THE FUTURE OF
GLOBAL
DISASTER
RISK REDUCTION

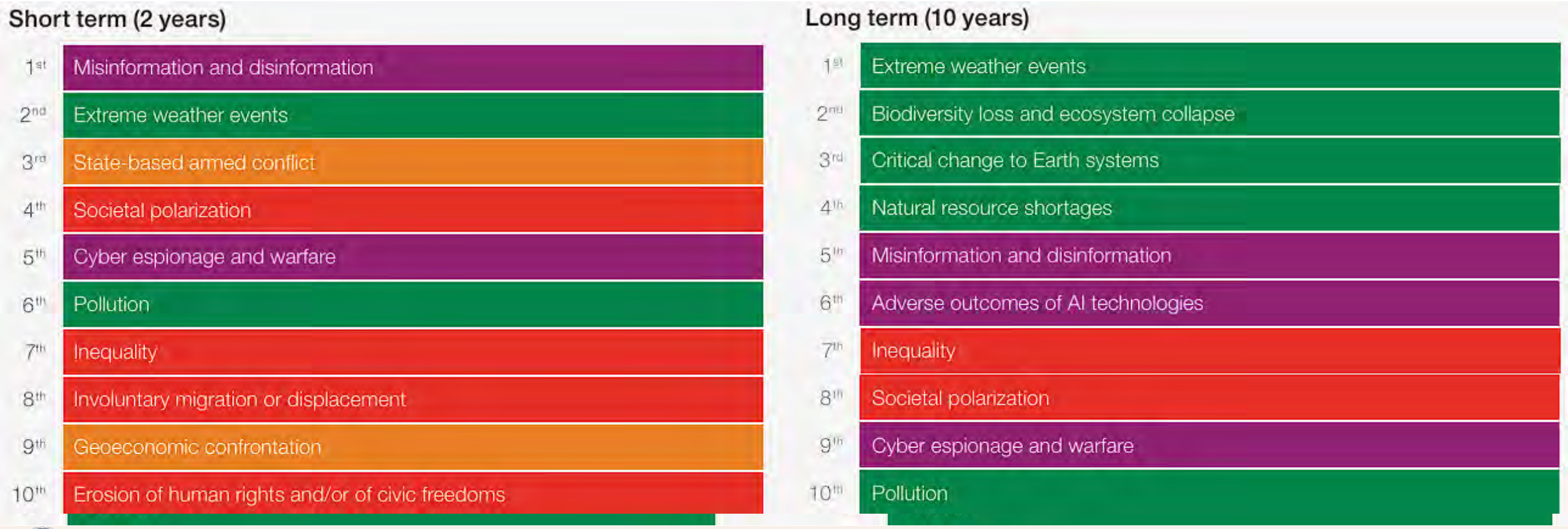
# IRDR Actions Supporting the Implementation of Sendai Framework

Saini Yang

Integrated Research on Disaster Risks

# The Changing Global Risks Landscape

## Global Risks Landscape 2025



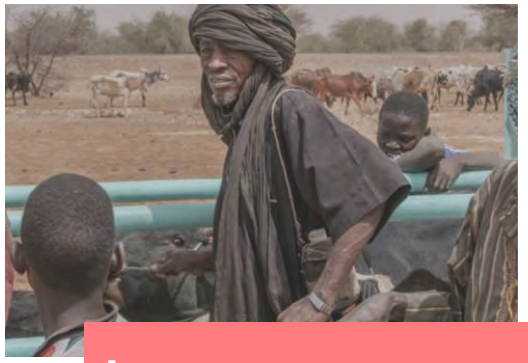
# Vision and Missions

IRDR Integrated Research on Disaster Risk

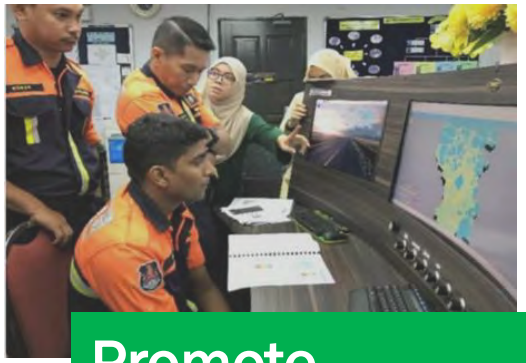
International Science Council

UNDRR UN Office for Disaster Risk Reduction

***Toward inclusive, safe and sustainable development***



**Improve** knowledge and understanding of risk and uncertainty



**Promote** innovation in research and action, and explore effective solutions in DRR

**Build** institutional capacity required for risk-informed development

SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION 2015-2030

SUSTAINABLE DEVELOPMENT GOALS

# IRDR Functions and Deliverables

Coordinating international research

Working at the science-policy-practice interface

As an international hub of centres of excellence for risk research and capacity building

**IRDR Main Deliverables will contribute to Open Science and Open Access**

IRDR Special Reports

IRDR Working Paper Series

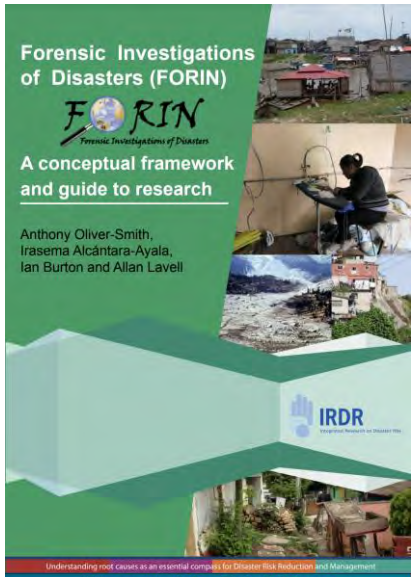
IRDR Lectures

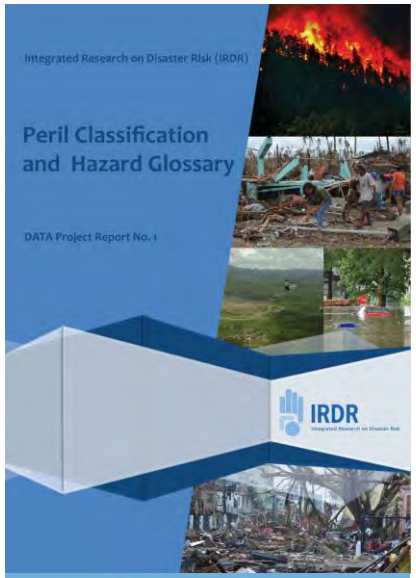
IRDR Trainings and Courses

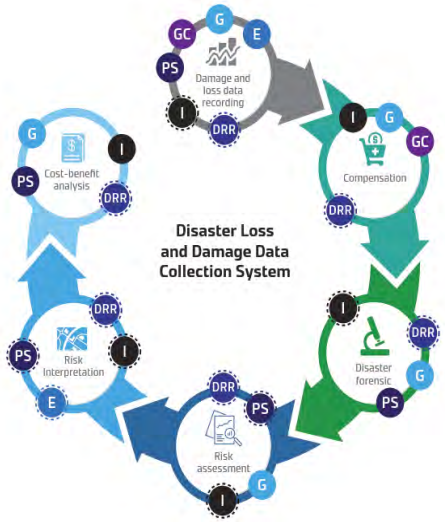
Service in organising DRR Science and Policy Forums

Promotion of risk science development and best examples

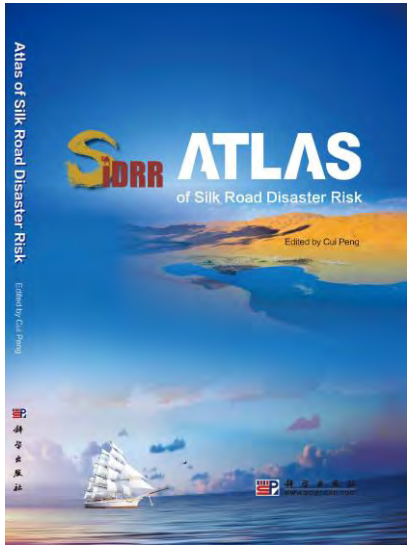
# Some Highlights in Phase I



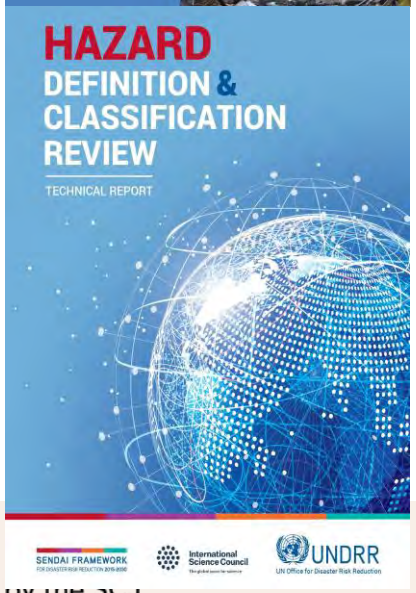



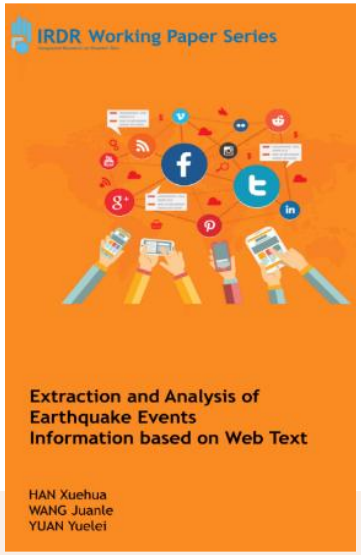



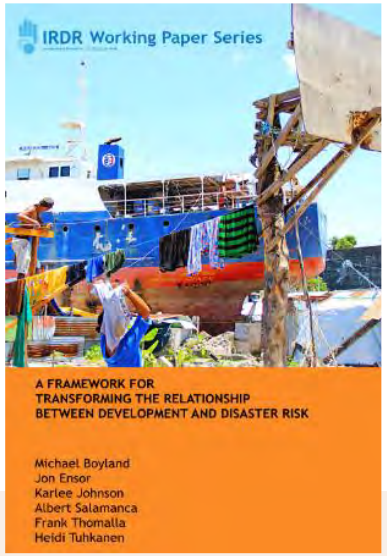


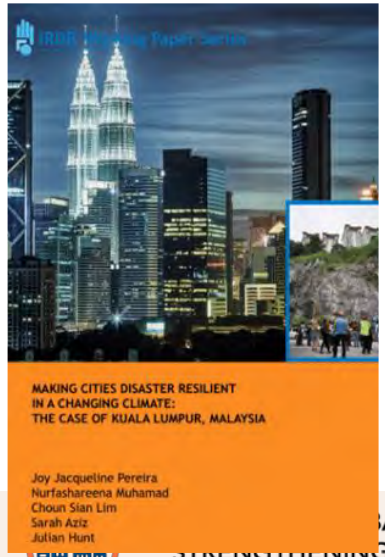



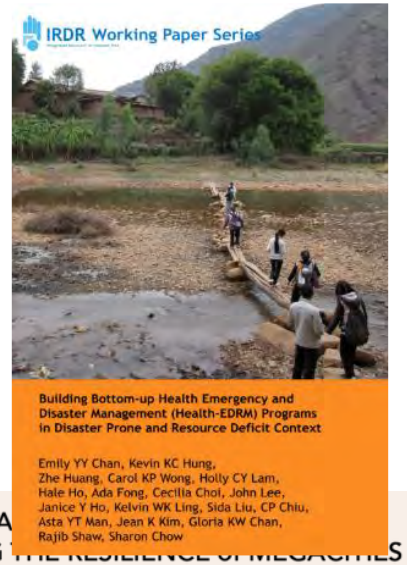




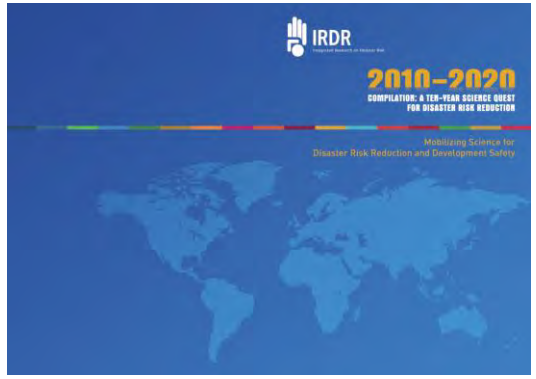



# A New Science Plan

A Science Plan for Integrated Research on Disaster Risk
Addressing the challenge of natural and human-induced environmental hazards

ICSU
International Council for Science






https://www.undrr.org/publication/framework-global-science-support-risk-informed-sustainable-development-and-planetary

IRDR
Integrated Research on Disaster Risk

## Declaration

### Science for an Inclusive, Safe and Sustainable World: Actions of IRDR Global Community

IRDR 2024 International Conference
2024 World Science and Technology Development Forum Thematic Session VI

Beijing, China during 22-24 October 2024

We, the members of the Scientific Committee of the Integrated Research on Disaster Risk Programme (IRDR), the representatives of IRDR International Centres of Excellence, IRDR National Committees and the Young Scientists Programme, together with international participants attending the IRDR 2024 International Conference and 2024 World Science and Technology Development Forum Thematic Session VI, proclaims this declaration entitled *Science for an Inclusive, Safe and Sustainable World: Actions of IRDR Global Community*.

Acknowledging the long-standing and ongoing contributions of the International Science Council (ISC); the United Nations Office for Disaster Risk Reduction (UNDRR); other United Nations (UN), intergovernmental, international and national organizations to the reduction of disaster risks for sustainable development;

Recognizing that the Conference is held at a critical conjuncture of time, Sendai Framework for Disaster Risk Reduction has passed its mid-term for the implementation but major challenges remain in reaching its main targets for 2030, while the global landscape of disaster risk has witnessed increasingly rapid and profound changes, bringing in new uncertainties for development and investment.

Toward safe,inclusive and sustainable development

电话：+86 8217 8917 网站：www.irdrinternational.org 地址：北京市海淀区邓庄南路9号B713室 100094/朝阳区国际科技组织总部集聚区12层 100102
Room B713, No.9 Dengzhuangnan Rd, Beijing, China 100094/ 12th Floor, Headquarters of International Science and Technology Organizations , Beijing, China 100102

- Agree that IRDR global community takes the following actions in accordance with the following global research priorities, namely:
  - **Harness technologies, data and knowledge for risk reduction (Priority 5)**
  - **Support regional and national science and knowledge for policy and action (Priority 6)**
  - **Address inequalities, injustice and marginalization (Priority 2)**

- A first set of IRDR Work Streams, Benchmarking Studies and Pilot Projects with resources mobilized from the multi-sectoral partners will be established for the implementation of the identified priorities above focusing on:
  - **Risk-informed development**
  - **Climate change and public health**
  - **DRR financing**
  - **DRR education**
  - **Citizen Science Research**

# Recent Visit of SRSG

Implementation Assessment of Sendai Framework ⟶ Post-2030 agenda


## Topics need more scientific input

**DRR STI Institutional Structure**

**DRR and other SDG indices**

**Resilient Infrastructure**

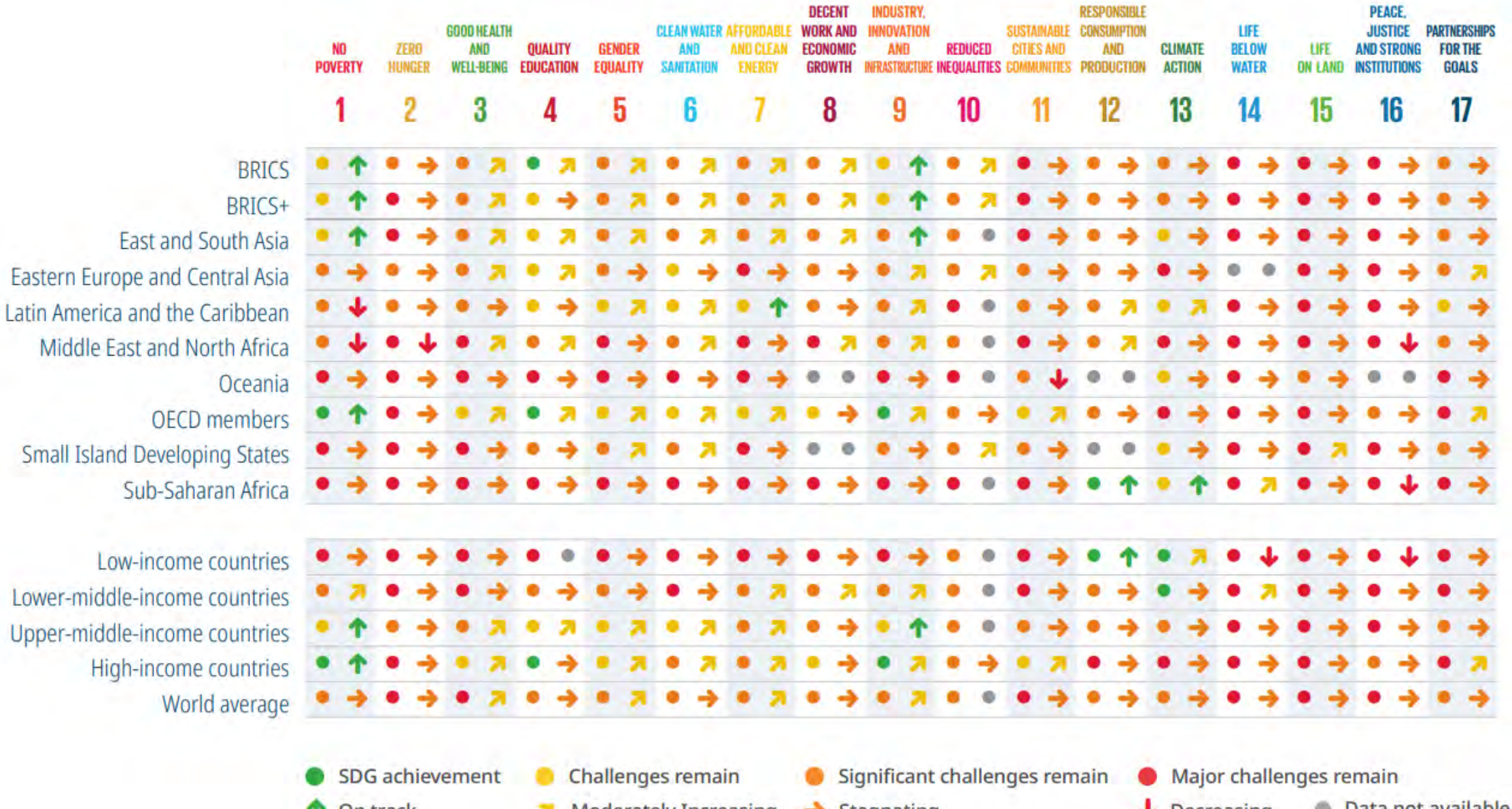
**Innovative Financial Instruments**

**Coupling of societal stressors with disaster risks**

**…**

**Figure 2.7**

2025 SDG dashboards by region and income group (levels and trends)




CTION:
GACITIES
NOVATION

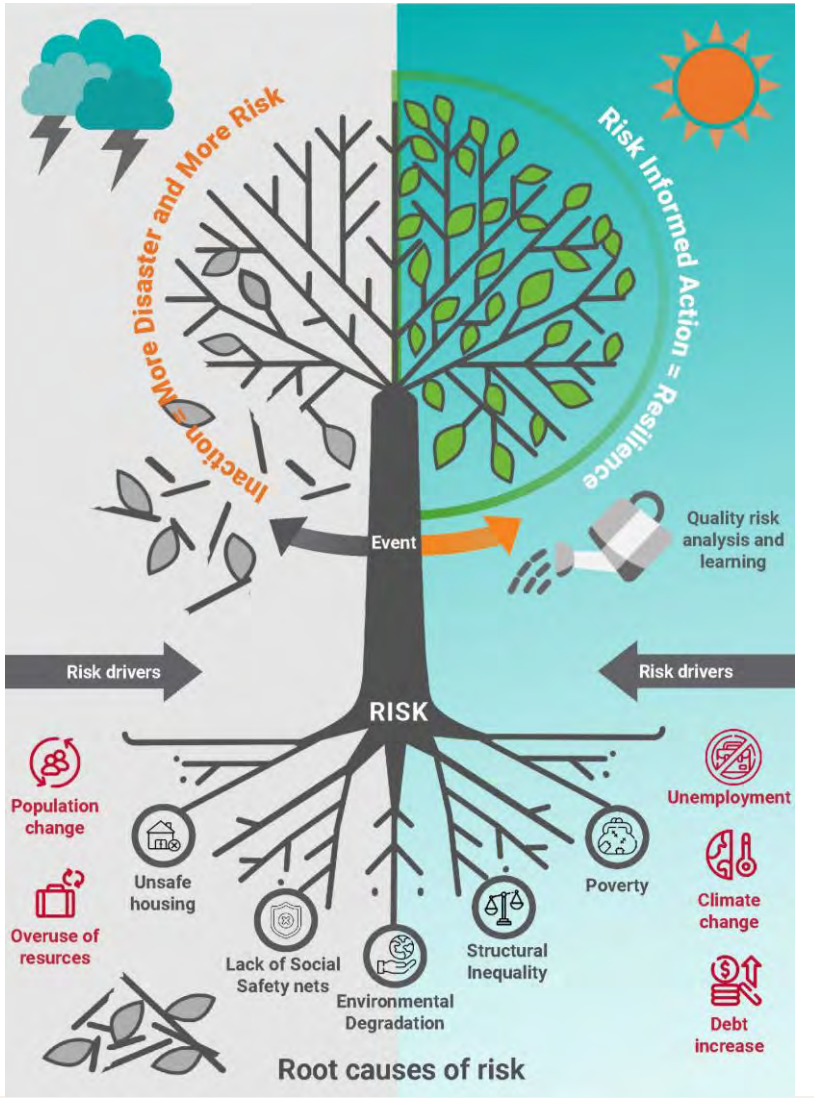
# Understanding Uncertainty and Risk

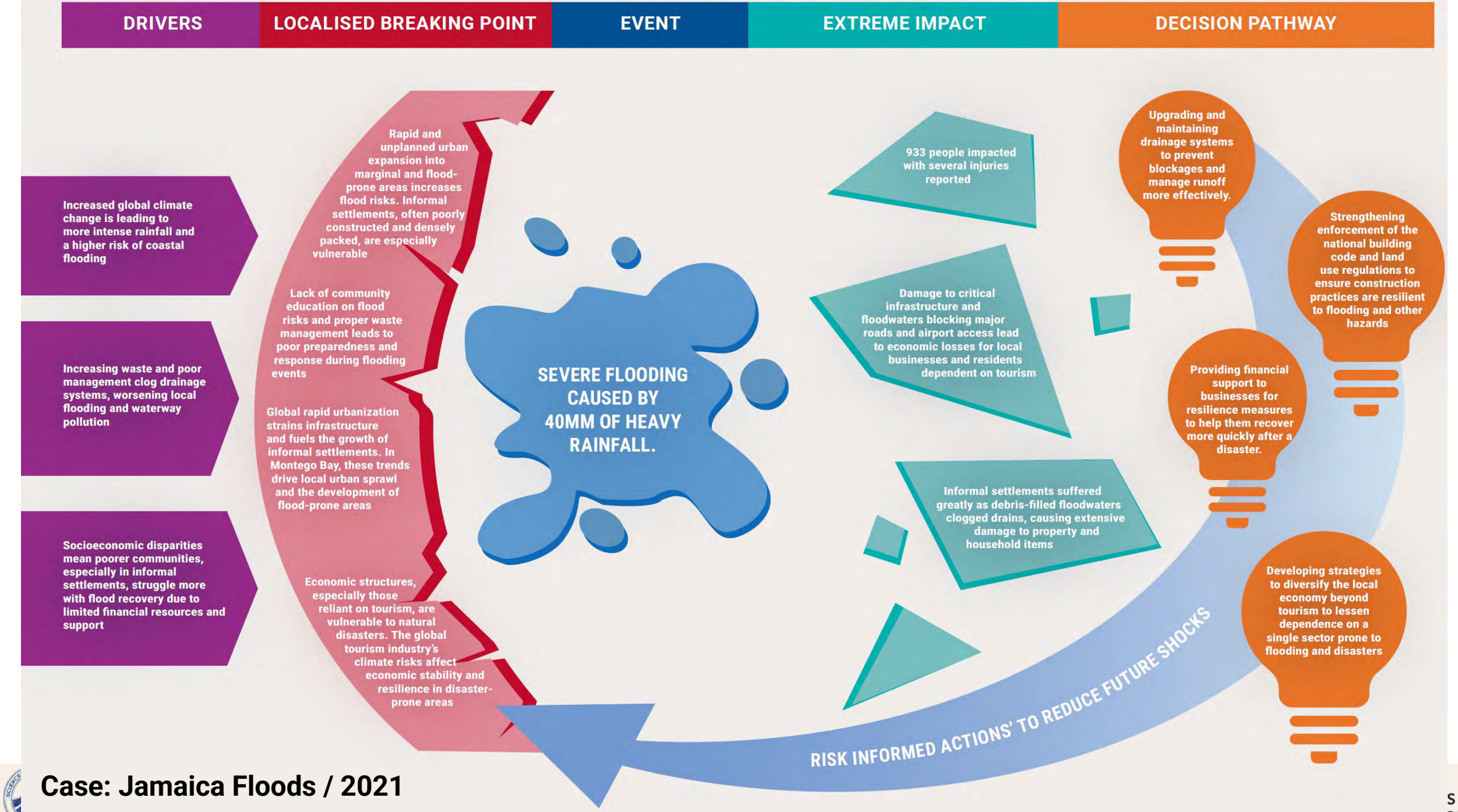
## Forensic Investigations of Disasters

The FORIN methodology, proposed in 2014, helps to **simplify** the process of studying disasters. It has several features which help to improve the understanding of disaster risk, offering policy options and other evidence-based recommendations that can be integrated with development policy and processes to reduce the risk of disaster. This methodology has been applied in catastrophes analyses in many developing countries, including the Haiti Earthquake 2010 and Jamaica Flood 2021.

## Innovations of the methodology

- Holistic root-cause analysis with emphasis on the social-cultural dimension
- "Disaster DNA" Framework
- Future-oriented thinking with a focus on resilience
- Avoiding blame and fostering collaboration



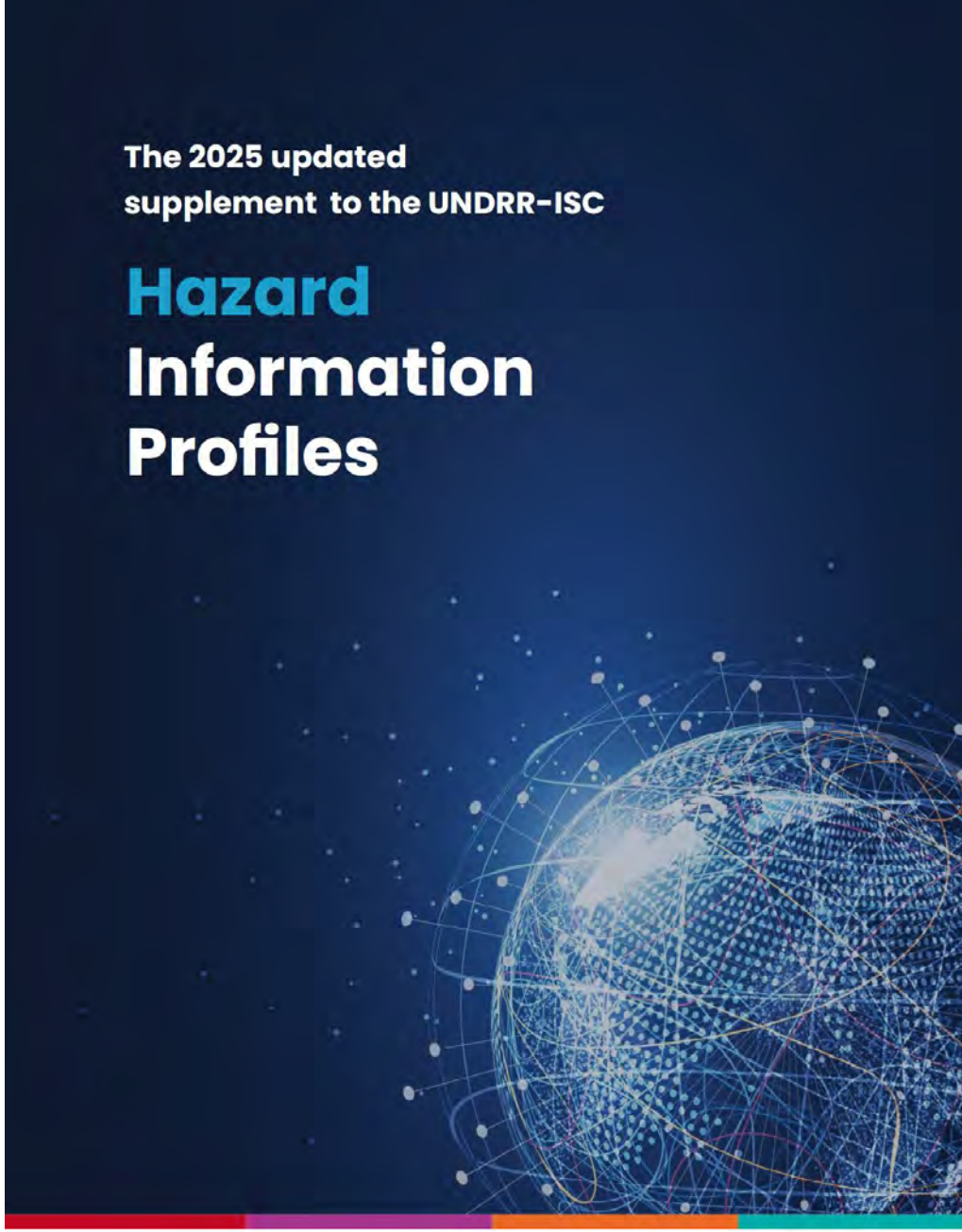

# Case: Jamaica Floods / 2021

# Understanding Uncertainty and Risk

IRDR launched the Hazard Classification in 2014. In 2021, IRDR and UNDRR, ISC together review the classification and launched the new Hazard Information Profiles. In 2025, HIPs were reviewed and the new edition reflects the complex and interconnected nature of today's global risk landscape. Hazards increasingly occur together, cascade across systems, and amplify one another. In response, the updated profiles emphasize a *multi-hazard approach*—critical for effective early warning systems, emergency planning, and disaster resilience.

This updated edition builds on that foundation with:

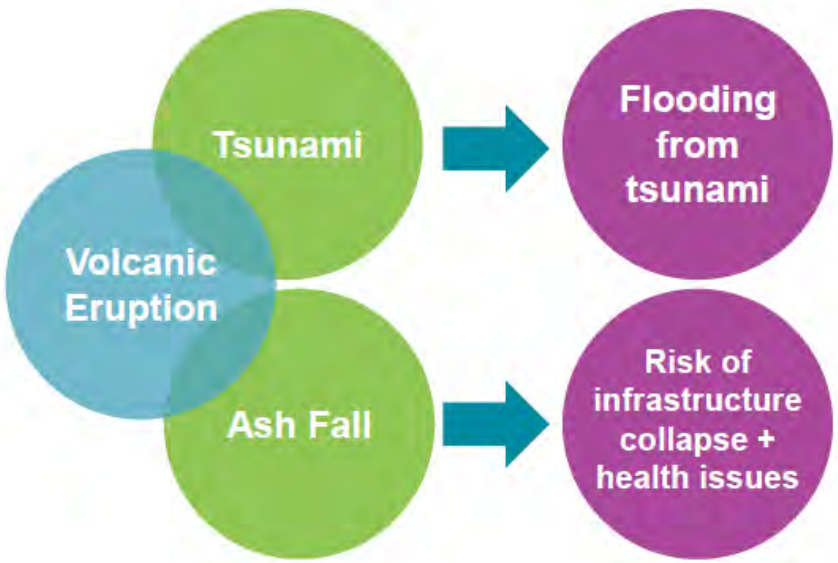
- 282 reviewed hazards across 8 types and 39 clusters
- Improved, machine-readable format to support their use across digital tools and systems
- Clearer articulation of hazard interactions and multi-hazard scenarios
- User-informed revisions and new content to support real-world planning and response



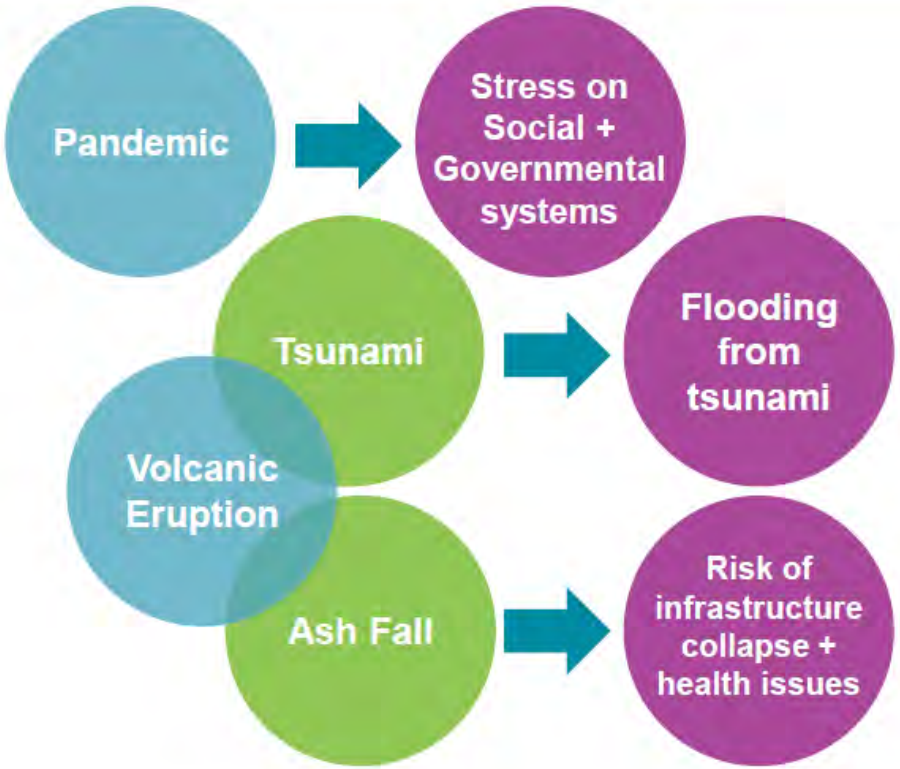
# Understanding Hazards | Tonga Eruption + Tsunami 2022

## Compound hazard


## Cascading hazard

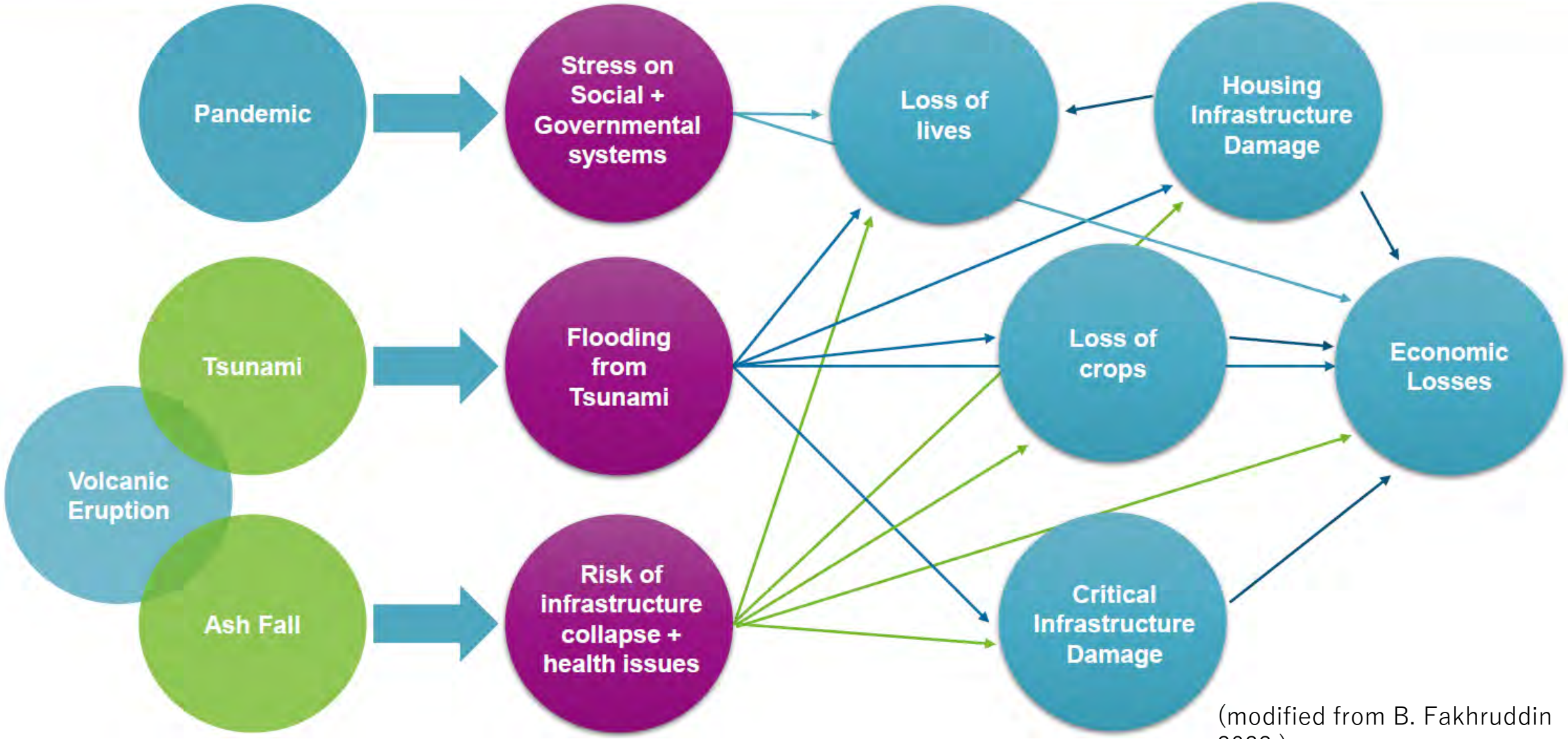



## Complex hazards




(modified from B. Fakhruddin 2022 )

# Cascading Compounding + Complex Impacts




(modified from B. Fakhruddin

# Disaster Losses and Damages

**The The Global Disaster Data Platform (GDDAT) can achieve real-time global disaster data monitoring and analysis.**

## 全球灾害实况 2022-05-12 12:10:24-2023-05-12 12:10:24

| 总频次 | 受影响人数 | 累计经济损失 |
|---|---|---|
| 943 次、 | 260120.79 万人 | 47150000 千美元 |

| | | | | | |
|---|---|---|---|---|---|
| 野火 | 507 次、起 | | 老挝 | 88 次、起 |
| 洪涝 | 244 次、起 | | 缅甸 | 46 次、起 |
| 地震 | 142 次、起 | | 尼日利亚 | 44 次、起 |
| 火山 | 18 次、起 | | 印度 | 41 次、起 |
| 干旱 | 14 次、起 | | 印度尼西亚 | 39 次、起 |
| 风暴 | 13 次、起 | | 智利 | 25 次、起 |
| 其他气象灾害 | 4 次、起 | | 中国 | 25 次、起 |
| 地质灾害 | 1 次、起 | | 菲律宾 | 24 次、起 |
| | | | 美国 | 23 次、起 |
| | | | 几内亚 | 22 次、起 |


2019

2021

GLOBAL NATURAL DISASTER ASSESSMENT REPORT

2023 GLOBAL NATURAL DISASTER ASSESSMENT REPORT

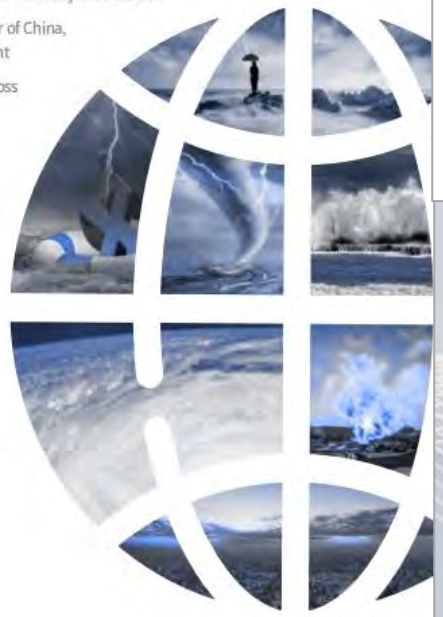
October 2024

Academy of Disaster Reduction and Emergency Management, Ministry of Emergency Management - Ministry of Education
School of National Safety and Emergency Management, Beijing Normal University
National Disaster Reduction Center of China - Ministry of Emergency Management
International Federation of Red Cross and Red Crescent Societies
Integrated Research on Disaster Risk

# 2020 Global Natural Disaster Assessment Report

Academy of Disaster Reduction and Emergency Management, Ministry of Emergency Management - Ministry of Education
National Disaster Reduction Center of China, Ministry of Emergency Management
International Federation of Red Cross and Red Crescent Societies

October 2021



## 2022 GLOBAL NATURAL DISASTER ASSESSMENT REPORT

October 2023

Academy of Disaster Reduction and Emergency Management, Ministry of Emergency Management - Ministry of Education
School of National Safety and Emergency Management, Beijing Normal University
National Disaster Reduction Center of China, Ministry of Emergency Management
International Federation of Red Cross and Red Crescent Societies

2022

## 2024 GLOBAL NATURAL DISASTER ASSESSMENT REPORT

Academy of Disaster Reduction and Emergency Management,
Ministry of Emergency Management - Ministry of Education
School of National Safety and Emergency Management, Beijing Normal University
National Disaster Reduction Center of China, Ministry of Emergency Management
China Association for Disaster Prevention
Integrated Research on Disaster Risk

October 2025

# MHEW

IRDR Working Group on Risk Interpretation and Action (RIA) proposed a framework of multi-hazard impact based early warning system(2019), which has been utilized by countries especially in the SIDS due to its **low cost**. This system aligns with the four pillars of the Early Warning for All initiative (2022).

**Case of application:** The Ministry of Humanitarian Affairs and Disaster Management (MoHADM) established a National Multi-Hazard Early Warning Centre (NMHEWC) to facilitate disaster preparedness and establish linkages between early warning and early action to reduce the impact of disasters in Somalia.

UNDRR filmed this case and will be promoting it in the lead up to International Day for Disaster Risk Reduction 2022.

# MHEW

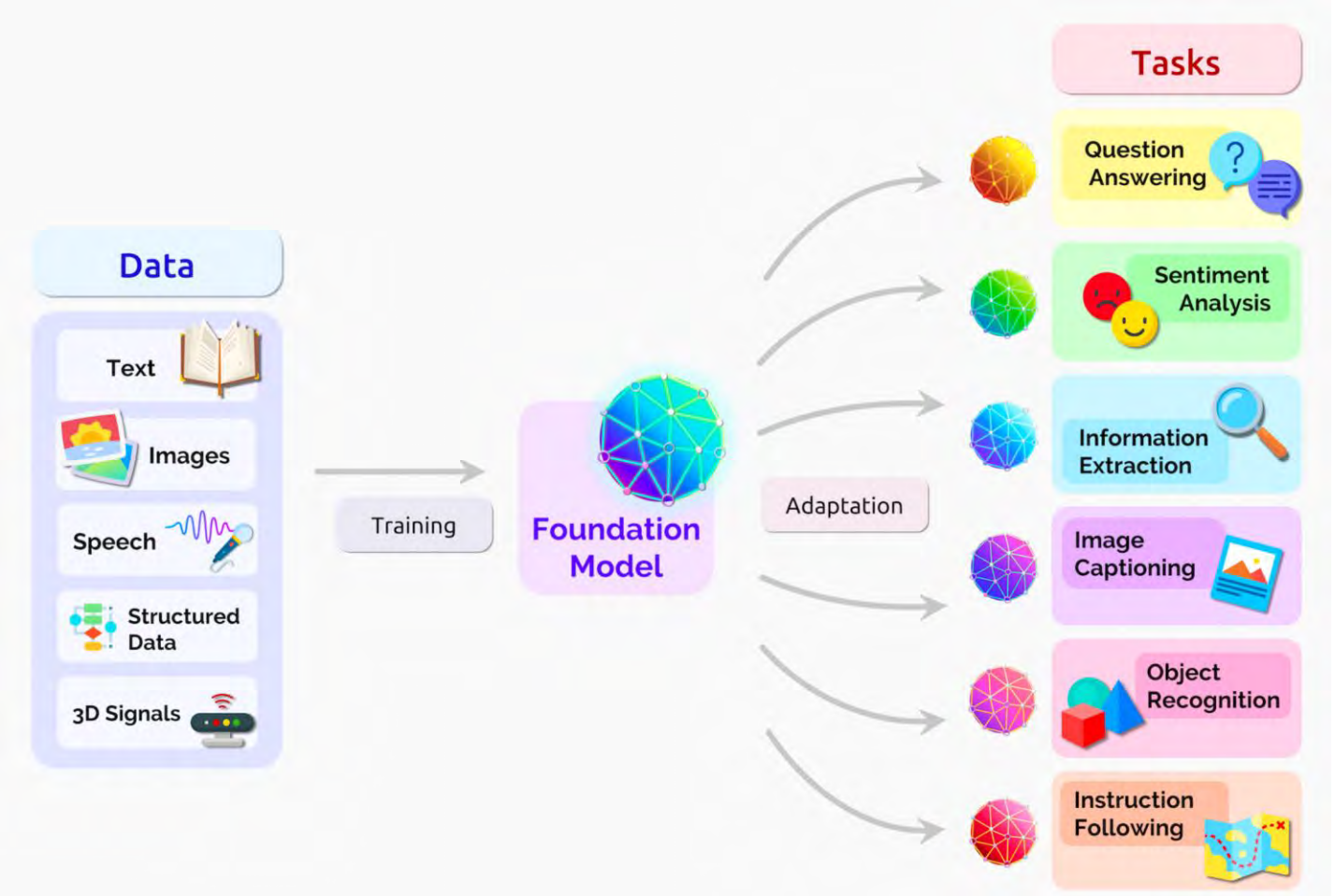
Some examples about the EWS projects (IRDR and IRDR engaged)

| Countries | Projects (IRDR and IRDR engaged) |
|---|---|
| **The Pacific Region**<br>Tonga, Samoa, Fiji, Cook Islands, Kiribati Niue and Tuvalu, Palau, Nauru, Marshall Islands Tokelau, Honiara, Papua New Guinea | The Pacific Resilience Program– Multi Hazard Early Warning System in Tonga and Samoa<br>Risk Interpretation and Application Program of IRDR<br>Climate Risk and Early Warning System Initiative (CREWS)<br>Coastal Inundation Forecasting Demonstration Project (CIFDP-Fiji)<br>United National Development Project |
| **Caribbean**<br>Antigua, Barbuda, Dominica, Dominica Republic, Saint Lucia, Saint Vincent and the Grenadines | Strengthen Integrated Early Warning Systems for more effective disaster risk reduction in the Caribbean though knowledge and tool transfer |

# AI for DRR

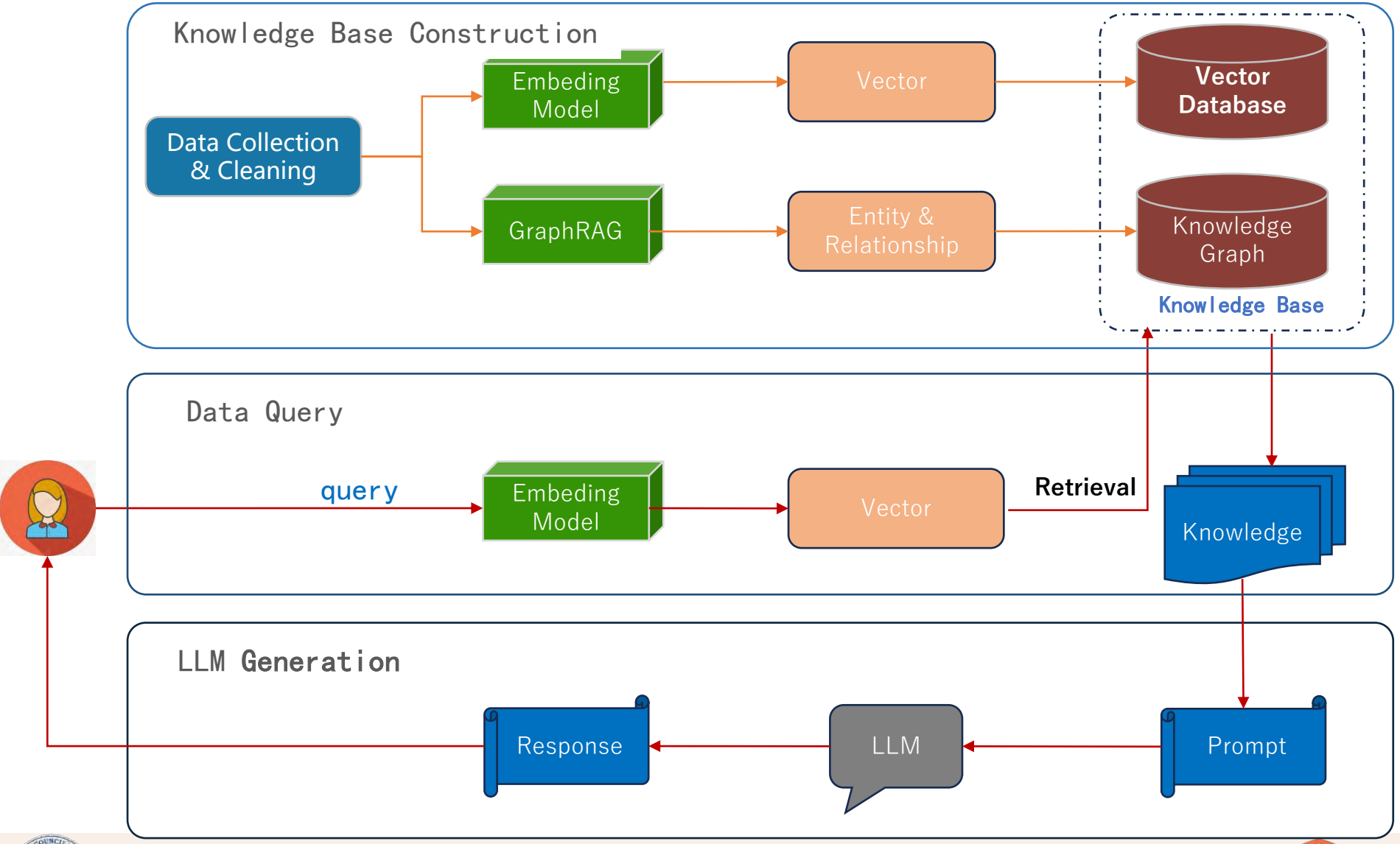
## LLM on DRR

1. Open Access Publications
2. Open Model
3. Research Toolbox
4. Capacity Building




Source: AI Thailand

# AI for DRR




- The Embedding Model converts documents into vector representations and injects them into the vector database.
- GraphRAG extracts entities and relationships from text to construct a knowledge graph.
- Encode the query into a vector using the Embedding Model.
- Perform matching and retrieval based on the vector database and knowledge graph to obtain relevant knowledge content.

Construct a Prompt based on the retrieval results and the user query, and feed it into the large language model to generate a response.

# DRR Practice from IRDR Young Scientists to close the gap between S&T and practice at community level


An Agent-Based Approach to Integrate Human Dynamics Into Disaster Risk Management

LEI Yu
Key Laboratory of Mountain Hazards and Earth Surface Processes
Institute of Mountain Hazards and Environment, CAS

Multi-hazard risk assessment of rural municipalities of Nepal

Sharad Wagle
National Society for Earthquake Technology (NSET)

Climate Smart Schools: Case study of Sikkim, India

Dr. Shyamli Singh
Coordinator Centre for Environment and Climate Change
Indian Institute of Public Administration, New Delhi, India

Climate Change Effects and Smart Agricultural Practices in Goat Production

Godfrey C. Onuwa
Federal College of Forest
Jos, Plateau state, Nigeria

Land Cover Conservation and Forest Fire Risk Management Arise in Ghana

Kueshi Sémanou DAHAN
Faculty of Natural Resources and Environment, Department of Environment and Sustainability Sciences, University for Development Studies, Tamale, Ghana.

Disaster and Climate Risk-sensitive Small and Medium Enterprises (SMEs) in the Northern and Eastern Provinces of Sri Lanka

A .M. Aslam Saja[1], Suresh Kanesh[2]
[1] Faculty of Engineering, South Eastern University of Sri Lanka, Oluvil
[2] Faculty of Arts, Eastern University of Sri Lanka, Vantharumoolai

Assessment of Gaps between Academia and Society in Landslide Risk Reduction

Sangeeta
Department of Civil Engineering
Punjab Engineering College
Chandigarh, India

Fuzzy cognitive mapping application for communities exposed to severe cyclones accompanied by storm surges, floods and other climatic extremities in India

Shruthi Dakey
VNIT, Nagpur,
India

Hydropower for Disaster Resilience Applications (HYDRA) in Greek

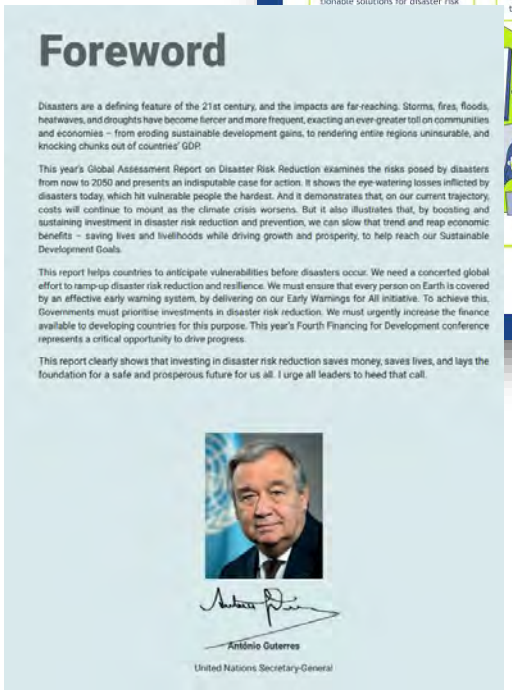
Spyros Schismenos
Humanitarian and Development Research Initiative (HADRI)
School of Social Sciences
Western Sydney University, Australia

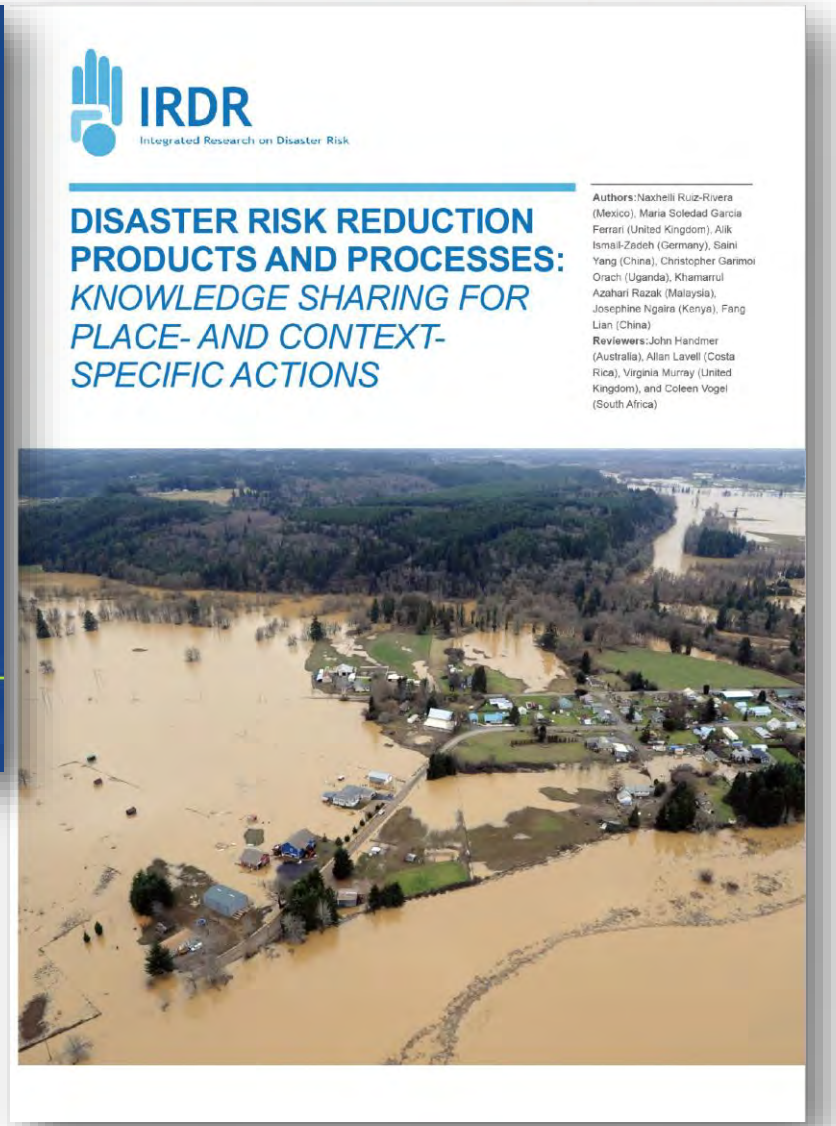
# Work With UN Agencies



## UNDRR






Advisory Board:
-Nesreen Alhmoud, IRDR Fellow, Former IRDR Scientific Committee Member
-Haruo Hayashi, IRDR Fellow, Former IRDR Scientific Committee Member
-Allan Lavell, Former IRDR Scientific Committee Member, Former Chair of IRDR Working Group on FORIN
-Shuaib Lwasa, Former Chair of IRDR Scientific Committee
-Saini Yang, IRDR Executive Director
Case Study Authors:
-Kaoru Takara, IRDR Scientific Committee Member, IRDR ICoE Coherence
-Suman Chapagain, Ramesh Gautam, IRDR ICoE INSET

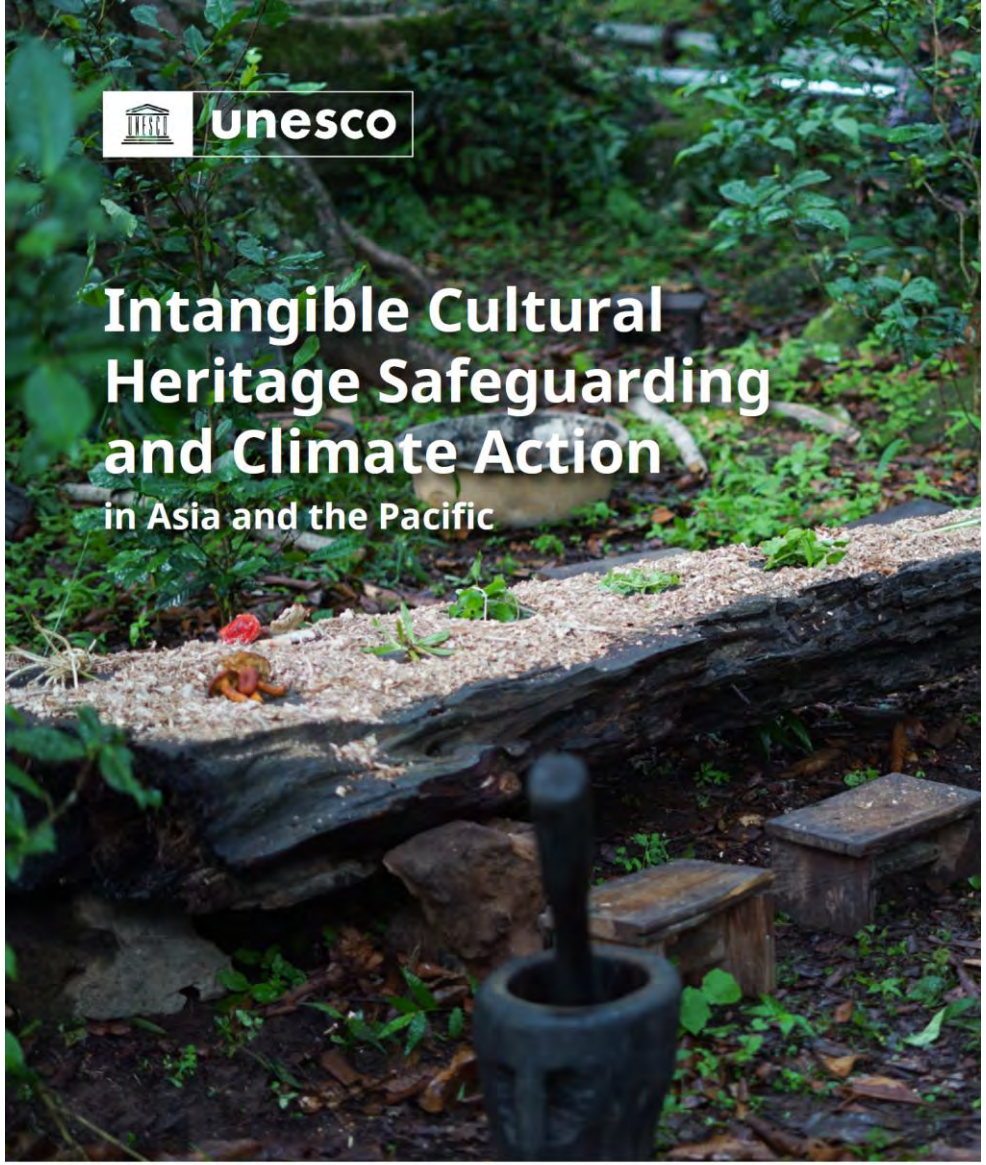
# Work with UN Agencies

**UNESCO** East Asia Office: Culture Sector and Science Sector

- Report on Intangile Cultural Heritage & Climate Action
- International science cooperation projects


## Cross-cutting themes

- Climate impacts on cultural practices;
- Indigenous knowledge and climate resilience;
- Cultural adaptation and sustainable agriculture; and
- Community-based strategies for climate actions




ichcap
International Information and Networking Centre for Intangible Cultural Heritage in the Asia-Pacific Region under the auspices of UNESCO
유네스코 아태무형유산센터
Centre under the auspices of UNESCO

International Research Centre for Intangible Cultural Heritage in the Asia-Pacific Region
Centre under the auspices of UNESCO

IRDR
Integrated Research on Disaster Risk

# Work with UN Agencies

## World Bank Group, GFDRR

- Integrating Disater Risk Information and Territorial and Spatial Planning
  - Korea
  - Australia
  - Phillipines
  - Brazil
  - China
- International symposium (scheduled in 2026)
- Knowledge Products

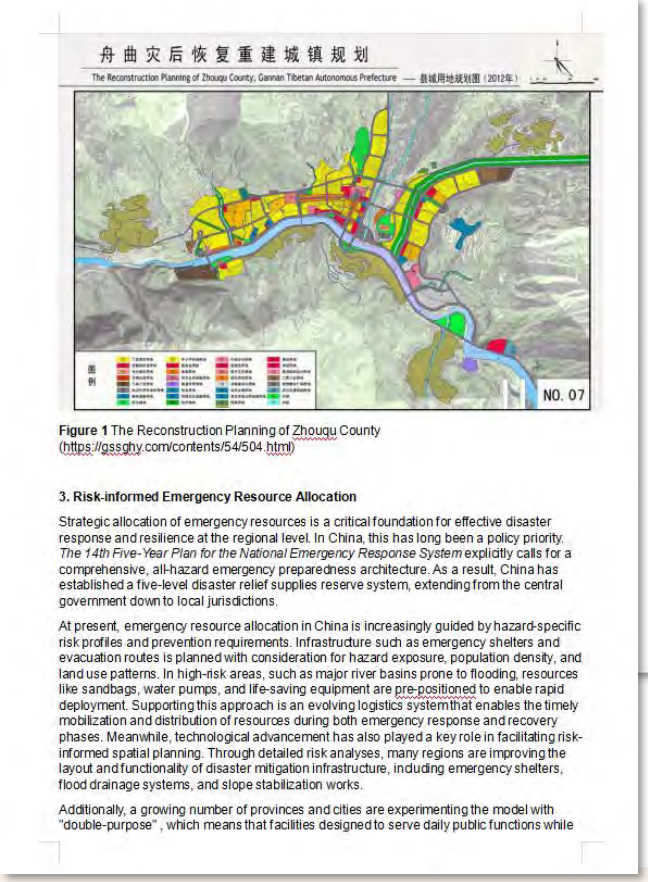


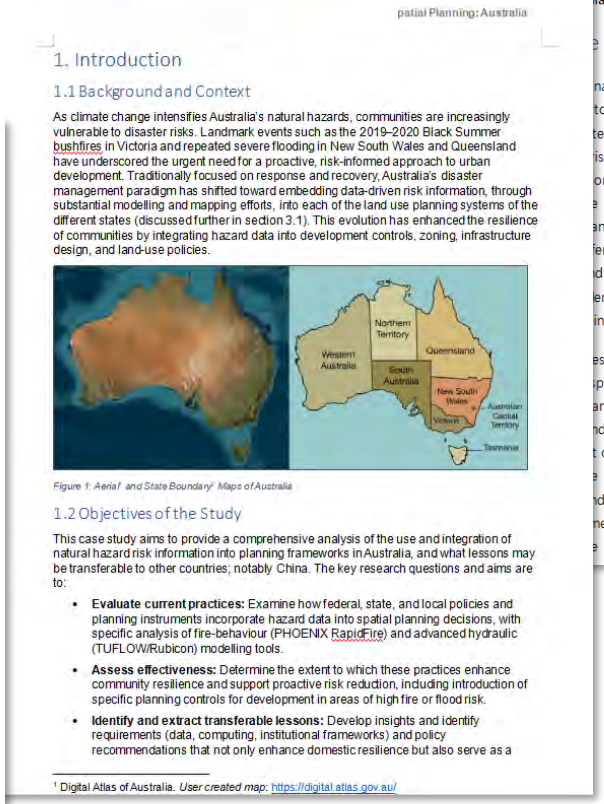

**Figure 1** The Reconstruction Planning of Zhouqu County (https://gssghy.com/contents/54/504.html)

**3. Risk-informed Emergency Resource Allocation**

Strategic allocation of emergency resources is a critical foundation for effective disaster response and resilience at the regional level. In China, this has long been a policy priority. *The 14th Five-Year Plan for the National Emergency Response System* explicitly calls for a comprehensive, all-hazard emergency preparedness architecture. As a result, China has established a five-level disaster relief supplies reserve system, extending from the central government down to local jurisdictions.

At present, emergency resource allocation in China is increasingly guided by hazard-specific risk profiles and prevention requirements. Infrastructure such as emergency shelters and evacuation routes is planned with consideration for hazard exposure, population density, and land use patterns. In high-risk areas, such as major river basins prone to flooding, resources like sandbags, water pumps, and life-saving equipment are pre-positioned to enable rapid deployment. Supporting this approach is an evolving logistics system that enables the timely mobilization and distribution of resources during both emergency response and recovery phases. Meanwhile, technological advancement has also played a key role in facilitating risk-informed spatial planning. Through detailed risk analyses, many regions are improving the layout and functionality of disaster mitigation infrastructure, including emergency shelters, flood drainage systems, and slope stabilization works.

Additionally, a growing number of provinces and cities are experimenting the model with "double-purpose" , which means that facilities designed to serve daily public functions while



patial Planning: Australia

1. Introduction

1.1 Background and Context

As climate change intensifies Australia's natural hazards, communities are increasingly vulnerable to disaster risks. Landmark events such as the 2019–2020 Black Summer bushfires in Victoria and repeated severe flooding in New South Wales and Queensland have underscored the urgent need for a proactive, risk-informed approach to urban development. Traditionally focused on response and recovery, Australia's disaster management paradigm has shifted toward embedding data-driven risk information, through substantial modelling and mapping efforts, into each of the land use planning systems of the different states (discussed further in section 3.1). This evolution has enhanced the resilience of communities by integrating hazard data into development controls, zoning, infrastructure design, and land-use policies.



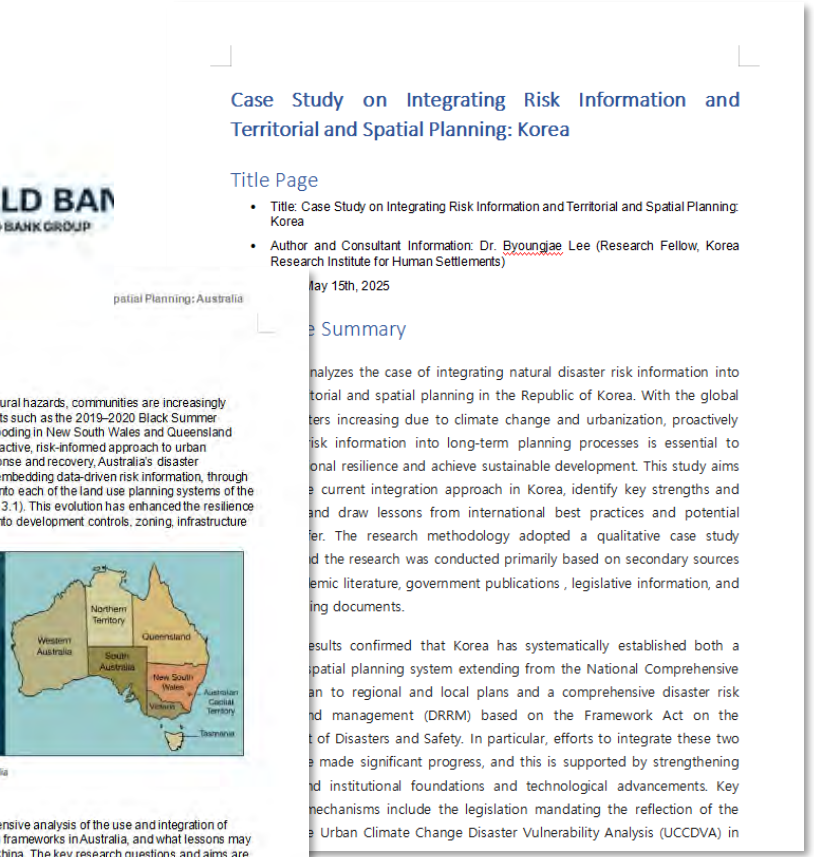

*Figure 1: Aerial[1] and State Boundary[2] Maps of Australia*

1.2 Objectives of the Study

This case study aims to provide a comprehensive analysis of the use and integration of natural hazard risk information into planning frameworks in Australia, and what lessons may be transferable to other countries; notably China. The key research questions and aims are to:

- **Evaluate current practices:** Examine how federal, state, and local policies and planning instruments incorporate hazard data into spatial planning decisions, with specific analysis of fire-behaviour (PHOENIX RapidFire) and advanced hydraulic (TUFLOW/Rubicon) modelling tools.
- **Assess effectiveness:** Determine the extent to which these practices enhance community resilience and support proactive risk reduction, including introduction of specific planning controls for development in areas of high fire or flood risk.
- **Identify and extract transferable lessons:** Develop insights and identify requirements (data, computing, institutional frameworks) and policy recommendations that not only enhance domestic resilience but also serve as a

[1] Digital Atlas of Australia. *User created map*: https://digital.atlas.gov.au/



Case Study on Integrating Risk Information and Territorial and Spatial Planning: Korea

Title Page

- Title: Case Study on Integrating Risk Information and Territorial and Spatial Planning: Korea
- Author and Consultant Information: Dr. Byoungjae Lee (Research Fellow, Korea Research Institute for Human Settlements)
- May 15th, 2025

Summary

nalyzes the case of integrating natural disaster risk information into torial and spatial planning in the Republic of Korea. With the global ters increasing due to climate change and urbanization, proactively isk information into long-term planning processes is essential to onal resilience and achieve sustainable development. This study aims e current integration approach in Korea, identify key strengths and and draw lessons from international best practices and potential er. The research methodology adopted a qualitative case study d the research was conducted primarily based on secondary sources emic literature, government publications , legislative information, and ing documents.

esults confirmed that Korea has systematically established both a patial planning system extending from the National Comprehensive an to regional and local plans and a comprehensive disaster risk nd management (DRRM) based on the Framework Act on the t of Disasters and Safety. In particular, efforts to integrate these two e made significant progress, and this is supported by strengthening nd institutional foundations and technological advancements. Key echanisms include the legislation mandating the reflection of the e Urban Climate Change Disaster Vulnerability Analysis (UCCDVA) in

# 13 National Committees，1 Regional Committee

| | | | |
|---|---|---|---|
| **IRDR Australia** | Bushfire & Natural Hazards Cooperative Research Centre (BNH CRC) | **IRDR New Zealand** | Natural Hazards Research Platform (NHRP) |
| **IRDR Canada** | Science and Technology Working Group, Canada's Platform for Disaster Risk Reduction | **IRDR USA** | Natural Hazards Center (NHC), Institute of Behavioral Science, University of Colorado at Boulder |
| **IRDR China** | China Association for Science and Technology (CAST) | **IRDR Iran** | A group of eight Iranian research institutes and scientific associations |
| **IRDR Colombia** | National Committee of Disaster Risk Knowledge, National Unit for Disaster Risk Management of the Presidency of the Republic of Colombia | **IRDR Indonesia** | Indonesia Institute of Sciences (LIPI) |
| | | **IRDR Japan** | Science Council of Japan (SCJ) |
| **IRDR France** | Scientific Council, Association Française Pour la Prevention des Catastrophes Naturelles (AFPCN) | **IRDR Republic of Korea** | National Disaster Management Research Institute (NDMI) in Ministry of the Interior and Safety |
| **IRDR Germany** | German Committee for Disaster Reduction | **IRDR Nepal** | National Reconstruction Authority of Nepal |

**IRDR Regional Committee** **ISC Regional Office for Latin America and the Caribbean**

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| | | | |
|---|---|---|---|
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| Understanding Risk & Safety, Colombia | ICoE- UR&S | Vulnerability & Resilience Metrics, USA | ICoE- VaRM |
| Critical Infrastructure & Strategic Planning, Germany | ICoE- CI&SP | Disaster Resilient Homes, Buildings, and Public Infrastructure, Canada | ICoE- DRHBPI |
| National Society for Earthquake Technology, Nepal | ICoE- NEST | Disaster and Medical Humanitarian Response, Hong Kong, China | ICoE-CCOUC |
| Disaster Risk and Climate Extremes, Malaysia | ICoE-SEADPRI-UKM | Spatial Decision Support for Integrated Disaster Risk Reduction, the Netherlands | ICoE-SDS IDRR |
| Transforming Development and Disaster Risk, Sweden/Thailand | ICoE-TDDR | Integrated Research on Disaster Risk Science, Australia | ICoE-IRDRS |
| Resilient Communities & Settlements, India | ICoE-RCS | Disaster and Climatic Extremes, Pakistan | ICoE-DCE |
| Risk Interconnectivity and Governance on WEather/Climate Extremes Impact and Public Health, Shanghai, China | ICoE-RIG-WECEIPHE | Coherence among Disaster Risk Reduction, Climate Change Adaptation, and Sustainable Development, Tokyo, Japan | ICoE - Coherence |

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ISC GeoUnions Standing Committee on Disaster Risk Reduction

WWRP WORLD WEATHER RESEARCH PROGRAMME

WORLD BANK GROUP

ADB ASIAN DEVELOPMENT BANK

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Culture Sector, Science Sector, MAB China, UNESCO Chairs, UNESCO Category II Centres (IKCEST, HIST,)…

IRDR
Integrated Research on Disaster Risk

# Thank you

Toward inclusive, safe and sustainable development