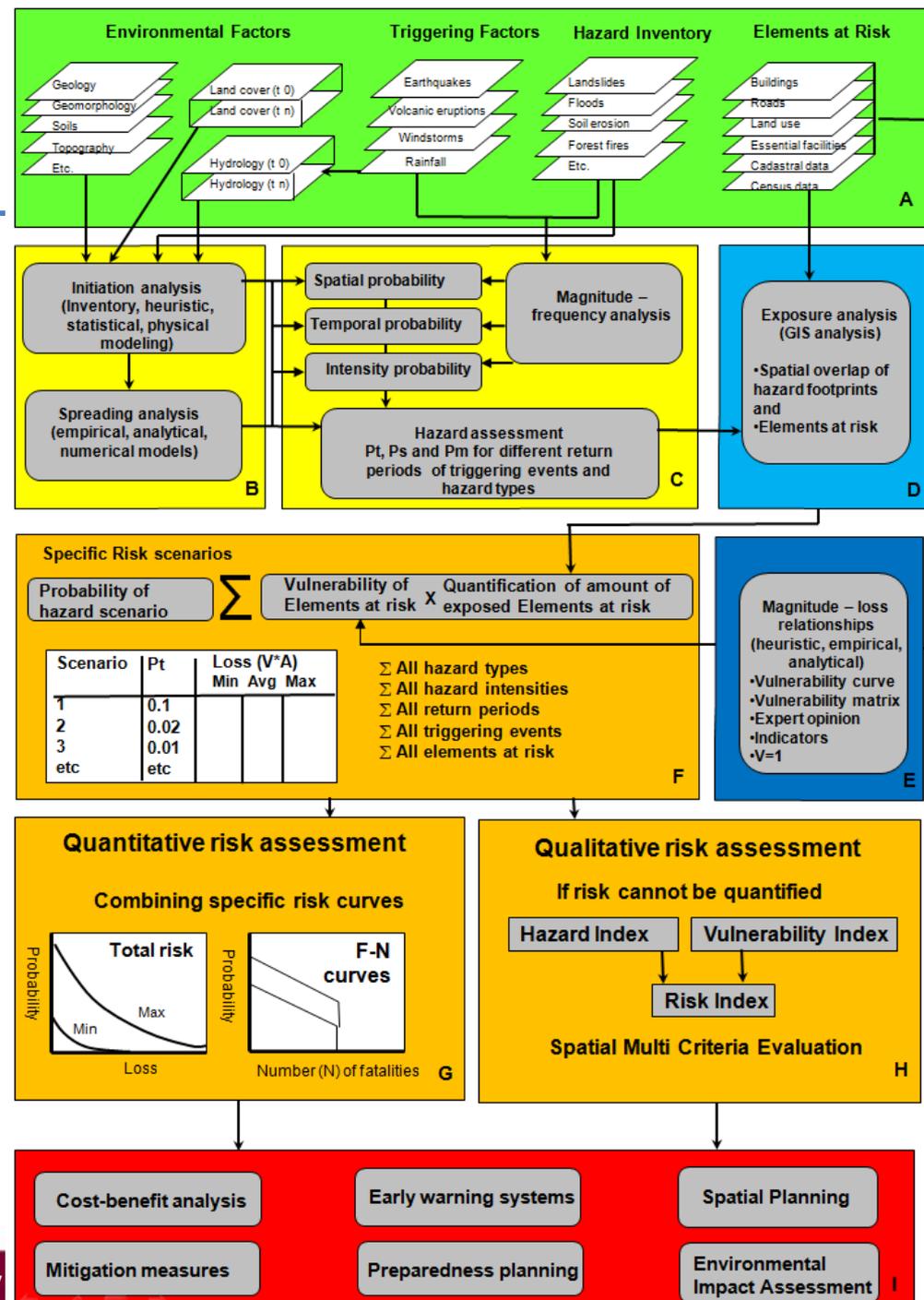
- Population risk

- Societal risk

- Individual risk

**H: Qualitative risk**

**I: Risk reduction measures**



Corominas et al. (2013)

# ELEMENTS AT RISK FOR MULTI- HAZARD AND DISASTER RISK

Van Westen et al. (2015)

Type of elements at risk	Scale of analysis			
	Small	Medium	Large	Detailed
<b>Buildings</b>	By Municipality <ul style="list-style-type: none"> <li>Nr. buildings</li> </ul>	Mapping units <ul style="list-style-type: none"> <li>Predominant land use</li> <li>Nr. buildings</li> </ul>	Building footprints <ul style="list-style-type: none"> <li>Generalized use</li> <li>Height</li> <li>Building types</li> </ul>	Building footprints <ul style="list-style-type: none"> <li>Detailed use</li> <li>Height</li> <li>Building types</li> <li>Construction type</li> <li>Quality / Age</li> <li>Foundation</li> </ul>
<b>Transportation networks</b>	General location of transportation networks	Road & railway networks, with general traffic density information	All transportation networks with detailed classification, including viaducts etc. & traffic data	All transportation networks with detailed engineering works & detailed dynamic traffic data
<b>Lifelines</b>	Main powerlines	Only main networks <ul style="list-style-type: none"> <li>Water supply</li> <li>Electricity</li> </ul>	Detailed networks: <ul style="list-style-type: none"> <li>Water supply</li> <li>Waste water</li> <li>Electricity</li> <li>Communication</li> <li>Gas</li> </ul>	Detailed networks and related facilities: <ul style="list-style-type: none"> <li>Water supply</li> <li>Waste water</li> <li>Electricity</li> <li>Communication</li> <li>Gas</li> </ul>
<b>Essential facilities</b>	By Municipality <ul style="list-style-type: none"> <li>Number of essential facilities</li> </ul>	As points <ul style="list-style-type: none"> <li>General characterization</li> <li>Buildings as groups</li> </ul>	Individual building footprints <ul style="list-style-type: none"> <li>Normal characterization</li> <li>Buildings as groups</li> </ul>	Individual building footprints <ul style="list-style-type: none"> <li>Detailed characterization</li> <li>Each building separately</li> </ul>
<b>Population data</b>	By Municipality <ul style="list-style-type: none"> <li>Population density</li> <li>Gender</li> <li>Age</li> </ul>	By ward <ul style="list-style-type: none"> <li>Population density</li> <li>Gender</li> <li>Age</li> </ul>	By Mapping unit <ul style="list-style-type: none"> <li>Population density</li> <li>Daytime/Nighttime</li> <li>Gender</li> <li>Age</li> </ul>	People per building <ul style="list-style-type: none"> <li>Daytime/Nighttime</li> <li>Gender</li> <li>Age</li> <li>Education</li> </ul>
<b>Agriculture data</b>	By Municipality <ul style="list-style-type: none"> <li>Crop types</li> <li>Yield information</li> </ul>	By homogeneous unit, <ul style="list-style-type: none"> <li>Crop types</li> <li>Yield information</li> </ul>	By cadastral parcel <ul style="list-style-type: none"> <li>Crop types</li> <li>Crop rotation</li> <li>Yield information</li> <li>Agricultural buildings</li> </ul>	By cadastral parcel, for a given period of the year <ul style="list-style-type: none"> <li>Crop types</li> <li>Crop rotation &amp; time</li> <li>Yield information</li> </ul>
<b>Economic data</b>	By region <ul style="list-style-type: none"> <li>Economic production</li> <li>Import / export</li> <li>Type of economic activities</li> </ul>	By Municipality <ul style="list-style-type: none"> <li>Economic production</li> <li>Import / export</li> <li>Type of economic activities</li> </ul>	By Mapping unit <ul style="list-style-type: none"> <li>Employment rate</li> <li>Socio-economic level</li> <li>Main income types</li> <li>Plus larger scale data</li> </ul>	By building <ul style="list-style-type: none"> <li>Employment</li> <li>Income</li> <li>Type of business</li> <li>Plus larger scale data</li> </ul>
<b>Ecological data</b>	Natural protected areas with international approval	Natural protected area with national relevance	General flora and fauna data per cadastral parcel.	Detailed flora and fauna data per cadastral parcel



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Disaster Preparedness and Prevention Center, MJIT  
Universiti Teknologi Malaysia (UTM) Kuala Lumpur

## An Integrated Research Framework “Disaster Resilience Model”

$$R = f (D, A, T)$$

Where

R: Resilience; D: Damage = f (H, E, V); **A: Human Activities**; T: Time

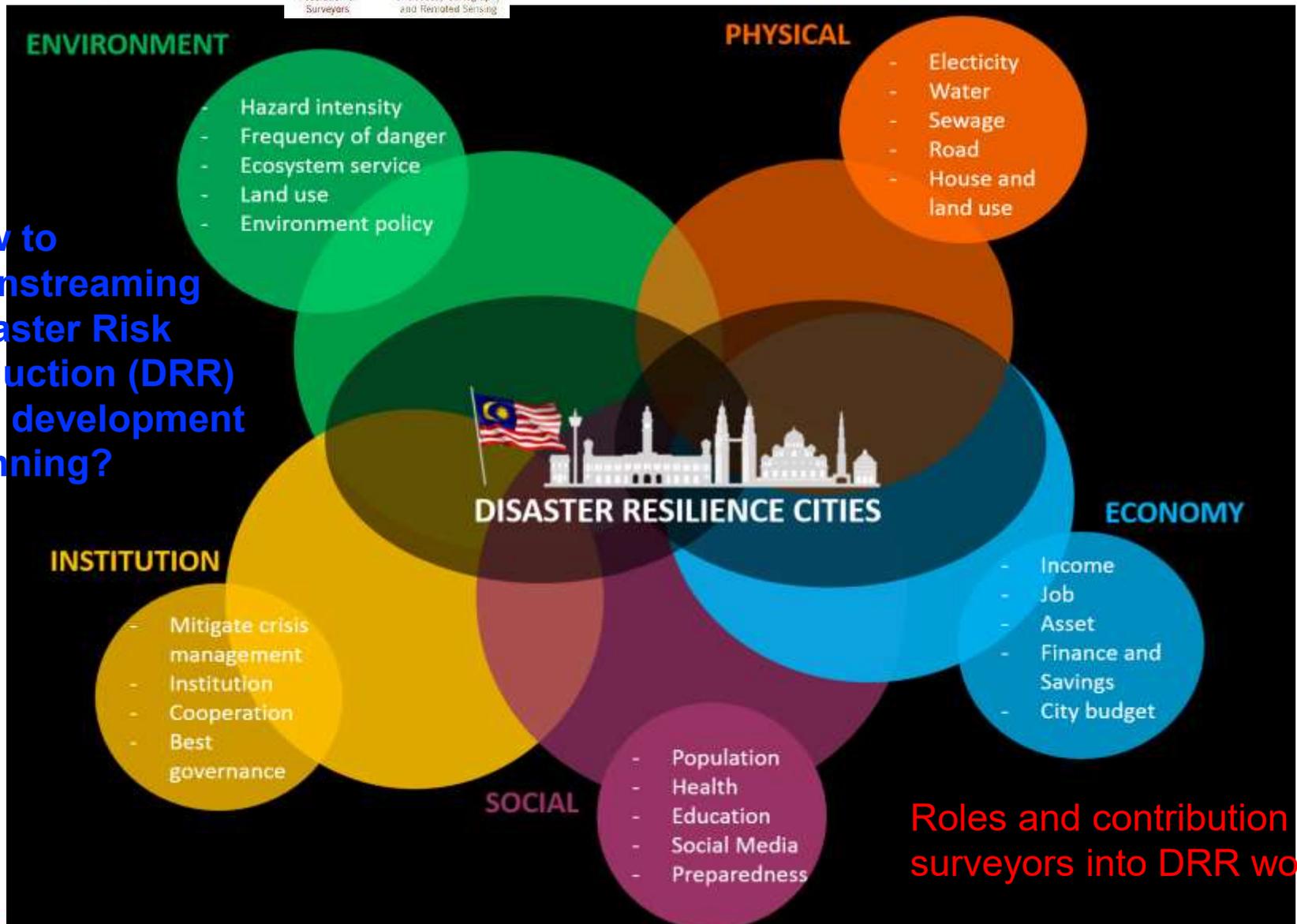
where D = f (H, E, V)

$$R = f \left( \underbrace{H, E, V}_{\text{Prevention}}, \underbrace{A, T}_{\text{Recovery}} \right)$$

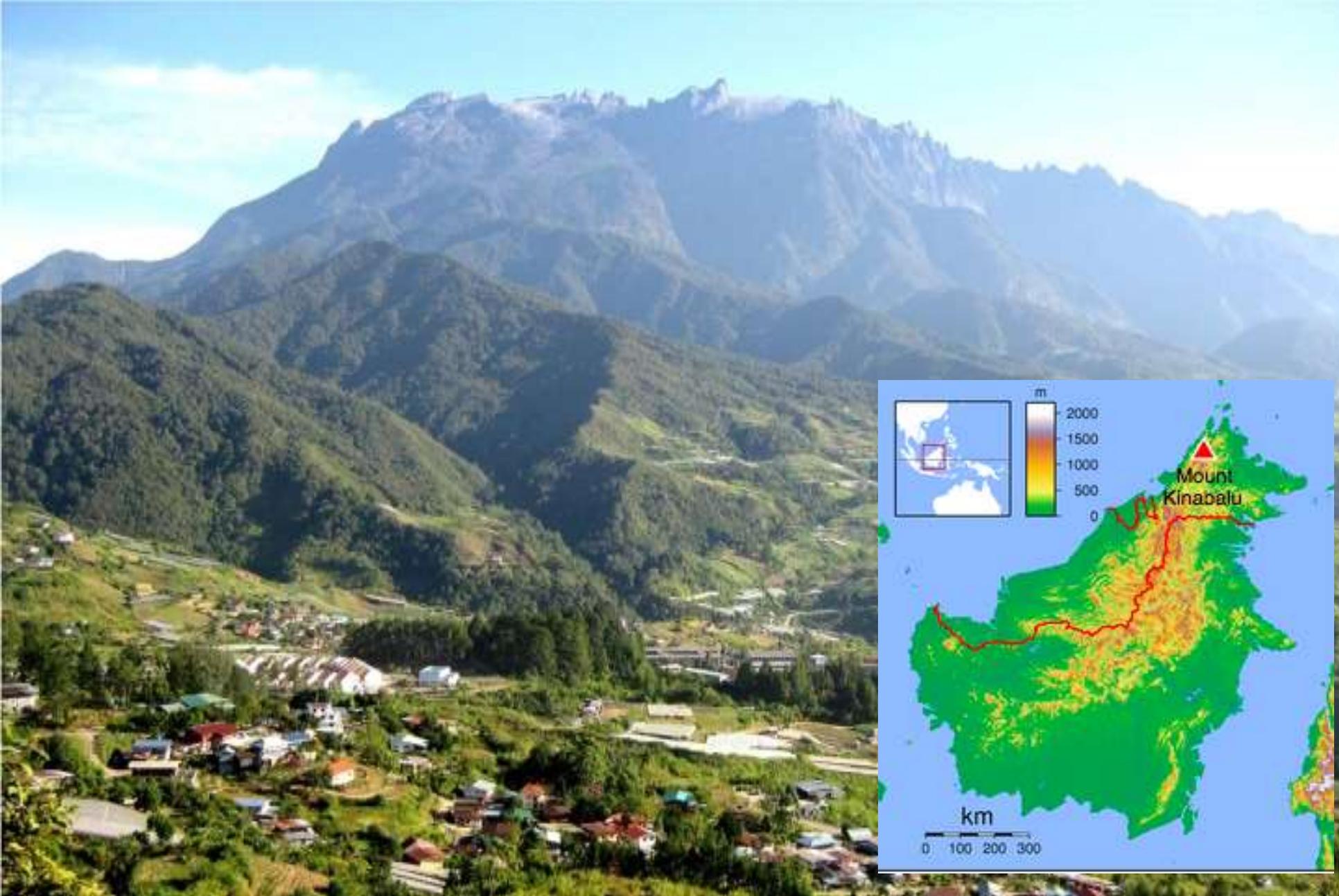
Prevention

Recovery

How to  
mainstreaming  
Disaster Risk  
Reduction (DRR)  
into development  
planning?

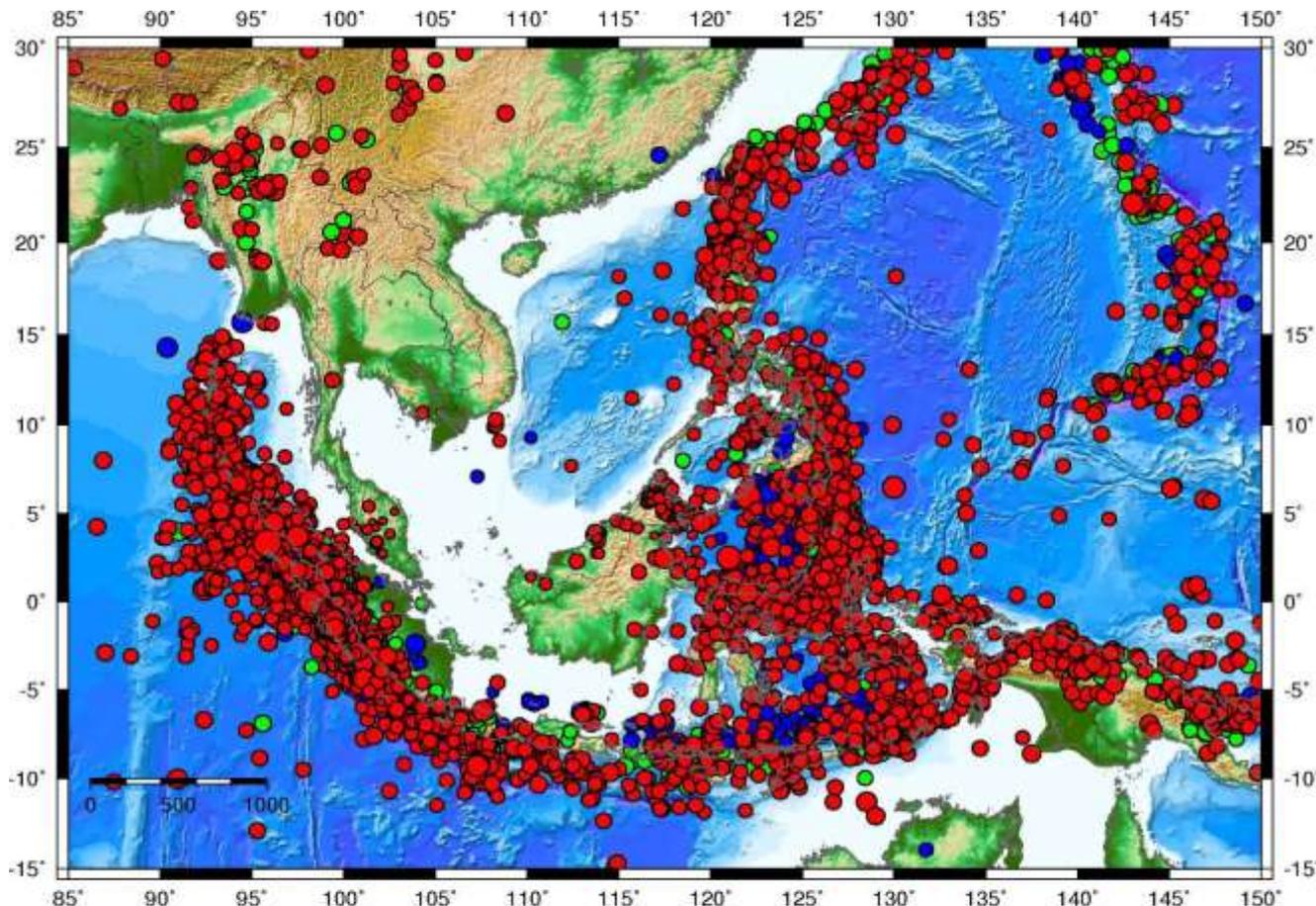


Roles and contribution of  
surveyors into DRR world?



**Kundasang (Ranau, Sabah) – home to UNESCO’s World Heritage Site in Malaysia  
– Most tectonically active region in Malaysia, most attractive to tourism, community-at-risk**

# SEISMIC ACTIVITIES (1976 – 2015)



Historical Earthquakes (1976 - 2015)						
● Depth (0-100 km)		● Depth (100-300 km)		● Depth (300-1000 km)		
○ M3	○ M4	○ M5	○ M6	○ M7	○ M8	○ M9
National Earthquake and Tsunami Center, MetMalaysia, Copyright@2015						

## More bodies found on Malaysia mountain as quake toll hits 13

By ASSOCIATED PRESS

PUBLISHED: 12:28 GMT, 6 June 2015 | UPDATED: 12:28 GMT, 6 June 2015



KUALA LUMPUR, Malaysia (AP) — Rescuers recovered the bodies of 11 more climbers from Malaysia's highest peak on Saturday, a day after it was struck by a strong earthquake, bringing the total number of dead to 13.

Six people remained missing on 4,095-meter (13,435-foot) -high Mount Kinabalu in eastern Sabah state on Borneo, where a magnitude-5.9 earthquake on Friday sent rocks and boulders raining down the trekking routes, trapping dozens of climbers.

"This is a very sad day for Kinabalu," said Sabah's tourism minister, Masidi Manjun.



A helicopter leaves Kundasang, Malaysia for Mount Kinabalu to recover the bodies of climbers who were killed in an earthquake. Several more climbers from Sabah were killed in the quake. (Munehiro Yamada/Kyodo)

## 5.9 magnitude earthquake hits Sabah (Updated)

Posted on 5 June 2015 - 09:36am

Last updated on 6 June 2015 - 09:38am



**ASA PACIFIC**

**Strong 6.0-magnitude quake strikes Malaysia's Sabah**

A strong 6.0-magnitude earthquake rocked the state of Sabah on Malaysia's Borneo island early Friday, say US geologists say.

POSTED: 05 Jun 2015 00:18 | UPDATED: 05 Jun 2015 10:57

PHOTOS

## Malaysia earthquake: 11 dead and eight missing after 5.9 magnitude quake hits Mount Kinabalu



The quake struck Malaysia's highest peak on Friday.

## Australian climber stranded after Malaysia earthquake slams rescue effort

An Australian climber has savaged Malaysian authorities following Borneo earthquake that killed 13 people when it jolted south-east Asia's highest peak



11 climbers trapped on Mount Kinabalu, Sabah state, Malaysia on Friday after a 5.9-magnitude earthquake. One climber says they waited nine hours for help before walking out by themselves as tremors continued. Photograph: Xinhua/Reuters/Shutterstock

## Malaysia's Sabah state jolted by earthquake of 5.9 intensity

By newsdesk 05 Jun 2015 10:27 AM

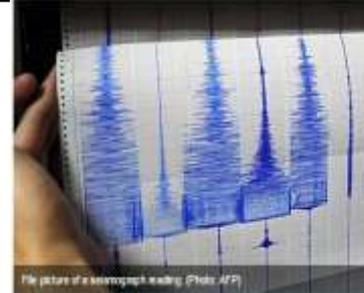


Kuala Lumpur: A 5.9-magnitude quake jolted Malaysia's Sabah state on Friday.

Initial reports from the Malaysian Meteorological Services Department said the quake struck a 30 km northwest of Ranau district. The state has the reported



Local residents take shelter at the open air in Ranau, Sabah state, Malaysia, June 5, 2015. A 5.9 magnitude earthquake has occurred in Malaysia's Sabah state on North Borneo early Friday morning, authorities said. (Khalid Photo)



File picture of a seismograph reading. (Photo AFP)



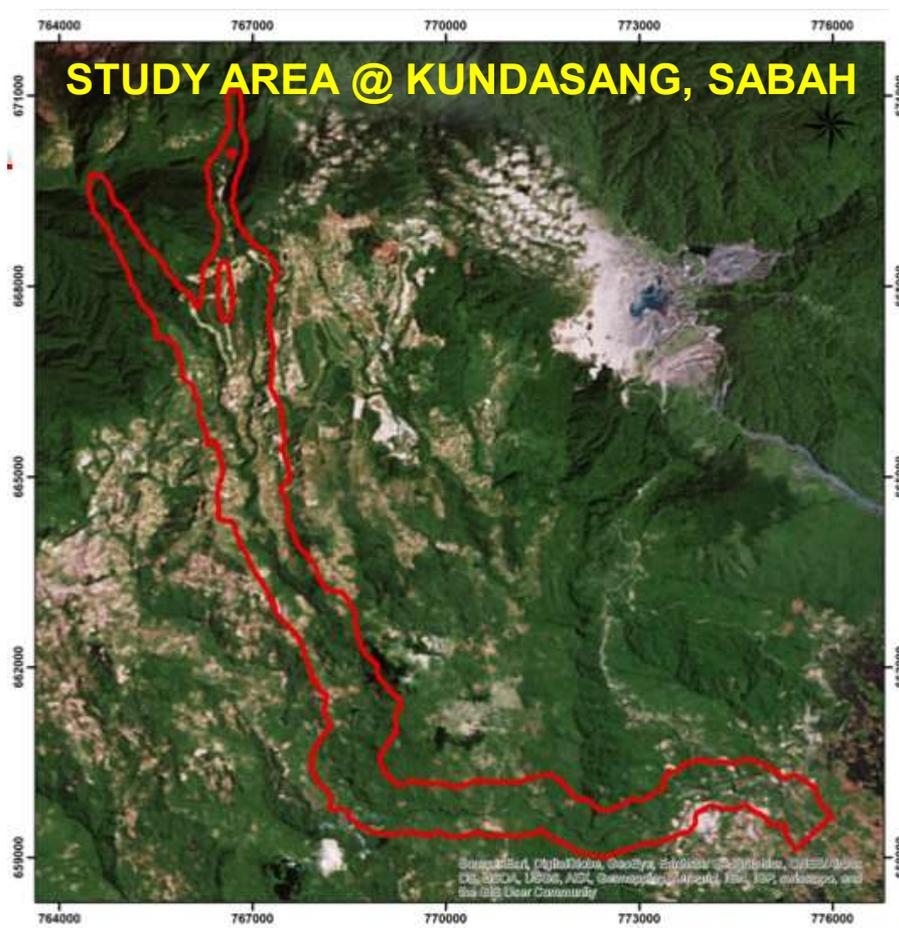
7 April 2015



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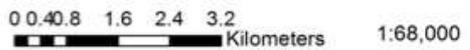
20 July 2015



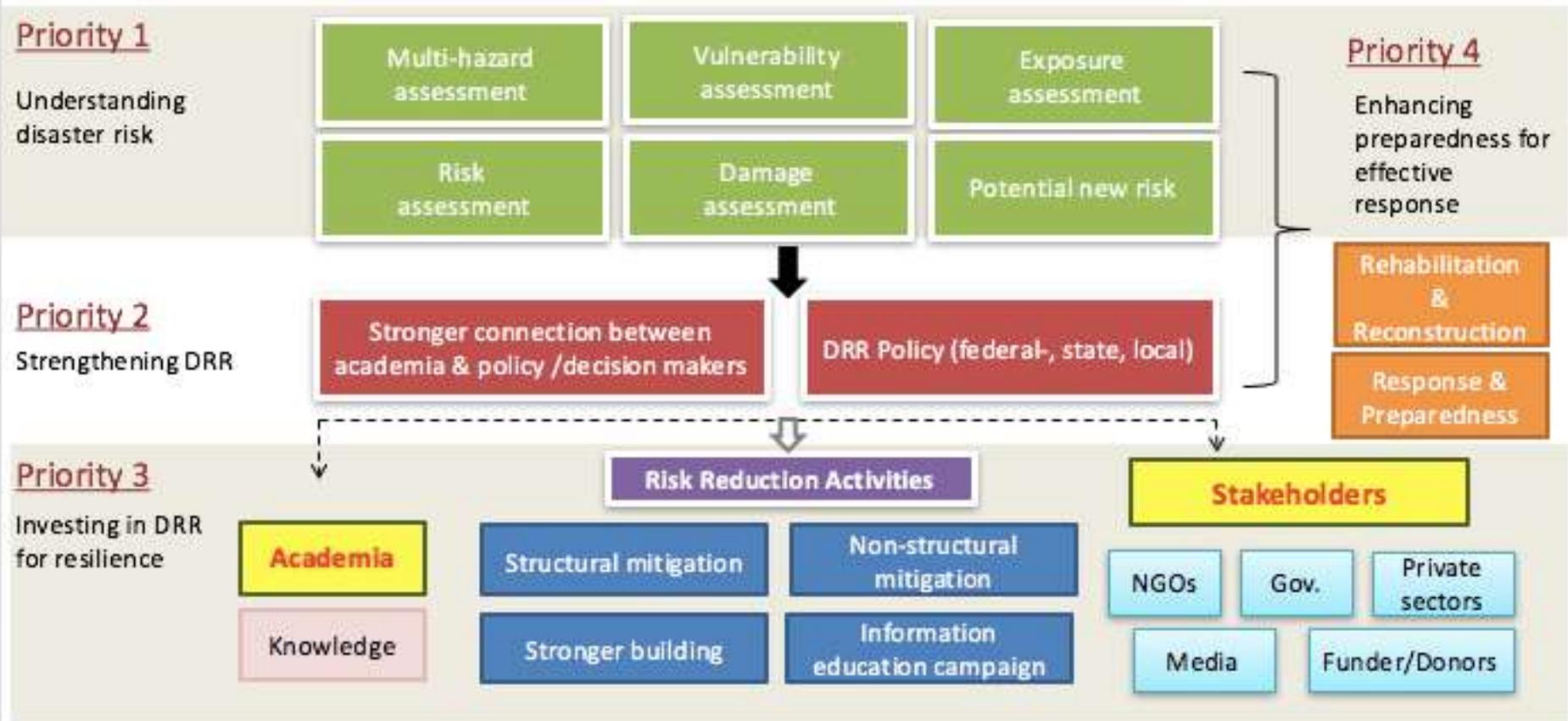
**Legend**

Zoning of Debris Flow

Coordinate System : GDM2000 BRSO East Malaysia  
Projection : Rectified Skew Orthomorphic Natural Origin  
Datum : GDM2000  
Units : Meter

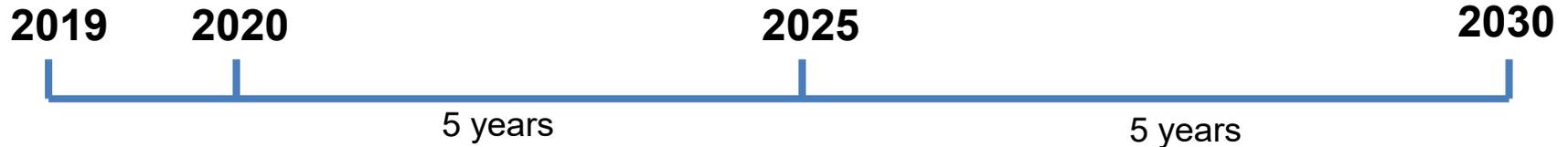


## Sendai Framework for Disaster Risk Reduction 2015-2030: Progress & Challenges



Complexity of disaster – multisectoral & disciplinary group - special need & interest  
Action oriented program – scientific-based decision support – transdisciplinary approach

Advancing science and technology for disaster risk



**National Conference on Science, Technology and Innovation for Disaster Risk Reduction 2019**, October 2019 @ Kuala Lumpur

**Asian Ministerial Conference on Disaster Risk Reduction 2020**

**Global Platform for Disaster Risk Reduction 2021**



**International  
Science Council**  
Regional Office for Asia and  
the Pacific



Interested for collaboration, please drop your email @ [khamarrul.kl@utm.my](mailto:khamarrul.kl@utm.my)

#DisasterRiskUTM

## CONCLUDING REMARKS

**H**

Harnessing and promoting **Transdisciplinary Approach** for bringing science into practice & word into action

**A**

Advancing **science and technology** for disaster risk management and reduction

**N**

Nurturing local knowledge, **future talents** and leaders

**O**

Owning and utilizing **modern technologies and latest techniques** for solving old problems (geohazard & disaster !!)

**I**

Integrating **Geo-led Disaster Risk Reduction (DRR)** into development planning and urban resilience

**“Change or Die**  
**- if you don’t change, you can’t survive”**

**Tadashi Yanai, Japan’s Richest Man**  
- one of most-watched CNA Insider video of 2016



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# THANK YOU FOR YOUR ATTENTION



## **Khamarrul Azahari Razak, PhD**

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Disaster Preparedness and Prevention Center  
Malaysia-Japan International Institute of Technology  
Universiti Teknologi Malaysia (UTM) Kuala Lumpur

Geospatial Intelligence Research Initiative  
Cascading GeoHazards Research Initiative  
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