Status of Science and Technology in Disaster Risk Reduction in Asia-Pacific

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About the Report

This report was developed by the UNDRR's Asia-Pacific Scientific and Technology Advisory Group (AP-STAG), with contributions from scientists and researchers in the Asia-Pacific region. It is based on a review and qualitative survey, which examine the application of science and technology to disaster risk reduction, specifically to the four Priorities for Action of the Sendai Framework for Disaster Risk Reduction.

The study is comprised of three parts:

Part 1 presents a regional, survey-based analysis of the progress made in regard to the Science and Technology Roadmap for Disaster Risk Reduction.

Part 2 includes a regional status review of seven selected themes, including (1) Science and synergies: focusing on sustainable development, climate change adaptation and disaster risk reduction, (2) The Sendai Framework and science and technology, (3) Localization and inclusivity: application of science and technology at the local level, (4) Cities, climate change and critical infrastructure, (5) Science, innovation and entrepreneurship, (6) Cascading (including natural hazards triggering technological accidents), compound and systemic risks, and (7) Youth and innovation.

Part 3 summarizes the findings of Part 1 and the common issues that cut across the themes explored in Part 2. It offers recommendations for consideration during the Sendai Framework Midterm Review.

The preparation of the report was coordinated by Rajib Shaw and Marco Toscano-Rivalta, with contributions from AP-STAG members and support from Noralene Uy and Rachelle Anne Miranda. The publication was commissioned by the United Nations Office for Disaster Risk Reduction.

Foreword

The Science and Technology Roadmap to Support the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 (the S&T Roadmap) provides a clear action plan in order to enhance the application of science and technology in all sectors and at various levels.

The year 2022 marks the third year of the COVID-19 pandemic, which demonstrated the increasing importance and urgent need to accelerate the use of science and technology (S&T) in decision- and policy-making for all hazards. A particular focus is innovation and the use of new and emerging technologies to address the systemic nature of risks, to take into consideration compound and cascading impacts and intersectional vulnerabilities in the society and the environment. Similarly, inclusive decision-making calls for the engagement of different stakeholders, of youth and young professionals in particular, who have shown great potential in harnessing science, engineering and technology to promote innovation in disaster risk reduction, while boosting social entrepreneurship.

Although there has been a greater recognition of the critical role played by S&T at global, regional and national levels, its application at the local level remains a challenge. Cities are increasingly becoming hotspots for disasters due to rapid urbanization, climate change and other anthropogenic pressures. Addressing risks to urban areas is crucial as we advocate for risk-informed sustainable development, that is based on science, adaptive governance and inclusivity.

This report comes at an opportune time with the Sendai Framework Midterm Review underway. This status report constitutes an essential contribution to the stocktaking process and the identification of strategic areas for further action. The review of the progress in the implementation of the S&T Roadmap can inform further deliberations and processes at the global level towards achieving the targets of the Sendai Framework as well as building a stronger regional network of the S&T community in the Asia-Pacific region.

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Acronyms

ADPC	Asian Disaster Preparedness Center
ANCST	Asian Network on Climate Science and Technology
AP-PLAT	Asia-Pacific Climate Change Adaptation Information
AP-STAG	Asia-Pacific Scientific and Technology Advisory Group
ARISE	Private Sector Alliance for Disaster Resilient Societies
ASEAN	Association of Southeast Asian Nations
CCA	Climate Change Adaptation
CDRI	Coalition for Disaster Resilient Infrastructure
CIC	Climate Innovation Challenge
DRI	Disaster Resilient Infrastructure
DRR	Disaster Risk Reduction
Eco-DRR	Ecosystem-based Disaster Risk Reduction
ESCAP	Economic and Social Commission for Asia and the Pacific
ESG	Environment, Social and Governance
FLL-DRR	Futures Literacy Labs on Disaster Risk Reduction
GAR	Global Assessment Report
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
HII	Hydro-Informatics Institute
ILO	International Labour Organization
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change

IRDR	Integrated Research on Disaster Risk
ISC	International Science Council
ISO	International Organization for Standardization
LAPA	Local Adaptation Plan of Action
LTD	Let's Talk Disaster Risk Reduction
M&E	Monitoring and Evaluation
MSMEs	Micro, Small and Medium Enterprises
NATECH	Natural Hazards Triggering Technological Accidents
NDMO	National Disaster Management Office
NGO	Non-Governmental Organization
OECD	Organisation for Economic Cooperation and Development
R&D	Research and Development
RIKA	Resilience Innovation Knowledge Academy
S&T	Science and Technology
SDGs	Sustainable Development Goals
SETI	Science, Engineering, Technology and Innovation
SLCF	Short-Lived Climate Forcer
SMEs	Small and Medium Enterprises
UAV	Unmanned Aerial Vehicle
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCO	United Nations Educational, Scientific and Cultural Organization
WMO	World Meteorological Organization
YYPs	Youth and Young Professionals

Executive Summary

THE SCIENCE AND TECHNOLOGY ROADMAP TO SUPPORT THE IMPLEMENTATION OF THE SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION 2015-2030 (THE S&T ROADMAP) AIMS TO "FOSTER COLLABORATION AMONG SCIENCE COMMUNITIES AND OTHER STAKEHOLDERS ACROSS GLOBAL AND REGIONAL MECHANISMS AND INSTITUTIONS FOR THE IMPLEMENTATION AND COHERENCE OF INSTRUMENTS AND TOOLS RELEVANT TO DISASTER RISK REDUCTION" (UNDRR, 2019). IT FOCUSES ON FOUR EXPECTED OUTCOMES AND 58 ACTIONS, STRUCTURED AROUND THE FOUR PRIORITIES FOR ACTION OF THE SENDAI FRAMEWORK.

An online survey was conducted by the Asia-Pacific Scientific and Technology Advisory Group (AP-STAG) in February 2022 to assess the implementation of the S&T Roadmap in the Asia-Pacific region and it was disseminated widely in various countries. A total of 145 responses were received from governments (at the national and local level), intergovernmental organizations, the United Nations and other stakeholders. The survey results indicate significant progress in many actions included in the S&T Roadmap, but more efforts are needed to reach the levels 'Very Good' and 'Great' in the implementation of these actions. There is increased interest in Priority for Action 4 and the least interest in Priority for Action 3. Overall, Priority for Action 3 and Priority for Action 4 were identified as having made the least progress among the four Priorities for Action.

This is demonstrated by the many actions where work needs to be amplified, including, for Priority 3, in assessing the status of mainstreaming science and technology into disaster risk reduction, providing funding for science and technology in disaster risk reduction and assessing the impact of the investment of science and technology in disaster risk reduction, and, for Priority 4, in reviewing build back better indicators, addressing gaps in early warning systems and institutionalizing effective recovery and reconstruction strategies, among others.

Focusing on the outcomes, Outcome 1 (data and knowledge) of Priority for Action 4 showed significant progress while Outcome 2 (dissemination) demonstrated uniform progress in the four Priorities for Action, achieving the highest score among all the outcomes. Outcome 3 (monitoring and review) garnered the least progress, which underlines the need for more strategic focus on implementing actions while Outcome 4 (capacity building) reveal substantial achievements in Priority for Action 1 and Priority for Action 2 but less in Priority for Action 3 and Priority for Action 4.

A regional status review was also provided for seven strategic themes, including (1) Science and synergies: sustainable development, climate change adaptation and disaster risk reduction, (2) The Sendai Framework and science and technology, (3) Localization and inclusivity: application of science and technology at the local level, (4) Cities, climate change and critical infrastructure, (5) Science, innovation and entrepreneurship, (6) Cascading (including NATECH), compound and systemic risks, and (7) Youth and innovation. This review was conducted through the analysis of challenges and gaps, opportunities and trends, and ways forward to accelerate S&T application for disaster risk reduction in the Asia-Pacific region.

The findings of the online survey and the common issues, which were identified from the discussion around thematic areas, are summarized for consideration during the Sendai Framework Midterm Review. Recommendations are suggested for the four outcomes: data and knowledge, dissemination, monitoring and review and capacity building, and on crosscutting issues such as governance, cooperation, funding and technology and innovation.

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Part 1: Regional Analysis

STATE OF IMPLEMENTATION OF THE SCIENCE AND TECHNOLOGY ROADMAP IN THE REGION

The Science and Technology Roadmap to Support the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 (the S&T Roadmap) is one of main outcomes from the Science and Technology Conference held in January 2016 in Geneva and organized by the United Nations Office for Disaster Risk Reduction. The S&T Roadmap aims to "foster collaboration among science communities and other stakeholders across global and regional mechanisms and institutions for the implementation and coherence of instruments and tools relevant to disaster risk reduction" (UNDRR, 2019). The S&T Roadmap focuses on four expected outcomes and 58 actions, structured around the four Priorities for Action of the Sendai Framework. It was further enhanced by the UNDRR Global Science and Technology Advisory Group in 2018 to ensure its coherence with other agreements, such as the Sustainable Development Goals (SDGs), the Paris Agreement and the New Urban Agenda and to strengthen its link to the Sendai Framework monitoring process.

An online survey was conducted by the Asia-Pacific Scientific and Technology Advisory Group (AP-STAG) in February 2022 to assess the implementation of the S&T Roadmap in the Asia-Pacific region. It was disseminated widely in various countries of the region, throughout governments, academia and research organizations, civil society networks and the private sector.

The survey questionnaire aimed to measure progress in the outcomes and actions under the S&T Roadmap in the four Priorities for Action of the Sendai Framework. The respondents provided a score for each action on a scale of 1 to 5, where 1 represents 'Poor' and 5 represents 'Great' in terms of implementation. The average scores for each of the actions and outcomes were used to assess the regional implementation of the S&T Roadmap. For the purpose of the analysis, the average values between 0 and ≤1 have been marked as 1, those between >1 and ≤2 have been marked as 2 and so on (Tables 1,2,3,4, and 6 and Figure 3).

A total of 145 responses were received from governments (at the national and local level), intergovernmental organizations, the United Nations and other stakeholders, from 10 countries in Asia and the Pacific. The other stakeholders included academia and research organizations; civil society organizations; children, youth and child-centered organizations; and the private sector (Figure 1). Of the 145 respondents, 82 were male and 63 were female. The survey demonstrated an increased interest in Priority for Action 4 and the least interest in Priority for Action 3 (Figure 2). This points to the focus on recovering from the COVID-19 pandemic.

Figure 1 Categories of survey respondents

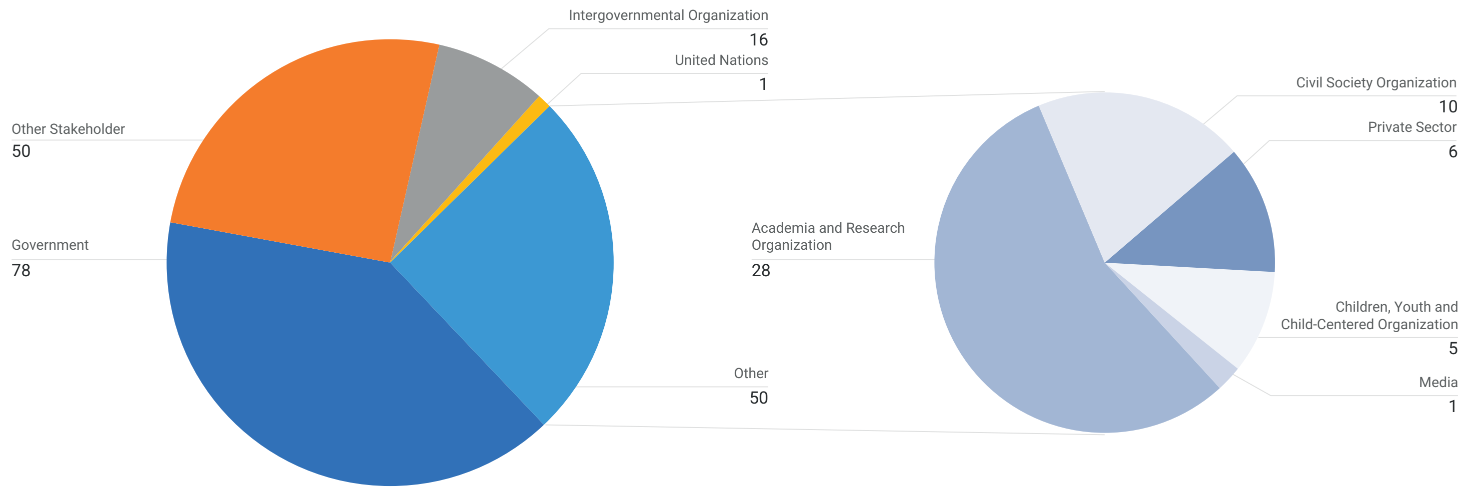
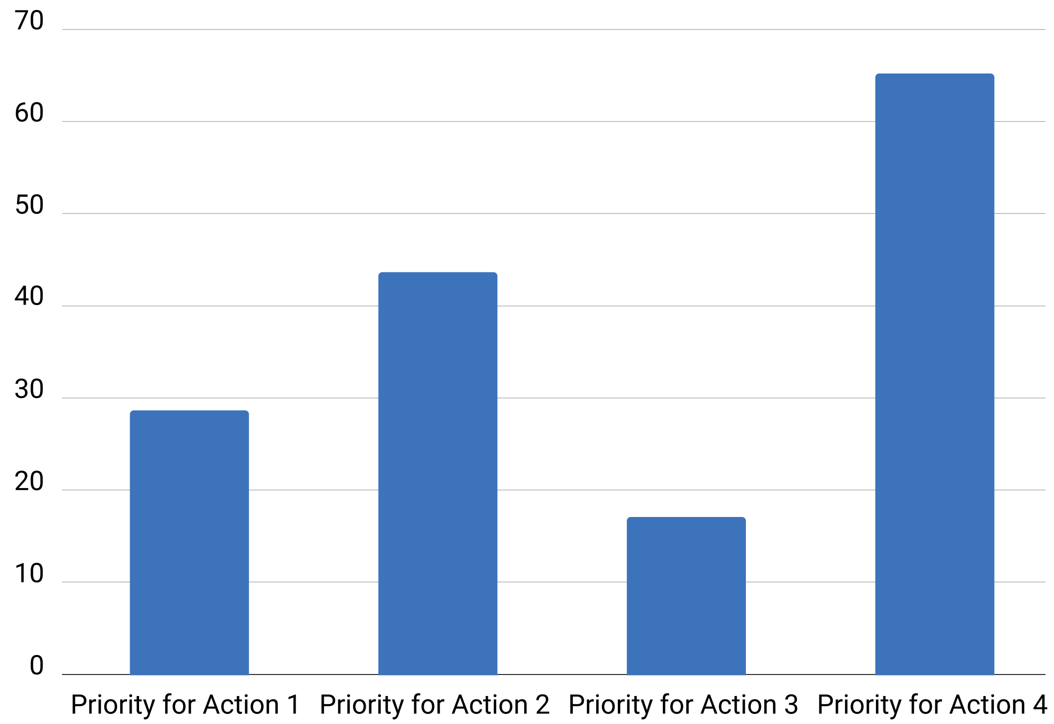


Figure 2 Interest in the Priorities for Action of the Sendai Framework



Summary

The survey results indicate significant progress in many actions of the S&T Roadmap, but more efforts are needed to reach the level of 'Very Good' and 'Great' in the implementation of these actions.

For Priority for Action 1, the actions on reviewing ethics of scientific input, adopting a multi-hazard approach, integrating traditional knowledge and practices, and S&T reporting through the Voluntary Commitment System require more focused attention (Table 1). The action 'Considering the root causes of risk and traditional knowledge in decision-making' in Priority for Action 2 was highlighted as requiring more effort (Table 2). The actions that need to be prioritized to enhance outcomes in Priority for Action 3 include (i) assessing the status of mainstreaming S&T in DRR, (ii) providing funding for S&T in DRR, (iii) assessing the impact of the investment of S&T in DRR, (iv) involving scientists of all disciplines in analyzing investment in DRR and climate change adaptation, (v) monitoring S&T investment in DRR as an integral part of national plans & policies, (vi) collecting information on the voluntary evaluation of S&T investment achievements, (vii) supporting innovations in earth observation and geospatial data for risk profiling and decision-making, and (viii) encouraging & enhancing the capacity of stakeholders in DRR to increase investment in S&T (Table 3). Finally, many of the actions for Priority for Action 4 need to be put into greater practice in order to achieve the target outcomes. These include reviewing build back better indicators, addressing gaps in early warning systems in least developed countries and small island developing states, incorporating build back better in insurance policies, institutionalizing effective recovery and reconstruction strategies, promoting science-based decision-making in resettlement, and utilizing scientific information to gain prior public consensus on post-disaster actions (Table 4).

Respondents also recommended specific actions for better application of S&T in the Asia-Pacific region, which are summarized in Table 5.

Regional Implementation of Priority for Action 1: Understanding Disaster Risk

Table 1 Regional Implementation of Priority for Action 1 (1-Poor, 2-Fair, 3-Good, 4-Very Good, 5-Great)

	OUTCOMES AND ACTIONS UNDER THE ROADMAP	1	2	3	4	5
1.1	ASSESS AND UPDATE DATA AND KNOWLEDGE					
1.1.1	Promote integrated and multi-disciplinary research			■		
1.1.2	Conduct solution-driven research at all levels that involve the users in the earliest stages			■		
1.1.3	Establish/link existing and update/maintain global databases			■		
1.1.4	Develop methods, models, scenarios and tools			■		
1.1.5	Integrate risk assessments across sectors			■		

1.1.6	Promote a scientific focus on disaster risk root causes, emerging risks and public health threats, insurance and social protection and safety nets			■		
1.1.7	Review ethics of scientific input		■			
1.1.8	Adopt a multi-hazard approach that integrates lessons learned, including transboundary, biological, technological and natural hazards triggering technological accidents (NATECH) hazards		■			
1.2	**DISSEMINATION**					
1.2.1	Develop evidence-based research on effective dissemination strategies for informed decision and policy-making			■		
1.2.2	Promote access to data, information and technology			■		
1.2.3	Integrate traditional, indigenous and local knowledge and practices		■			
1.2.4	Develop partnerships between all S&T and DRR stakeholders, and integrate gender equality			■		
1.3	**MONITORING AND REVIEW**					
1.3.1	Link S&T progress to Sendai Framework Monitoring indicators			■		
1.3.2	Link S&T reporting using online Voluntary Commitment System		■			
1.3.3	Promote coherence in data collection and monitoring and evaluation (M&E) indicators with the SDGs and Paris Agreement			■		
1.3.4	Develop a liaison group between the DRR community and the major global assessments, such as the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report and other related assessments			■		
1.4	**CAPACITY BUILDING**					
1.4.1	Build national and local capacities for the design, implementation and improvement of DRR plans			■		
1.4.2	Promote inclusiveness, interdisciplinary and inter-generational participatory approaches			■		
1.4.3	Develop expertise and personnel to use data, information and technology			■		
1.4.4	Promote the development and use of standards and protocols, including certifications			■		
1.4.5	Utilize knowledge resources of the S&T community for effective education programs on disaster risk reduction for scientists, practitioners and communities			■		
1.4.6	Promote a systems approach in understanding disaster for better-informed decisions			■		

Regional Implementation of Priority for Action 2: Strengthening Disaster Risk Governance to Manage Disaster Risk

Table 2 Regional Implementation of Priority for Action 2 (1-Poor, 2-Fair, 3-Good, 4-Very Good, 5-Great)

	OUTCOMES AND ACTIONS UNDER THE ROADMAP	1	2	3	4	5
2.1	**ASSESS AND UPDATE DATA AND KNOWLEDGE**					
2.1.1	Consider root causes of risk and inputs from traditional knowledge for decision-making		■			
2.1.2	Promote disaster risk assessment in spatial planning and development in both public and private sectors and increase participation of civil society in this process			■		
2.1.3	Integrate climate change adaptation & DRR and other relevant sectors (such as well-being, environment, health, economy, etc.) in the governance mechanism			■		
2.1.4	Develop flexible governance system to adapt to emerging risks and climate change			■		
2.1.5	Promote the assessment of ecosystem-based development option			■		
2.2	**DISSEMINATION**					
2.2.1	Promote dialogue and networking on DRR between scientists, academia, policy-makers, civil society, media, business and private sectors at the regional, national and sub-national level			■		
2.2.2	Raise scientific awareness and improve understanding			■		
2.2.3	Establish an understandable, practical, evidence-based scientific knowledge that is needed by all actors			■		
2.2.4	Improve access to data on DRR generated by international organizations, S&T communities, governments and different levels and stakeholders			■		
2.3	**MONITORING AND REVIEW**					
2.3.1	Strengthen the engagement of S&T in national coordination and promote sub-national implementation			■		
2.3.2	Promote disaster risk assessment in planning and development			■		
2.3.3	Promote participatory monitoring mechanism involving civil society organizations and local communities			■		
2.4	**CAPACITY BUILDING**					
2.4.1	Promote dialogue and networking on DRR between scientists and policy-makers, civil society and business			■		
2.4.2	Raise scientific awareness and improve understanding, considering future risk			■		

Regional Implementation of Priority for Action 3: Investing in Disaster Risk Reduction for Resilience

Table 3 Regional Implementation of Priority for Action 3 (1-Poor, 2-Fair, 3-Good, 4-Very Good, 5-Great)

	OUTCOMES AND ACTIONS UNDER THE ROADMAP	1	2	3	4	5
3.1	**ASSESS AND UPDATE DATA AND KNOWLEDGE**					
3.1.1	Assess & update the status of mainstreaming S&T in DRR		■			
3.1.2	Provide funding for S&T in DRR to enhance knowledge, research, and technology transfer		■			
3.1.3	Assess the impact of the investment of S&T in DRR		■			
3.1.4	Include scientists of all disciplines in analyzing investment in DRR as well as climate change adaptation, including loss and damages		■			
3.1.5	Conduct research, develop tools, explore challenges in S&T in DRR			■		
3.2	**DISSEMINATION**					
3.2.1	Promote various means of science communication for decision-making & policy-makers			■		
3.2.2	Promote changing roles of science and reflective practices of implementation that will contribute to the effectiveness of disaster risk reduction			■		
3.3	**MONITORING AND REVIEW**					
3.3.1	Monitor S&T investment in DRR as an integral part of national plans & policies		■			
3.3.2	Collect information on the voluntary evaluation of S&T investment achievements periodically in collaboration with S&T partners		■			
3.3.3	Support innovations in earth observation and geospatial data for risk profiling and decision-making			■		
3.4	**CAPACITY BUILDING**					
3.4.1	Encourage & enhance the capacity of stakeholders in DRR to increase investment in S&T		■			

Regional Implementation of Priority for Action 4: Enhancing Disaster Preparedness for Effective Response, and to "Build Back Better" in Recovery, Rehabilitation and Reconstruction

Table 4 Regional Implementation of Priority for Action 4 (1-Poor, 2-Fair, 3-Good, 4-Very Good, 5-Great)

	OUTCOMES AND ACTIONS UNDER THE ROADMAP	1	2	3	4	5
4.1	**ASSESS AND UPDATE DATA AND KNOWLEDGE**					
4.1.1	Promote multi-hazards early warning systems with improved climate information, aerial and spatial data, emergency response services and communication to end-users			■		
4.1.2	Develop and share best practices in new threats and risks (including infectious diseases) to inform preparedness planning			■		
4.1.3	Identify, collect and analyze case studies and assess options to strengthen recovery and rebuilding efforts			■		
4.1.4	Collaborate with the humanitarian community in exploring best practices for survivor-led response and reconstruction			■		
4.2	**DISSEMINATION**					
4.2.1	Develop, disseminate information and practices on contingency planning and protection of critical infrastructure including the promotion of build back better approach in recovery, rehabilitation and reconstruction			■		
4.2.2	Inform national disaster risk reduction plans and strategies that focus on community preparedness and awareness, including the needs of women, children, people living with a disability and the elderly in vulnerable situations			■		
4.2.3	Review and share build back better indicators among the relevant stakeholders		■			
4.3	**MONITORING AND REVIEW**					
4.3.1	Identify and address the need for, and gaps in, early warning systems in least developed countries and small island developing states		■			
4.3.2	Incorporate build back better in insurance policies		■			
4.4	**CAPACITY BUILDING**					
4.4.1	Institutionalize effective recovery and reconstruction as strategies to reduce risk and promote resilient developments		■			
4.4.2	Promote science-based decision-making for resettlement processes		■			
4.4.3	Generate and utilize scientific information to gain prior public consensus on post-disaster actions and to enable their smooth implementation after a disaster		■			

Table 5 Recommendations for a better application of S&T

AREA OF CONCERN	RECOMMENDATIONS
DATA AND KNOWLEDGE	• Availability and access to data and information • Developing accessible decision support systems • Enhanced use of geospatial methods • Investing in frontier technologies • Translation into the local language • IEC materials on S&T in DRR • Enhancing knowledge sharing, exchange and communication • Increased opportunities to learn from good practices locally and internationally
MULTI-STAKEHOLDER COOPERATION	• Increased partnerships to build resilience • Enhanced coordination among stakeholders • Promoting vertical and horizontal integration of S&T in DRR • Community participation • Enhanced youth participation • Engagement with non-traditional actors and sectors • Multidisciplinary and action-oriented collaboration
GOVERNANCE	• Periodic review and assessment • Strengthened use of S&T • Coherence among national and local plans • Consistency and sustainability of actions • Increased funding for R&D in S&T • Continuous advocacy of the science-policy nexus
PRIORITY FOCUS	• Enhancing local resilience • Focus on local governance • Focus on mental health in DRR

Overall, Priority for Action 3 and Priority for Action 4 were identified to have made the least progress among the four Priorities for Action, as demonstrated by the many actions where work needs to be amplified (Table 6). Priority for Action 1 showed substantial improvement compared to data from the 2020 Status Report.

Table 6 Overall Regional Implementation of Priorities for Action (1-Poor, 2-Fair, 3-Good, 4-Very Good, 5-Great)

		2020					2022				
	PRIORITIES FOR ACTION	1	2	3	4	5	1	2	3	4	5
1	Understanding Disaster Risk		■						■		
2	Strengthening Disaster Risk Governance to Manage Disaster Risk			■					■		
3	Investing in Disaster Risk Reduction for Resilience		■					■			
4	Enhancing Disaster Preparedness for Effective Response, and to "Build Back Better" in Recovery, Rehabilitation and Reconstruction		■					■			

Focusing on the outcomes (Table 7 and Figure 3), Outcome 1 (data and knowledge) for Priority for Action 4 showed significant progress, highlighting the increased interventions in promoting multi-hazard early warning systems, sharing best practices to inform preparedness planning, collecting case studies, and collaborating with the humanitarian community in recovery.

Outcome 2 (dissemination) demonstrated uniform progress in the four Priorities for Action, achieving the highest score among all the outcomes. Compared to the 2020 data, dissemination actions in Priority for Action 1 and Priority for Action 4 increased. Clearly, information dissemination through dialogue, data exchange and reporting, partnerships and integration into policy was a high priority of stakeholders in the Asia-Pacific region.

Outcome 3 (monitoring and review) showed the least progress, emphasizing the need for more strategic focus on implementing actions - particularly on monitoring and evaluation of S&T investments in DRR, participatory monitoring with relevant stakeholders, linking with innovations and trends, and reporting against international frameworks. Scores for monitoring and review actions in Priority for Action 2 and Priority for Action 3 dropped in 2022 compared to 2020.

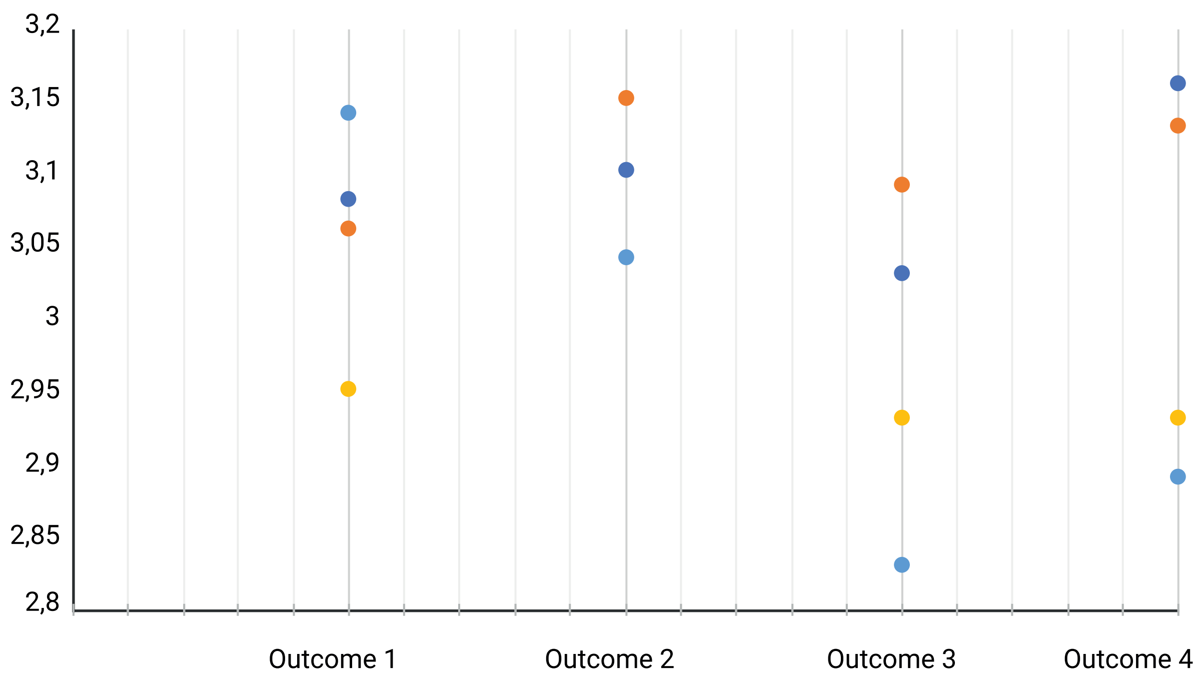
Outcome 4 (capacity building) revealed substantial achievements in Priority for Action 2 but less in Priority for Action 3 and Priority for Action 4. Capacity building actions related to Priority for Action 1 and Priority for Action 3 decreased compared to the 2020 data. Building capacity to understand risk and implement risk-informed development activities as well as strengthen governance systems was a high priority. In contrast, there were less interventions to develop capacity to enhance S&T investments for DRR, promote science-based decision-making and institutionalize strategies for effective response and recovery.

Table 7 Implementation Status Matrix of Outcomes per Priority for Action

OUTCOME	2020					2022				
	Priority for Action 1	Priority for Action 2	Priority for Action 3	Priority for Action 4	Ave-rage	Priority for Ac-tion 1	Priority for Action 2	Priority for Action 3	Priority for Action 4	Ave-rage
OUTCOME 1: DATA AND KNOWLEDGE	2.84	2.97	2.85	3.00	2.90	3.08	3.06	2.95	3.14	3.06
OUTCOME 2: DISSE-MINATION	2.96	3.12	3.00	2.82	2.98	3.10	3.15	3.04	3.04	3.08
OUTCOME 3: MONI-TORING AND REVIEW	2.68	3.15	2.97	2.48	2.81	3.03	3.09	2.93	2.83	2.97
OUTCOME 4: CAPA-CITY BUILDING	3.18	2.95	3.14	2.63	3.00	3.16	3.13	2.93	2.89	3.03
AVERAGE	2.94	3.05	2.93	2.77	2.92	3.09	3.11	2.96	2.98	3.03

LEGEND: Poor Fair Good Very Good Great

Figure 3 Outcome-wise Progress in Implementation in 2022



LEGEND: Priority for Action 1 Priority for Action 2 Priority for Action 3 Priority for Action 4

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Part 2: Thematic Regional Status

1. SCIENCE AND SYNERGIES: FOCUSING ON SUSTAINABLE DEVELOPMENT, CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

Qunli Han[1] and Saini Yang[2]

1. Introduction

Asia and the Pacific region have been experiencing severe disaster risks. According to the State of the Climate in Asia 2020, extreme weather and climate change impacts across Asia in 2020 caused thousands of deaths and taking a heavy toll on infrastructure and ecosystems. Sustainable development was threatened, with food and water insecurity, health risks and environmental degradation on the rise (WMO, 2021). The 2030 Agenda for Sustainable Development, the Sendai Framework and the Paris Agreement, adopted seven years ago, are designed to enhance global, regional and national capacities to cope with risks, which are increasingly systemic and cascading in nature and cut across all three agreements. Despite the increased recognition of the need to integrate climate change adaptation (CCA), disaster risk reduction (DRR) and sustainable development goals (SDGs), taking joint action through comprehensive approaches to risk remains hampered by many challenges.

The scientific and research community is often more open and flexible to take the lead in responding to existing and emerging challenges, pushing for synergy and coherence. For example, it has pushed for the conceptual integration of CCA as a part of DRR, within the larger context of sustainable development (IRDR, 2021). The scientific community has been increasing its efforts in interdisciplinary and multidisciplinary research, to uncover the interactions between climate change, natural, biological and technological hazards, and their impacts on people, communities and ecosystems, thereby promoting the coordination of actions and the integration of achievements towards the goals of the aforementioned agreements.

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2. Status of synergies and coherence between DRR, CCA and SDGs promoted by S&T

At the regional level

Opportunities for synergies across the different domains with regards to community and sector vulnerability at the local, national and international levels have been identified and characterized by emphasizing the need for integrated reporting across agreements. Moreover, international law can play a role in promoting national, regional and international actions to tackle the impacts of climate change and disasters on people. An "hourglass" model of the legal relationships between the three different international frameworks has been proposed. It is based on systemic coherence at the international level, vertical alignment between the international, regional and national levels and horizontal integration of international norms at the national level.

Synergies in monitoring and reporting provide opportunities for coherence through the interconnections between addressing climate change and disaster risk reduction and achieving sustainable development. However, exploiting synergies is not without its own challenges. To date, while resilience-related indicators from one agenda can be aligned with those in the other two agendas, there is still no common indicator set which would be shared across all three agendas. Nonetheless, such connections can help address the complex and interconnected social, economic and environmental elements that undermine societal resilience and the sustainability of the planet.

With regard to CCA, synergies have tended to be oriented towards specific sectors. The literature emphasizes the potential benefits of synergies in developing Monitoring and Evaluation frameworks, in order to enhance societal and environmental resilience. Perhaps due to the stronger institutional structures addressing climate change, many of these have been undertaken under the umbrella of CCA. In this context, resilience complements adaptation, by invoking processes that secure flexibility in the societal response to current and future changes, embedding these terms in wider notions of interconnected social, economic and environmental development expectations.

At the regional level, Southeast Asian countries have realized the need to address disaster risk reduction and climate change adaptation in an integrated manner. The Declaration on Institutionalizing the Resilience of ASEAN and its Communities and Peoples to Disasters and Climate Change, issued in April 2015, acknowledged the threats posed by climate change and ensuing extreme weather events and called for the mainstreaming of DRR and CCA into overarching development agendas. Multi-sectoral collaborations in multi-level governance are key to make such integration happen. The ASEAN Vision 2025 on Disaster Management adopted the Sendai Framework direction by encouraging ASEAN Member States to develop new DRR strategies by 2020. The ASEAN Agreement on Disaster Management and Emergency Response will need to be linked to the integration efforts under the ASEAN Economic Community and would be perhaps the first systematic attempt to integrate both DRR and CCA into wider development policy in the region.

In terms of policy instruments, the region is on the right track in terms of mainstreaming and integrating the two sectors. Most countries in the region already have a dedicated law governing disaster management, and action plans for climate change adaptation are largely in place. However, institutional integration is not yet on the horizon. Maintaining and strengthening cross-sectoral and multi-level collaboration is therefore critical to ensure the effective implementation of integrated DRR and CCA efforts.

At the national level

China: China has established coherent and science-based strategies for CCA and DRR. For instance, a white paper, entitled Responding to Climate Change: China's Policies and Actions, was released by the State Council in October 2021. The white paper promotes climate change adaptation actions in key sectors, enhanced monitoring, early warning and disaster prevention and mitigation capabilities. It also stresses the need to strengthen the role of scientific and technological innovation. The white paper reflects the ongoing integration of CCA, DRR and sustainable development based upon the application of science and technology.

Nepal: Nepal has taken several CCA and DRR measures to deal with climate-related hazards that put over one million people at risk every year (S.V. R. K. Prabhakar, et al., 2015). In order to implement the National Adaptation Program of Action at the local level, the Government of Nepal has developed a National Framework on Local Adaptation Plans for Action (LAPA). CCA and DRR synergies were also highlighted in the LAPA document (S.V. R. K. Prabhakar, et al., 2015).

Australia: Australia's response to climate change and sustainable development follows its federal constitutional governance structure (UN, 2019). According to the United Nations' Sustainable Development Report 2021, released in June 2021, although Australia ranked 35th in the SDG Index and scored high on health, education, clean water and some economic indicators, it still faces major challenges in realizing SDG 13 (climate action), with a need for urgent actions.

3. Reflection on the lessons learned during the COVID-19 era in Asia-Pacific

The COVID-19 pandemic has had not only widespread negative impacts on human health and socioeconomics but has also caused compounded damage when combined with the disasters caused by other hazards. With the increasing impact of climate change, these compounding risks are expanding. To alleviate this issue, a multi-hazard approach to disaster risk management is utilized (UNDRR Asia-Pacific, 2020). Meanwhile, there is significantly enhanced research collaboration between the more traditional "disaster risk reduction" communities, and the various health and science communities worldwide. In Taiwan Province of China, researchers completed a joint work sharing management experience in natural disasters and the COVID-19 pandemic (Wang et al., 2021). In Bangladesh, scholars in the fields of environment and sustainability, medicine, clinical epidemiology and biostatistics work together to explore floods and landslides amid the COVID-19 pandemic (Patwary & Rodriguez-Morales, 2022). In Japan, evacuation measures during natural disasters were updated in the context of the COVID-19 pandemic, benefiting from the experience in the response to complex disasters (Sakamoto et al., 2020). Researchers in mathematics, bioinformatics and information management from South Korea, Indonesia and China evaluated vulnerability to natural hazards, non-natural hazards and social hazards in West Papua (Caraka et al., 2021).

We also saw a greater focus on "ecosystem-based approaches" (also called "nature-based solutions") in DRR and CCA. This trend, which had already been underway prior to the COVID-19 pandemic, was probably accelerated by the recognition that it is impossible to separate research on zoonotic diseases from research and policy on the health of our ecosystems. The COVID-19 pandemic has highlighted the complex linkages between emerging infectious diseases and the unregulated trade in wildlife, habitat loss, biodiversity fragmentation and shifting dispersal patterns caused by new weather extremes (UNEP, 2020). Incorporating nature into a range of sectoral and overarching strategies to meet societal challenges is a cornerstone of addressing current global sustainability challenges (PEDRR & FEBA, 2020). Ecosystem-based Disaster Risk Reduction (Eco-DRR) not only supports livelihoods through regular ecosystem services, but also reduces climate and disaster risks. Sudmeier-Rieux et al. (2021), after a review of 529 English-language articles, concluded that the functions of Eco-DRR are cost-effective as well as cost-efficient, particularly with regards to flood mitigation, vegetation cover for slope stabilization and avalanche mitigation, and storm protection of beaches and foredunes. Recently, an increasing number of policies, laws and agreements at national and international levels are explicitly addressing ecosystems in their DRR efforts. For instance, at national level, after the occurrence of the Great East Japan Earthquake (2011), Japan started to mainstream Eco-DRR. Eco-DRR is recognized in Japan's Fundamental Plan for National Resilience, the National Land Grand Design Plan 2015 and the National Biodiversity Strategy.

Finally, we learned more about how to effectively use internet-based technologies to conduct virtual collaborations.

Remote work. Many companies required employees to work from home. Remote work is enabled by technologies, including virtual private networks, voice over internet protocols, virtual meetings, augmented reality, cloud technology, work collaboration tools and even facial recognition technologies that enable a person to appear before a virtual background to preserve the privacy of their home. These technologies contributed to limiting the spread of the coronavirus while helping businesses stay open. (Espitia, Mattoo, Rocha, Ruta, & Winkler, 2022; Karl, Peluchette, & Aghakhani, 2021). Remote work even helped some countries to improve their participation in international conferences and research, leading to greater openness in science cooperation.

Distance learning. The pandemic led to the closure of schools and universities. Many educational institutions started offering online courses to mitigate the impact of quarantine measures (Amir et al.,2020). Technologies involved in distant learning are similar to those for remote work and also include virtual reality, augmented reality, 3D printing and artificial intelligence-enabled robot teachers.

Data crowdsourcing. Vast amounts of data are being generated that could help advance COVID-19 research efforts. Some institutes have created national data analytics platforms to make data more open, accessible and systematic for studying COVID-19 and identifying potential treatments.

4. Trends and Way forward

With the increased recognition that risks are systemic, the scientific community will adopt more interdisciplinary and multidisciplinary approaches to enhance coherence and synergies between DRR, CCA and SDGs in the Asia-Pacific.

There is a clear, recent increase in efforts towards developing interdisciplinary programs integrating DRR, CCA and SDGs in the AP region, including the contribution of regional expertise to the establishment of A Framework for Global Science in Support of Risk-Informed Sustainable Development and Planetary Health (ISC-UNDRR-IRDR, 2021).

To further support these trends in the Asia-Pacific region, the following actions are suggested:

- To further enhance open access to data and knowledge, the sharing of solutions and integrating monitoring and reporting systems of the three international agreements.
- To mobilize scientific communities in Asia-Pacific to address systemic and cascading risks with new and cross-cutting work streams, such as the One Health Approach (Zhang et al. 2022).
- To study the interconnections of the Sendai Framework and other UN agreements, focusing in particular on multi-stakeholder co-design and co-production.
- To link research and higher education efforts: conduct university curricular transformation that fully reflects the needs for sustainable development and strengthen research-based approaches (or project-based approaches) in which students work in interdisciplinary teams on real challenges.
- To initiate a set of flagship programs that build better synergies between DRR, CCA and SDGs in communities, regions and countries. Science and technology groups should summarize, refine and share experiences to form new synergies, paradigms at different governance levels, and initiate a set of engineering and non-engineering demonstration programs of synergies.
- To enhance evidence-based research to demonstrate the efficiency and significance of synergies and coherence in the Asia-Pacific region so as to increase the support from governments, society and other stakeholders. Governments at all levels, society and stakeholders should pay more attention to build better synergies between DRR, CCA and SDGs, in order to optimize resource allocation.

2. THE SENDAI FRAMEWORK AND SCIENCE AND TECHNOLOGY

Ailsa Holloway[1] and Aslam Perwaiz[2]

1. Introduction

Revisiting the Sendai Framework for Disaster Risk Reduction

The crucial role played by science, as well as contributions by scientific and academic communities, represent integral elements of the Sendai Framework for Disaster Risk Reduction. The need for science-based evidence is an underpinning principle of the Framework. This is specifically foregrounded by Priority for Action 1, which focuses on advancing the understanding of risk, not only at local and national levels, but also at regional and global scales (UNISDR, 2015).

The advancement of the Sendai Framework's aspirations in Asia and the Pacific has benefitted substantially from the engagement of the two regions' scientific and academic communities. This reflects vigorous participation of scientists and academics at (sub)national levels, as well as region-wide collaborations enabled by scientific networks and transboundary partnerships.

Not only has this guided (sub)national decision-making in relation to managing the COVID-19 pandemic risks that have prevailed since 2020, but sound science, embedded in policy and action, has also underpinned crucial risk reduction actions. This is reflected in the greater use of science-based information as well as strengthened government systems at all levels for effective risk management at all levels. It has also seen the grounded application of risk reduction measures in local and (sub)national development efforts.

In many countries across both regions, the use of forecasting and warning technologies for geophysically-triggered and hydrometeorological threats is increasingly embedded both in policy and implementation. This was illustrated in practice in 2021, by widespread evacuations in response to tsunami warnings in Aotearoa, New Zealand, as well as in advance of super typhoon Rai (Odette) in the Philippines. The life-saving value of integrating scientific and local understanding of tsunami risk was also materially reflected in the spontaneous evacuation of Tonga's residents away from tsunami-exposed coastal areas following the eruption of Tonga's Hunga Tonga-Hunga Ha'apai volcano in January 2022.
Such responses underline the protective benefits of science-based warnings when these actively inform (sub) national policy and risk management decisions. They also underscore the imperative to frame science-based risk reduction interventions through the active engagement of the communities most at-risk. Specifically, these evacuation responses reinforce the value of scientific and technical information when it is understandable and resonates with people's concerns and worldviews. Box 1 below provides one clear example of how science innovation is addressing climate and disaster resilience needs in South Asia.

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2 Asian Disaster Preparedness Center

2. Advancing the Framework for Global Science in Support of Risk-informed Sustainable Development and Planetary Health

BOX 1: FROM INNOVATION TO IMPACT – SCALE-UP THE USE OF EMERGING TECHNOLOGY TO ADDRESS CLIMATE AND DISASTER RESILIENCE NEEDS IN SOUTH ASIA

Climate change is a major driver of disaster losses and failed development. Climate-related disasters, including extreme weather events, have come to dominate the global disaster landscape in the 21st Century. This is shaping new approaches to science and practice in disaster risk reduction, resilience building and climate change adaptation.

In the South Asian Region, the decision-making spaces are shared by scientists and policy-makers with the local community. The shared decision space is characterized by co-learning and knowledge production. Amidst the COVID-19 pandemic, national disaster management offices (NDMO), public finance and planning, supply chain drivers such as water and transportation, and public health authorities in South Asian countries are facing unprecedented challenges but also unparalleled opportunities in fighting an uphill battle against ever-increasing climate and extreme weather events.

Leveraging advanced technology and prioritizing a demand-driven approach to disaster and climate resilience, ADPC, in partnership with the World Bank, has been breaking new ground in using innovative approaches to help decision-makers better respond to disaster resilience. The Climate Innovation Challenge (CIC)1 and the TechEmerge Resilience Challenge2, financed by the Foreign Office of the British Government through the World Bank's PARCC Trust Fund, is supporting innovation challenges across South Asian countries, to identify crowd-sourced, innovative and disruptive technoloical solutions for resilience. The CIC aims to facilitate science-based innovative solutions for their application and scale-up across different sectors and tiers (national, sub-national and local/community) for greater impact.

This presents incredible opportunities to deploy emerging and future technologies such as Artificial Intelligence, Internet of Things (IOT), Blockchain and Robotics, to anticipate and mitigate disaster and climate risks to protect development gains and build up the resilience of communities, assets, livelihoods and systems and address disasters and impacts of climate change.

As technology development scales up, technologies for all aspects of disaster and climate risk management would also need to scale up and be widely adopted, making disaster and climate risk management smarter, more efficient, affordable and accurate.

1 https://www.adpc.net/cic/
2 https://www.techemerge.org/resilience

The Sendai Framework for Disaster Risk Reduction builds on a decades-long tradition of science engagement in the disaster risk domain. Its recognition of the global contribution that science networks can make to accelerate disaster risk reduction is reflected by recent publications produced by UNDRR, the International Science Council (ISC) and Integrated Research on Disaster Risk (IRDR). These include a comprehensive Hazard Definition and Classification Review (UNDRR & ISC, 2020) and UNDRR/ISC Hazard Information Profiles (Murry et al., 2021). They are also reflected in the forward-thinking Framework for Global Science in Support of Risk-Informed Sustainable Development and Planetary Health (ISC-UNDRR-IRDR, 2021). This initiative represents a transformative call for a transdisciplinary approach in disaster science as well as a more inclusive engagement of diverse stakeholder groups. It also seeks to enable synergies between, and to integrate disaster risk science with, other global development and climate imperatives.

The proposed science agenda comprises nine priorities:

1. Understand risk creation and perpetuation: systemic, cascading and complex risks
2. Address inequalities, injustices, marginalization and vulnerabilities
3. Enable transformative governance and action to reduce risk
4. Understand the implications of new thinking on hazards
5. Harness technologies, innovations, data and knowledge for risk reduction
6. Support regional and national science and knowledge innovation for policy and action
7. Support just and equitable transitions, adaptation and risk reduction
8. Measurement to help drive progress
9. Foster transdisciplinary and multi-stakeholder collaboration for solutions to risk challenges.

Figure 4 Overview of the Nine Priorities for Research (ISC-UNDRR-IRDR, 2021, p. 24)

The new framework responds to an evolving knowledge-to-action dynamic that necessarily involves scientists, policy-makers, practitioners and local communities. With respect to the science-policy interface, increasingly, policy- and decision-makers are strengthening their own science and research capabilities. They are underpinning their public policy decisions with evidence- and research-based solutions, including in the disaster risk reduction domain.

The Framework's implementation also calls for more shared decision space and the greater involvement of communities with diverse knowledge related to disaster, risk and development. These include indigenous scholars and the private sector. However, the approach specifically cautions against generic or one-size-fits-all approaches that are not locally and contextually embedded (ISC-UNDRR-IRDR, 2021, p.37), recognizing that the capacities of communities to reduce risk is informed by local perceptions of risk as well as capabilities and local agency to respond.

3. Challenges and Opportunities for Strengthening Science Engagement in Advancing the Sendai Framework for Disaster Risk Reduction

Across Asia and the Pacific, as well as globally, there is growing recognition that disaster events reflect the interaction between natural and human forces. This view is shaping new approaches to science and practice in the inter-related agendas of disaster risk reduction, resilience building and climate change adaptation.

On one hand, both regions are host to active scientific and technology communities. This was materially reflected in the collective contribution by more than 80 researchers from ten countries of the region to the Scoping Study on Compound, Cascading and Systemic Risks in Asia and the Pacific (UNDRR & AP-STAG, in press). On the other hand, countries in both regions face challenges in applying current scientific approaches to advance disaster risk reduction, let alone taking forward the aspirations described by the new science Framework for risk-informed sustainable development.

As underscored during the COVID-19 pandemic, since 2020 Asia and the Pacific continue to face a changing and dynamic risk landscape. In this context, the Economic and Social Commission for Asia and the Pacific's 2021 Asia Pacific Disaster Report, entitled Resilience in a Riskier World, describes the region's disaster landscape as becoming increasingly complex, characterized by overlapping and cascading hazards. The report foregrounds the cumulative pressures of responding simultaneously to the COVID-19 pandemic as well as to other hazards, including "cyclones, typhoons, storm surges, floods, droughts, heatwaves, glacial lake outbursts, locust swarms, earthquakes and volcanic eruptions" (ESCAP, 2021). It also cautions that historic capability to manage individual disasters is not synonymous with a capacity to manage the complex, overlapping threats that face both regions. In this context, science capabilities geared towards single hazards, while necessary, would need to regear for more cascading, interlinked multi-scalar processes that involve multiple threats.

In addition, while more economically developed countries in Asia and the Pacific have built institutional and science capabilities to respond to geophysical, hydrometeorological and biological hazards, this national capacity is not evenly distributed. In many of the region's least developed countries, there has been limited sustained investment to advance disaster risk-related sciences or to strategically integrate these within relevant fields.

Taking forward the priorities described in the new Framework for Global Science to advance disaster risk reduction could also prove challenging across both regions. The rationale for a transdisciplinary and inclusive research agenda clearly resonates with Asia-Pacific's increasingly complex risk profile. However, it also presupposes the capability to work across scientific fields and with diverse stakeholder groups. While there is widespread disaster risk science expertise in geophysically-oriented fields such as engineering, geography and environmental science, this is less apparent in health and social sciences or development studies. These knowledge fields not only enable a clearer understanding of the structural determinants of risk and vulnerability, they are also key for engaging marginal and excluded groups, as well as unlocking space for dialogue and building trust.

4. Conclusion

Asia and the Pacific have continued to build their disaster science capabilities. Across both regions, science-based warning systems have shown success in informing life-saving evacuation decisions for hydrometeorological threats and tsunamis. However, despite these achievements and progress in the availability and accessibility of disaster risk reduction knowledge, there is still a wide gap between science and practice, between research and concrete DRR outcomes.

The recently released Framework for Global Science in Support of Risk-Informed Sustainable Development and Planetary Health (ISC-UNDRR-IRDR, 2021) is a transformative response to address these gaps. It calls for a transdisciplinary approach in disaster science as well as a more inclusive engagement of diverse stakeholder groups in the processes for understanding risk.

Promoting this approach in Asia and the Pacific offers scope to close the gaps between disaster science and prevailing practice. However, this requires support and sustained investment, especially to strengthen the disaster risk-related science capabilities in the region's least developed countries. It also presupposes a purposive inclusion of health and social sciences and development studies, as well as of indigenous scholars and the private sector. This would recognize their crucial role in engaging at-risk, marginal and excluded groups, as well as in promoting dialogue and trust-building.

3. LOCALIZATION AND INCLUSIVITY: FOCUSING ON THE APPLICATION OF SCIENCE AND TECHNOLOGY AT THE LOCAL LEVEL

Takako Izumi[1] and Sutat Weesakul[2]

1. Context of the theme

The impact of hazards has become more diverse and serious in recent years. "Hazards" were often used to describe natural hazards but have now been extended to include various types of hazards such as technological, biological and virological hazards. The Sendai Framework clearly applies to the risk of disasters caused by natural or manmade hazards and related environmental, technological, and biological hazards. Regardless of the type of hazard, those who are most vulnerable and easily impacted are those living in poor socio-economic situations, people with disabilities, children and the elderly. Various social parameters such as urbanization, poverty and environmental degradation affect these vulnerable groups most seriously. Therefore, DRR processes and measures, including response and recovery, must consider and protect the interests of these vulnerable groups. While there is still a long way to go on that front, the importance of community participation and community-based DRR is fortunately widely recognized.

In a survey conducted in 2019 about the most effective innovations in DRR, the element with the highest score was "community-based disaster risk management." Other innovations in the top ten included hazard mapping, geographic information systems (GIS) and remote sensing, disaster risk insurance, drones and social networking service. But overreliance on advanced technology has been acknowledged and it is important to devise a key conceptual approach that serves as a guiding principle and framework for the implementation of DRR efforts and the application of technology and innovations in actual practice. Localization and inclusivity are thus fundamental in DRR.

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2 Hydro-Informatics Institute

2. Key regional challenges and issues

A number of DRR measures have been developed based on the collaboration and close linkage of science, technology and local people. For instance, the popularization of smartphones has made it possible for locals to receive early warnings for earthquakes, floods and typhoons. In addition, it facilitates safety confirmation and information collection regarding hazards. However, this is limited to people who have good Internet access. From this situation, it is still difficult to say definitely that science and technology can really help local communities.

Another question or challenge is whether science and technology are applied in the framework of a national DRR policy / measures. For instance, few Asian countries have developed hazard maps. Even when they do exist, it is hard for citizens to access these hazard maps and understand the hazard risks in their living area as well as where and how to evacuate in case of emergencies. Thus, hazard maps might not be the best tools for DRR measures. Understanding disaster risk is Priority 1 in the Sendai Framework. If the effective use of science and technology was leveraged, risk understanding would be achieved more easily and more broadly; however, it has not yet materialized. It is thus crucial to strengthen collaboration between academic institutions and government agencies, through information exchange, and increase learning opportunities for both DRR efforts.

3. Major global and/or regional initiatives

As stated in the 2020 Status of Science and Technology in Disaster Risk Reduction in Asia-Pacific report, the use of new technology is imperative, but it will be more effective if it can effectively empower locals and their indigenous knowledge. Demonstration through examples and good practices is a unique way of bridging the gap between science and policy. At present, there is increasing global awareness of the role played by S&T and the need to support its implementation at all levels. The role of S&T at national and regional levels has always been prominent in various global strategies and policies. At the local level, the initiatives mostly focus on the implementation of science-supported advice and its potential application at the local government level, which is a good indication of its value and usefulness. There are some movements to enhance local resilience, such as the Resilient Cities project by the OECD and UNDRR's Making Cities Resilient 2030 initiative. The agricultural sector, which is often the first to be affected by climate change, is an area that could benefit greatly from the application of science, both in terms of guidance and practice.

At a certain point, including ordinary citizens will be unavoidable. The next step, enhancing local citizens' involvement in science-policy practices, should be emphasized to sustainably reduce disaster risk at all levels.

BOX 2: COMMUNITY PREPAREDNESS IN SAKON NAKHON

In late July 2017, Tropical Storm Sonca hit Thailand. The torrential rains brought by the storm triggered flashfloods in 44 of the 76 provinces and killed 23 people. While the storm caused widespread flooding throughout northeastern Thailand, the hardest hit province was Sakon Nakhon, where the damage exceeded 110 million baht (US$3 million); it was considered the worst flooding the province had seen in the past 43 years.

Multi-stakeholder collaboration was established after the disaster for better preparation in the Sakon Nakhon Province. A Provincial Water Resources Management Operation Center was formed with the collaboration of all sectors, including the local and national government. The Center served as an interconnection between national information and local implementation. The Hydro-Informatics Institute (HII) is a state agency which provides scientific information support to set up the Center's water situation monitoring system using three datasets: water monitoring, forecasting, and summary from Thailand's National Hydroinformatics Data Center hosted by HII.

Local participation, including of local institutions and residents, is key to effective disaster awareness, preparation and prevention. HII, in partnership with the Friends in Need Volunteers Foundation (of "PA"), the Thai Red Cross and the National Farmers Council, collaborated with the Wa Yai community, the local community in Sakon Nakhon province, to provide academic and scientific information support for local development, rehabilitation and a plan to deal with all uncertainties.

All stakeholders, including local villagers and governments, carefully reviewed their current status, discussed their limitations and how to solve them. The communities learned from each other, especially from experienced and successful communities. The local risk area was identified with all the necessary details and information for further preparedness. This information urged all relevant stakeholders to conduct appropriate fieldwork for better integration of plans and preparations for disaster resilience. Since communication is an effective tool for flood warning, radio trunks were prepared and provided to volunteers.

Critical water level information of the major local river, the Yam River, was identified. The local community had built their own water level monitoring tool called "Hua Pla" (Fish Head), which was painted in three universally understood colors: green for normal, yellow for alert, and red for critical and evacuation levels. However, automated telemetry was also installed in local areas for real-time monitoring, even at night. The community set up a special team for the monitoring of the Yam River water level, using both Hua Pla and a telemetry station installed on the river, and they communicated via social media every day during the crisis.

Hua Pla (Fish Head)

Automated telemetry station on the bridge

The community did not focus only on their monitoring attempts, but they also turned adversity into opportunity by renovating the local water storage to increase its maximum capacity and store floodwater for agricultural use in the dry season.

After a few years of preparation and development, the area was again hit by Tropical Storm Dianmu in September 2021. The remnants of Dianmu caused heavy rainfall in northeastern and central Thailand. Sakon Nakhon was also one of the provinces impacted by the storm. With good preparation and collaboration, the community was safe from a major disaster and did not suffer any losses.

2021 Disaster preparation
Wa Yai Community, Wa Yai sub-district, Akat Amnuai district, Sakon Nakhon province

April 2021

National Farmers Council (NFC) Sakon Nakhon Province joined Thailand 2021 weather and rain forecasting seminar

"CYCLONE YAAS"

25 - 27 May 2021

HII warned heavy rain monitoring **NFC and community** discussed for situation planning and preparation for heavy rain

June-August 2021

- Drain out water in ponds and canals for future flood and heavy rain
- Increase pond's bank to increase storage for agricultural use in dry season
- Monitor and warning via radio communication

TROPICAL STORM DIANMU

8 - 30 September 2021

- Local Community Water Resources Management Committee set up team to monitor water level in Yam river from staff gauge, Hua Pla, and automated telemetry station.
- Summarize and send daily report in group communication channel daily
- No effect

April 2021 | May 2021 | June-August 2021 | September 2021

4. Conclusions/Suggestions

Localization includes the empowerment of communities, the recognition of local capacities, and support for grassroots DRR processes. While community participation should include everyone affected, minority and vulnerable groups (people living with disabilities, children and the elderly) are often overlooked in practice. Academia and universities can play an important role in linking S&T with locals by introducing new tools, technology and approaches to improve access. Their role also includes establishing strong communication with local governments, practitioners such as non-governmental organizations, the private sector and communities to disseminate information on S&T and how it can contribute to strengthen DRR capacities. At the same time, it is also crucial for academia and universities to learn about and understand the actual challenges at the local level. Based on this knowledge, research can be further enhanced and used to overcome the challenges of achieving localization and inclusivity of DRR.

4. CITIES, CLIMATE CHANGE AND CRITICAL INFRASTRUCTURE

Joy Jacqueline Pereira[1] and Mahua Mukherjee[2]

Synopsis

Climate and weather extremes, that have been progressively assigned to human influence, are already impacting the well-being of people in cities and urban settlements, and disrupting critical infrastructure. The major cause of disasters in Asia and the Pacific is climate hazards such as floods, droughts, hurricanes, storms and tornadoes. South and Southwest Asia have seen the highest number of fatalities, affected people and annual average resultant damages, while reported economic losses reached 64% of the gross domestic product for one Pacific Island State after it was hit by a tropical cyclone. The population in cities is unevenly affected, with informal settlements and underserved areas bearing the brunt of the impacts.

Failure to limit global warming to 1.5°C or exceeding this level, even for a short period, would lead to serious impacts, some of which could not be reversed, when natural and human systems are pushed beyond their ability to adapt. While limiting global warming to 1.5°C would substantially reduce climate-related losses, adaptation action is still urgent to reduce risks from climate hazards and other threats that are already being experienced in Asia-Pacific. Cities offer an excellent solution space for integrating climate change mitigation, near-term disaster risk reduction and long-term climate adaptation. There are many options for cities to transform risks of climate change into opportunities, and attain an inclusive and equitable society.

Climate action for cities include promoting investment in renewable energy, enhancing water harvesting, adopting green building technologies, combining nature-based and engineering approaches, urban agriculture, establishing green and blue spaces, social safety nets for disaster management and encouraging multi-stakeholder partnerships. Rapidly scaled up investment is key for cities and infrastructure, through increased international cooperation to mobilize resources and technology transfers. Partnerships and diverse knowledge are required to make cities resilient and develop new critical infrastructure in the context of multi-hazard scenarios, with emphasis on early warning and nature-based approaches. A way forward is through enhanced multi-stakeholder engagement and incorporation of science, engineering, technology and innovation in policy- and decision-making.

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1. Introduction

Disasters due to natural hazards have affected 6.9 billion people and killed more than 2 million since 1970 in Asia and the Pacific (ESCAP, 2021). Over the past decade, fatalities were the highest in South and Southwest Asia (44%), followed by East and Northeast Asia (29%) and Southeast Asia (25%). With respect to fatalities as a proportion of the population, Southeast Asia has the highest fatality rate, with 4.3 people per million, followed by the Pacific with 2.6 people per million. While progress has been made in reducing fatalities, the number of people affected shows only a small reduction, with 75% of the global victims located in Asia and the Pacific. Climate hazards such as floods, droughts, hurricanes, storms and tornadoes have been the major cause of disasters affecting people in the region and they resulted in damages estimated at 0.34% of the GDP between 1990 and 2018, compared to the global average of 0.22%. The worst affected areas were South and Southwest Asia, followed by East and Northeast Asia. The economic losses due to tropical cyclones in the Small Island States in the Pacific range up to 64% of the GDP; Vanuatu for example with damages valued at USD 56.5 million in 2015 (IPCC, 2022).

Cities and their surrounding landscape in Asia-Pacific have transformed due to rapid urbanization, in tandem with population and economic growth. Asset concentration, including critical infrastructure and resource consumption, is high in cities. The risk to the population and assets in the cities due to climate hazards has increased in the region. More severe climate and weather extremes are already impacting the well-being of people in cities and urban settlements and disrupting essential facilities and services (IPCC, 2022). Such extremes are magnified in cities, for example, heatwaves combined with the urban heat island effect, aggravated air pollution events and limited functioning of infrastructure. Populations in informal settlements, which constitute the highest proportion of urban dwellers in the region, tend to be the most affected. Climate and weather extremes as well as impacts on natural and human systems from slow-onset processes have been progressively assigned to human-induced climate change. Some irreversible impacts have already been observed when natural and human systems are pushed beyond their ability to adapt.

Climate change, increasing urbanization and other anthropogenic pressures are already turning cities and urban settlements into hotspots for disasters. The disruption of essential infrastructure and services such as communication, transport, water, energy, healthcare, flow of finance and support can cripple society in cities and its surrounding settlements. With increased investment to develop new infrastructure and improve ageing facilities in cities, such disruptions have wide socio-economic and environmental implications in cities, which extend to their rural connections. Coastal cities in the Small Islands States of the Pacific are most severely impacted by sea level rise, heavy rainfall events, tropical cyclones and storm surges (IPCC, 2022). About half of the population on these Islands live within 10 km of the coast, with more than half of the infrastructure concentrated within 500 m of the coast.

The investment need for global infrastructure is estimated to be about USD 94 trillion between 2016 and 2040, with Asia accounting for 54% of this amount (Global Infrastructure Outlook, 2017). Building critical infrastructure for digital connectivity, health, education, transportation and energy has proven to be vital during the Covid-19 pandemic. Diverse funding mechanisms, including private participation, are required to develop infrastructure that enables socio-economic development meeting the targets of the SDGs and climate action (World Bank, 2020).

Science, engineering, technology and innovation provide an opportunity for advancing resilient cities and critical infrastructure through policy, planning, design, development and investment, as well as efficient management. The development of science-based decision-making by leveraging knowledge from the Intergovernmental Panel on Climate Change (IPCC) and the application of multi-hazard risk reduction through multi-stakeholder partnerships, would contribute to the implementation of the Sendai Framework for Disaster Risk Reduction in Asia-Pacific.

2. Challenges

Climate change is expected to delay or reverse the progress made towards achieving development goals if global actions to reduce greenhouse gas (GHG) emissions to limit global warming to 1.5°C are not effective (IPCC, 2018). While reducing GHG emissions to limit global warming to 1.5°C would substantially reduce climate-related losses, adaptation action is still urgent to reduce risks from climate hazards and other threats that are already being experienced in Asia-Pacific. Based on current demographics and coastal protection, the number of people in coastal cities and settlements at risk of a 100-year coastal flood increases by about 20% if global mean sea level rises by 0.15 m relative to current levels. The risk doubles at 0.75 m and triples at 1.4 m (Dodman et al., 2022). Even if global warming were to exceed 1.5°C only for a short while, additional serious impacts are expected, some of which could not be reversed (IPCC, 2022). These would include increased risks for infrastructure, mountainous and low-lying coastal settlements as well as for cultural and spiritual values. Adaptation measures that draw on nature-based solutions would also be at risk.

The urban population exposed to climate hazards in Asia-Pacific is expected to expand significantly within the next three decades (Dodman et al., 2022). There is high confidence that flood risks will increase in low-lying coastal cities and settlements due to sea level rise, tropical cyclone storm surges and higher rainfall intensity. As global warming inches towards 1.5°C, it is also expected that urban dwellers will be exposed to water scarcity from severe droughts. Most of the population exposed to heatwaves will be in cities where concrete buildings retain heat, a factor which, combined with the loss of green spaces, contributes to the “urban heat island” effect. Heatwaves are an emerging climate hazard that requires more attention in the Asia-Pacific region, where residents in poor-quality housing on marginal land are most vulnerable (ESCAP, 2021). Vulnerable populations will be concentrated in underserved areas and informal settlements with poor infrastructure and lacking basic services such as safe water, sanitation, healthcare and education. Groups that are particularly vulnerable in Asia-Pacific cities include women, children, the elderly and people with disabilities (ESCAP, 2021).

Critical infrastructure for sanitation, water, health, transport, communications and energy will be increasingly vulnerable if design standards do not account for changing climate conditions (IPCC, 2022). Increased urbanization drives the expansion of critical infrastructure. Both existing and new infrastructure must be protected from the impacts of disaster and climate change as well as from other threats such as cyber-attacks on public and private networks at the state and local level. There are several challenges in this respect. These include access to resources and balanced allocation for developing and maintaining resilient infrastructure, as well as the application of advanced technologies including the Internet of Things (IoT) in building and operations. This is relevant to infrastructure associated with the road and transport sector, the energy sector, the production of clean drinking water and rural and municipal utility systems, among others. An infrastructure strategy that considers land use and land cover change as well as the implementation of nature-based solutions is also an important aspect. Regional dialogues are critical but challenging when conducting a needs assessment as well as when planning and designing transboundary critical infrastructure (SAADRI, 2022).

Short-lived climate forcers (SLCFs) are substances with a relatively short lifetime in the atmosphere compared with carbon dioxide (IPCC, 2021). They include methane, ozone and aerosols (black carbon, PM 2.5), sulphur dioxide and nitrous dioxide. Many of these substances cause air pollution in cities. Recent findings indicate that on 10 to 20-year timescales, the influence of SLCFs is at least as significant as that of CO2 for global warming. This means that by reducing SLCFs, there is an immediate and direct benefit to the health and well-being of populations through improved air quality. A review of data from countries in Southeast Asia for the 2000–2016 period revealed that carbon dioxide and particulate matter (PM2.5) are major risk factors for lung cancer (Farhad and Farzad, 2020; Fong et al., 2020). Increasing the use of renewable energy and higher healthcare expenditure per capita are expected to reduce lung cancer prevalence in the region. The reduction of SLCFs is a low-regret option for climate change mitigation that could be further advanced in Asia-Pacific to limit global warming to 1.5°C, while immediately benefiting city dwellers through reduced air pollution. Cities offer an excellent solution space for integrating climate change mitigation, near-term disaster risk reduction and long-term climate adaptation. However, this potential has yet to be fully explored and leveraged.

Adaptation actions in Asia-Pacific cities are generally at an initial stage and are relatively reactive, with lopsided progress favoring large cities over smaller cities and settlements (Shaw et al., 2022). Actions taken thus far include improving infrastructure resilience, strengthening institutional capacity and promoting nature-based solutions, technological approaches and behavioral changes. More urgent actions are required, particularly in low-lying and coastal cities, to build new facilities and retrofit existing infrastructure. A major challenge is the prioritization of finance to reduce the risk for low-income and marginalized city populations, which would bring about the biggest benefits and could spill over to rural areas.

3. Strengthening Resilience

Cities and urban settlements could host 75% of the world's population by 2050. This provides a narrow window of opportunity to advance climate-resilient development (IPCC, 2022). There are many options for cities to transform climate change risks into opportunities. These include promoting investment in renewable energy, enhancing water harvesting, adopting green building technologies, combining nature-based and engineering approaches, urban agriculture, establishing green and blue spaces, social safety nets for disaster management and encouraging multi-stakeholder partnerships, which could all lead to a more inclusive and equitable society (IPCC, 2022). Advanced technologies, including forecasting, citizen science and strategic partnerships, have contributed to improve risk awareness, weak governance, informed decision-making and financial deficits in Asia (Shaw et al., 2022).

There are many actions undertaken at the global, regional and country level to tackle climate risks in the Asia-Pacific region. Nature-based mitigation and adaptation actions are increasingly gaining ground in the expansion of cities and the development of critical infrastructure. River basin approaches have also been emphasized, where there are clusters of settlements of various densities that allow for both adaptation and mitigation to be considered (Pereira and Shaw, 2022). In this approach, short-term risks can be handled through immediate disaster risk management with a special focus on multi-hazards and early warning. Medium to long-term planning and resilience development can draw on insights from climate modeling.

Central to the advancement of climate-resilient development is enabling partnerships that bridge divergent perspectives, build on diverse knowledge about climate risk and practice carefully designed interventions with a focus on capacity building and meaningful participation (IPCC, 2022). Processes that link scientific, indigenous, local, practitioner and other forms of knowledge lead to more effective and locally relevant actions. There are many partnerships operating in the region to disseminate information on the latest knowledge, conduct capacity building and promote best management practices. The partnerships range from formal global initiatives with institutional memberships that are well-funded, to informal partnerships of individuals on a limited budget who advance knowledge in the multidisciplinary fields of climate science and technology.

The Coalition for Disaster Resilient Infrastructure (CDRI) was established to promote disaster resilient infrastructure (DRI) in 2019 (https://www.cdri.world/cdri-overview). It has members from many different backgrounds, including about 30 national governments (as of 4 February 2022) as well as international agencies, banks and financial organizations, private corporate sectors, academic and research institutions. The CDRI's knowledge platform initiatives are dispensed through DRI Dialogues and DRI Connect. DRI Dialogues leverage collaborative learning experiences about futuristic and implementable solutions within the DRI domain; and DRI Connect helps create impactful, resilient infrastructure practices through the engagement of diverse stakeholders. The promotion of investment in resilient infrastructure is crucial for the development of Asia-Pacific countries. An example is the Infrastructure Investment and Jobs Act of the United States, that was enacted on 15 November 2021. The legislation provides investments across critical infrastructure sectors such as road and transportation systems and nodes like airports, broadband, safe water, power, clean energy and the electric grid, aiming for improved resilience and environmental quality. An outlay of 1.2 trillion USD is targeted for investment by the FY 2026 to encourage funding of small businesses in the country (https://www.gfoa.org/the-infrastructure-investment-and-jobs-act-iija).

The Asian Network on Climate Science and Technology (ANCST) was established with seed-funding from the Cambridge Malaysian Education and Development Trust and the Malaysian Commonwealth Studies Centre in 2013 (http://www.ancst.org/). This international network is flourishing with considerable impact, with support from experts in world-class Commonwealth institutions, on key climate science and technology topics specific to Asian conditions and phenomena, including monsoon dynamics, land-sea interactions, climate change effects on the urban environment, and climate-driven disaster risk reduction and resilience building. Over 2500 scientists, policy-makers and practitioners, have been assembled in Asia and the Pacific to enhance their engagement in global processes such as the Sixth Assessment Cycle of the IPCC. Recently, ANCST has also promoted the Kuala Lumpur Multi-Hazard Platform (MHP), a forecasting system developed with support from the Newton-Ungku Omar Fund. Improved forecasting capacity for flashfloods, landslides, sinkholes, strong winds, urban heat and air pollution at the city and neighbourhood level is expected to greatly contribute to enhanced climate and disaster resilience in tropical areas (Pereira et al., 2021). The capacity of the MHP to forecast short-lived climate forcers is currently being expanded to support climate change mitigation action at the city scale.

4. Concluding Remarks

Current global warming levels are already a challenge for cities and critical infrastructure. Decisions made in the next decade will determine the extent and severity of these difficulties. In all pathways compatible with 1.5°C warming, carbon dioxide emissions fall by 45% by 2030, reaching net zero around 2050, with deep cuts in methane and other emissions (IPCC, 2018). This is possible through more ambitious action from all countries. Global warming levels that exceed 1.5°C will limit adaptation possibilities for some natural and human systems. Development will not be possible in some regions, particularly low-lying coastal cities and settlements and small islands. Rapidly scaled-up investment is key for cities and infrastructure, through increased international cooperation to mobilize resources and technology transfers.

Climate change has already impacted cities, damaged infrastructure, disrupted services and affected supply chains in the Asia-Pacific region. The risk to cities and infrastructure is expected to increase as global warming inches closer to 1.5°C. Climate change offers an opportunity to invest in low carbon disaster-resilient cities and climate-resilient infrastructure in the region. Cities and critical infrastructure need to be inclusive, safe, resilient and sustainable. There is a need to prioritize partnerships. Expertise and multi-layered knowledge are required to make cities resilient and develop new critical infrastructure, in the context of a multi-hazard scenario, with special focus on early warning systems and nature-based solutions. Communication among different stakeholders is key to maintain resilient cities and infrastructure. A way forward is through enhanced multi-stakeholder engagement and incorporation of science, engineering, technology and innovation in policy and decision-making.

BOX 3: MULTIPURPOSE CYCLONE AND FLOOD SHELTER IN ODISHA, INDIA

Odisha is an Eastern State of India situated on the Bay of Bengal, which frequently faces cyclones and floods. In the last 22 years, Odisha has witnessed 10 major cyclones, including Yass in 2021 and Amphan in 2020. The Odisha State Disaster Management Authority, with the financial support of the government and the World Bank, took major initiatives to provide multipurpose cyclone and flood shelters. Over 180 cyclone and flood shelters were constructed at strategic locations in cyclone and flood-prone areas in Odisha.

The main aim of the multipurpose shelters was to ensure that every single individual in the flood and cyclone prone areas would have access to a safe shelter. The locations of the shelters were chosen in such a way that the maximum distance to the shelters was 2.25 km. Also, these shelters were constructed near existing public buildings such as schools, so that they could be used as an extension of the existing facility during normal times. Additionally, the government of Odisha also planned to use these multipurpose shelters as community halls, training centres, child services (anganwadi Kendra), marriage mandaps and for other social gatherings. In order to maintain the multipurpose shelters, community stakeholding was well integrated in the system. These shelters could also be put to economic use in exchange for the payment of a nominal user fee, without affecting their primary use. Source: Odisha State Disaster Management Authority (2012).

Image Source: Odisha State Disaster Management Authority,2012


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5. SCIENCE, INNOVATION AND ENTREPRENEURSHIP

Antonia Yulo Loyzaga[1] and Ranit Chatterjee[2]

1. Introduction

Science, Engineering, Technology and Innovation (SETI) are driving the disaster risk management and sustainable development paradigm across the globe. The private sector is emerging as a crucial stakeholder in promoting SETI by funding, supporting and engaging with government, academia and communities. Having said that, it is important to highlight that the private sector is not a homogenous entity, and hence the risk and capacities vary according to multiple contributing factors like scale, legality, investment and sector, among others. The Global Assessment Report on Disaster Risk Reduction (GAR) of 2013 stressed the higher risk faced by micro, small and medium enterprises (MSMEs) when faced with a disaster. On the other hand, MSMEs are more likely to invest in technology and innovation to get an edge over their competitors.

Governments have historically played the lead role in disaster risk management. The magnitude of destruction and lasting impacts of disasters such as the Indian Ocean Tsunami in 2004, Cyclone Nargis in 2008, the 2011 Great East Japan Earthquake and Tsunami, the floods in Thailand and Super Typhoon Haiyan in 2013 have significantly altered this perspective. By 2015, these disasters had catalyzed a shift in global strategies from disaster management to an all-hazard and whole-of-society approach towards disaster risk reduction for resilience. Significantly, also in 2015, international agreements on the SDGs and the Paris Climate Agreement were reached. Along with the Sendai Framework, these agreements clarified and reinforced the roles of non-governmental sectors in development trajectories leading to the generation of disaster risk and introduced opportunities for them to proactively contribute to climate and disaster resilience.

The private sector's traditional role in disaster risk management had been that of a relief donor to affected communities. By 2015 however, four other types of private sector engagement had been identified, which highlighted the shift from ex-post to ex-ante approaches in risk management. These are: investments in business preparedness, the development of innovative products, assuming the role of implementer in joint projects with government, NGOs and international organizations, and establishing corporate vehicles for outreach, foundations and trusts (Izumi and Shaw, 2015).

Some countries in the Asia-Pacific region have consistently ranked among the top ten most affected countries in the world in terms of the human cost of disasters between 2000-2019 (UNDRR, 2020). Apart from mega-disasters in the region, the impacts of more frequent but less intense and slow-onset climate-related hazards on businesses processes, the work force and supply chains are now among the key drivers of private sector investment in SETI for risk prevention and recovery. In terms of exposure and vulnerability, critical factors influencing priorities and capacities to invest in disaster risk reduction include the type of sector, the nature and scale of the business in terms of capital size and revenues as well as location and level of digitalization.

1 National Resilience Council
2 Kyoto University and Resilience Innovation Knowledge Academy

Large corporations, that operate in multiple locations, have greater access to financial capital and to different types of human and technical resources, are typically capable of adopting a broader range of anticipatory investments in SETI-based business continuity management systems to insulate core business value cycles. This is not the case for MSMEs, some of which are corporate contractors, suppliers and service providers.

Limitations on mobility due to the COVID-19 pandemic catalyzed digitalization in economies across the globe. Since 2020, large corporations and MSMEs came under pressure to pivot towards digital processes and adapt their business models to the epidemiology and social dynamics of this biological hazard. The combination of hazards such as tropical cyclones, earthquakes and volcanic eruptions with the pandemic poses new challenges to the viability of private enterprises and has left many MSMEs across the Asia-Pacific region struggling or unable to survive financially.

MSMEs do not have uniform, defining parameters across countries in the Asia-Pacific region. The baseline distinction between large and micro-, small and medium enterprises in the Asia-Pacific region is centered on the number of employees and investment. However, the cut-offs, which range from 200 to 1000 employees and other economic criteria, vary across countries within the region and across sectors (ADB, 2018). Given these variations, we rely on estimates from different bodies to establish their approximate number. The Asia Pacific Economic Cooperation organization estimates that SMEs account for over 97% of all businesses in the region. Sub-regionally, the Institute of Southeast Asian Studies reveals that 99% of operating businesses in Southeast Asia are MSMEs, with micro-enterprises employing the largest number of people. A 2019 International Labour Organization (ILO) study found that self-employment and microenterprises accounted for as much as 80% of employment in South Asia. While these figures confirm that the MSME sector is an essential partner in the growth and dynamism of both national and global economies, they do not reflect associated, unregistered enterprises and livelihoods that constitute the informal economy. In 2018, the ILO estimated that 1.3 billion people in the Asia-Pacific region work in the informal economy (ILO, 2019). Considering the high risks for MSMEs coupled with the high employment dependency on them, it is imperative that MSMEs be the prime focus of disaster risk management.

2. Challenges and Opportunities

Large corporations may have a single or multinational presence. This will determine the combinations of hazards and risks a company needs to address and the opportunities to innovate and invest in the resilience of its business(es). Multinational corporations, while potentially exposed to more hazards, might efficiently adapt under different regulatory, socio-ecological and geopolitical settings. Their capacity for risk reduction would necessarily have transboundary implications on their overall business performance. Corporations located in a single country are however not fully insulated from the impacts of regional and global events due to globalization and connected supply chains. While the range of natural hazards they are directly exposed to may be geographically limited, the impacts of climate change and pandemics, their reliance on financial flows, supply chains and information technology can generate and/or deepen vulnerabilities in their operating systems.

To cope with potential disruptions, corporations have adopted a range of business continuity and risk management standards, policies and practices established by the International Organization for Standardization (ISO, 2019). ISO provides guidance and certification for investments in, among others, business continuity management systems, information security, environmental management and, most recently, climate resilience (ISO, 2022). These standards intend to ensure rapidity, resourcefulness, redundancy and robustness in the event of disruptions. Additionally, the Global Reporting Initiative's standard of sustainability reporting and efforts such as those of the Task Force for Climate-Related Financial Disclosures show increasing levels of awareness and investment by corporations in the need to manage impacts on markets, host communities and supply chains in light of disasters, climate change and Sustainable Development Goals. The introduction of the Environment, Social and Governance (ESG) component into sustainability reporting opens new pathways to integrate climate and disaster resilience into business operations and outreach. United Nations agencies have likewise led intersecting efforts with the private sector towards sustainability and resilience, such as the Global Compact Network, the Connecting Business Initiative and the Private Sector Alliance for Disaster Resilient Societies (ARISE).

Corporations have taken steps to invest in evidence-informed climate and disaster risk reduction for the resilience of their operations, partners and communities. The Jollibee Food Corporation, a Philippine fast-food corporation with branches in 34 countries worldwide, in cooperation with IBM, trains Filipino farmers in their supply chain to interpret weather data, manage impacts on high-value crops and develop diversified livelihoods (Jollibee Group Foundation, 2021). The global corporation Unilever collaborates with non-governmental organizations and communities in the fields of post-disaster relief, disaster planning, environmental management and providing technical expertise for business continuity of its small and medium-sized enterprises (Unilever, n.d.). The shipping company UPS has a consistent partner in disaster response logistics, not just during rapid-onset events such as Super Typhoon Haiyan, but also to provide support for vaccine delivery during the COVID-19 pandemic (UPS, 2019).

MSMEs are considered more vulnerable to natural hazards due to the limited resources they command, the marginalized locations they tend to occupy, as well as limited insurance and other safety nets. UNDP (2013) highlighted the differential risk within MSMEs as an interplay of exogenous and endogenous factors. The high rate of informality within MSMEs leads to a lack of baseline data, which in turn becomes an impediment to plan an effective recovery in the aftermath of a disaster. On the positive side, MSMEs are invaluable to the wellbeing of local economies. In the aftermath of Nepal's 2015 earthquake, MSMEs were the main driver, providing essential commodities to affected communities (Chatterjee and Okazaki, 2018).

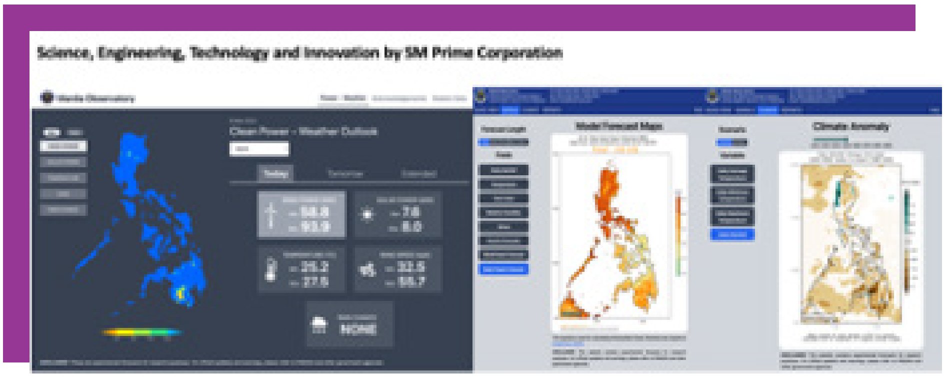
The United Nations General Assembly declared June 27th MSME Day to highlight the role of MSMEs in a sustainable and resilient economy and decent work for all. The Covid-19 pandemic stands testimony to the importance of MSMEs in providing basic amenities and keeping local economies afloat. The supply of PPE kits, ventilators and other essentials were supported by MSMEs and startups across the world. In India, where chain grocery stores stopped operations during the 1st phase of the pandemic, local grocery stores provided food to the people. Swiggy, an Indian startup, made door-to-door deliveries of groceries and other commodities even during the lockdown period. Similarly in 2015, during the Chennai floods, OLA, a taxi service startup, started an online boat service to rescue stranded people. It also assisted government response agencies by providing navigational maps of local areas.

Innovation is an inherent characteristic of MSMEs to compete and create their own niche in the market. A 2020 ADB report suggests that MSMEs need to build synergies with industry 4.0 tools, especially in the pandemic situation, to deal with human resources and other resources. Studies have found that MSMEs which are adaptive to market and technological changes are better off (Wardi et al, 2018). Anggadwita et al. (2021) stress that innovation is driven by the technological capacities of MSMEs, which are crucial for strengthening business resilience and ensuring business continuity.

3. New Modes of Partnership: SETI-Driven Multi-Stakeholder Action Research and Social Enterprise

To address the complexities of local exposure and vulnerability to risks from climate and other hazards, new modes of public-private partnerships have emerged. These trans-disciplinary and multi-stakeholder collaborations have embraced resilient development outcomes and impacts rather than humanitarian approaches to risk reduction for resilience. Kokusai Kogyo of Japan was among the first members of UNDRR's ARISE network of companies. In 2017, it collaborated with national and local governments, Tohoku and Osaka Universities and Nippon Electrical Company, to model flooding and tsunami damage for disaster prevention and response (Nippon Electrical Company, 2017). The Zuellig Family Foundation is a private foundation associated with Zuellig Pharma, which operates in all of Asia and is a key vaccine logistics and distribution partner of the Philippine government's pandemic containment campaign. The Foundation has partnered with the Department of Health and local governments, corporate foundations and academic institutions in the development of resilient health service delivery networks (Zuellig Family Foundation, n.d.). The National Resilience Council in the Philippines has engaged large corporations, national government agencies, local government units, academic partners and civil society organizations in capacity building for science and technology-based multi-hazard risk governance (National Resilience Council, n.d.). In India, the Tata Group established the Jamsetji Tata School of Disaster Studies for the education and training of disaster managers and professionals (Tata Institute of Social Sciences, n.d.). This direct investment by a private corporation in the institutionalization of knowledge and expertise is a significant recognition of the need to systematically confront the complexity of disaster risk in the country.

BOX 4: SETI AND SM PRIME CORPORATION



Images courtesy of the Manila Observatory: https://panahon.observatory.ph/ecw/

SM PRIME Corporation utilizes localized multi-hazard risk analysis as inputs to the architecture, engineering and operation of their core business of retail mall construction and management. Selected urban malls are designed with floods retention capacity and for use as evacuation centers. In 2020 SM Prime provided research funding and site management to the automated weather station network of the Manila Observatory for the High Definition Clean Energy, Weather and Climate Forecasts for the Philippines Project. Forty-nine automated weather stations are located in SM Malls throughout the Philippines. SM Prime is the lead partner of the National Resilience Council (NRC) and a global member of UNDRR Alliance for Disaster Resilient Societies (ARISE).

BOX 5: RESILIENCE INNOVATION KNOWLEDGE ACADEMY

The Resilience Innovation Knowledge Academy (RIKA) is a social enterprise startup that bridges the research and policy gap in disaster risk management. RIKA is a member of ARISE India and has been working in various countries in the Asia-Pacific region, supporting regional, national and local governments, UN agencies, academia, and NGOs. RIKA has recently been engaged in developing the UNDRR's Quick Risk Estimation (QRE) Tool for supporting MSMEs' Covid risk estimate. In addition, RIKA has been engaging with universities in Japan and India to promote innovation in disaster risk reduction and climate change through an innovation challenge. Recently, RIKA has expanded its work through its sister RIKA Institute to further disaster education, research & development for disaster risk management.

4. Way Forward

It is evident that S&T is one of the crucial driving factors for the private sector, irrespective of its heterogeneity. Science and technology are important enablers for addressing the various risks present in the private sector. Considering that the private sector has the strongest connection to the community among all the stakeholders of disaster risk management, this can be leveraged to promote a culture of safety and resilience.

It is often noted that private enterprises work within their own domain of expertise, seldom bringing in interdisciplinary collaboration for common goods. Such collaborations are essential for addressing new and emerging hazard risks. Establishing a platform, such as the Spatial Finance Initiative, to draw synergies from cutting edge technologies used by different sectors would lead to the creation of new solutions. The large and medium size corporations often have a transboundary presence, either through their own subsidiaries or through suppliers. This is an effective mechanism for sharing new technologies along the supply chain. In case of a transboundary disaster like the 2004 Indian Ocean Tsunami, the relief and response efforts can be supported by the private sector with ease through their own networks.

Promoting innovation and social entrepreneurship among youth and young professionals, to address data gaps and bring in new research and cutting edge technology, is the need of the hour. The case of the Tata Institute for Disaster Studies is a good example of a way to promote disaster education and encourage youth to take up a career in disaster management. Addressing the digital divide within the private sector is of the utmost importance. Having access to technology would allow private enterprises to develop internal capacities to face hazards and threats. Large corporations could support technology transfers down their supply chain to reduce disruption and ensure business continuity. The access to risk estimates and other such tools for MSMEs is extremely important to raise awareness of disaster risk management and contribute to socio-economic stability.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6. CASCADING (INCLUDING NATECH), COMPOUND AND SYSTEMIC RISKS

Rajib Shaw[1] and Emily Chan[2]

1. Introduction

In the increasingly interconnected and globalized world, multiple hazard scenarios have been drastic reminders of the evolving nature of risk, manifested as compound, cascading and systemic risks. Conventional risks, coupled with the context of climate change and rapid urbanization, and increasingly interdependent supply chains and systems, have taken on unprecedented, often irreversible characteristics by becoming more intense, frequent and complex. Over the past two years, the world has witnessed how the COVID-19 pandemic, along with various natural and human-made hazards, has led to devastating direct and indirect impacts on communities and infrastructures across sectors and countries. Furthermore, it has been observed that risk management is often too compartmentalized to delegate responsibilities at the local, regional and global scales (UNDRR, 2019). However, this compartmentalized risk assessment and management approach overlooks not only the linkages between the different elements of a system or inter-dependencies, but also the intersectionality of multiple dimensions of vulnerability and the fact that the failure of one element may lead to compound, cascading and/or systemic failures in other interconnected systems.

Due to its geographical and geological location, the Asia-Pacific region is exposed to an intimidating array of natural and human-made hazards and is severely impacted by disasters (UNESCAP, 2019). Since 1970, the region has accounted for 57% of global fatalities and 87% of the global population affected by disasters rooted in natural hazards. Poverty, rapid urbanization, weak risk governance, the decline of ecosystems and climate change exacerbate the complex nature of risk. Complex risk and its manifestations not only undermine the years and decades of development gains but also act as an impediment to sustainable development (IRP, 2020). This raises the need to embed risk management into sustainable development in order to create the resilient and sustainable future enshrined in the 2030 Agenda for Sustainable Development.

2. Current Knowledge Base

A thorough literature review, through keyword search on ScienceDirect, was undertaken to analyze the temporal trend change in the publications concerned with compound, cascading and systemic risks. The keywords used for the search were as follows:

- "Compound risk" OR "Compound disaster"
- "Cascading risk" OR "Cascading disaster"
- "Systemic risk"

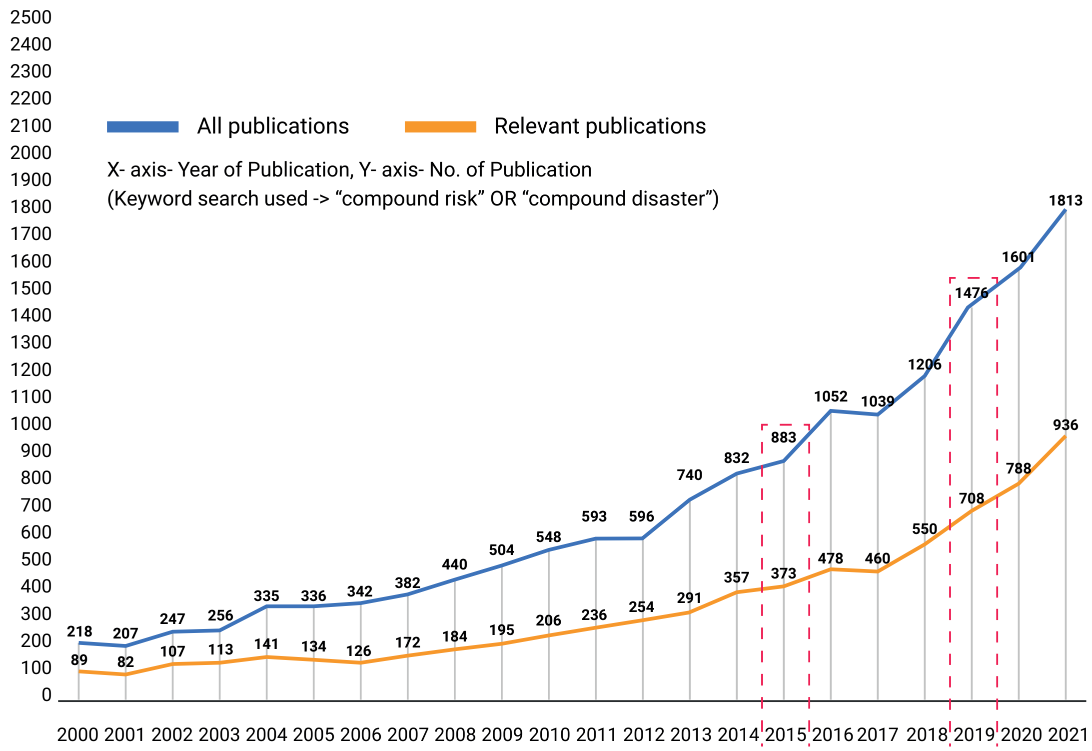
Based on the keyword inputted, ScienceDirect categorized the available publications according to the following subject areas: Medicine and Dentistry, Biochemistry, Genetics and Molecular Biology, Immunology

1 Keio University
2 The Chinese University of Hong Kong

and Microbiology, Pharmacology, Toxicology and Pharmaceutical Science, Neuroscience, Nursing and Health Professions, Environmental Science, Agricultural and Biological Sciences, Veterinary Science and Veterinary Medicine and Social Sciences. Out of all the publications, the relevant ones, mostly belonging to the subject areas of Environmental Science and Social Sciences, were mapped. The temporal trend from 2000 to 2021 (up to 1st November 2021) of relevant literature on compound, cascading and systemic risks and the types of publications, are shown below in Figures 5 to 7.

Figure 5 Relevant Publications on Compound Risk/Disaster

(a) Temporal trend of relevant publications on compound risk/disaster



(b) Types of relevant publications on compound risk/disaster

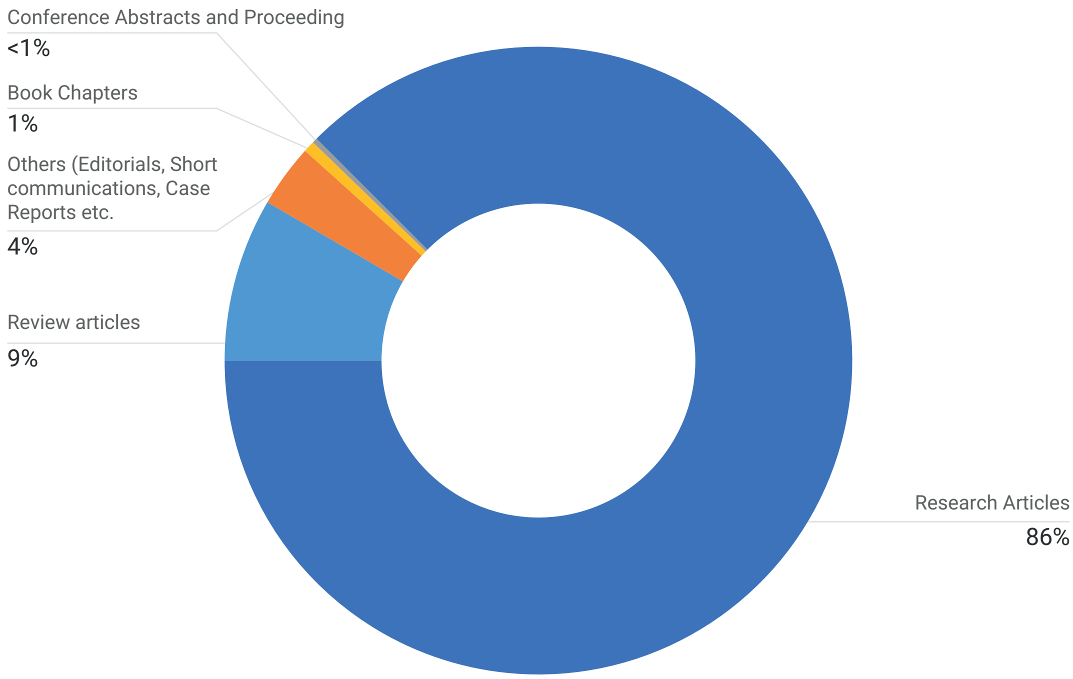
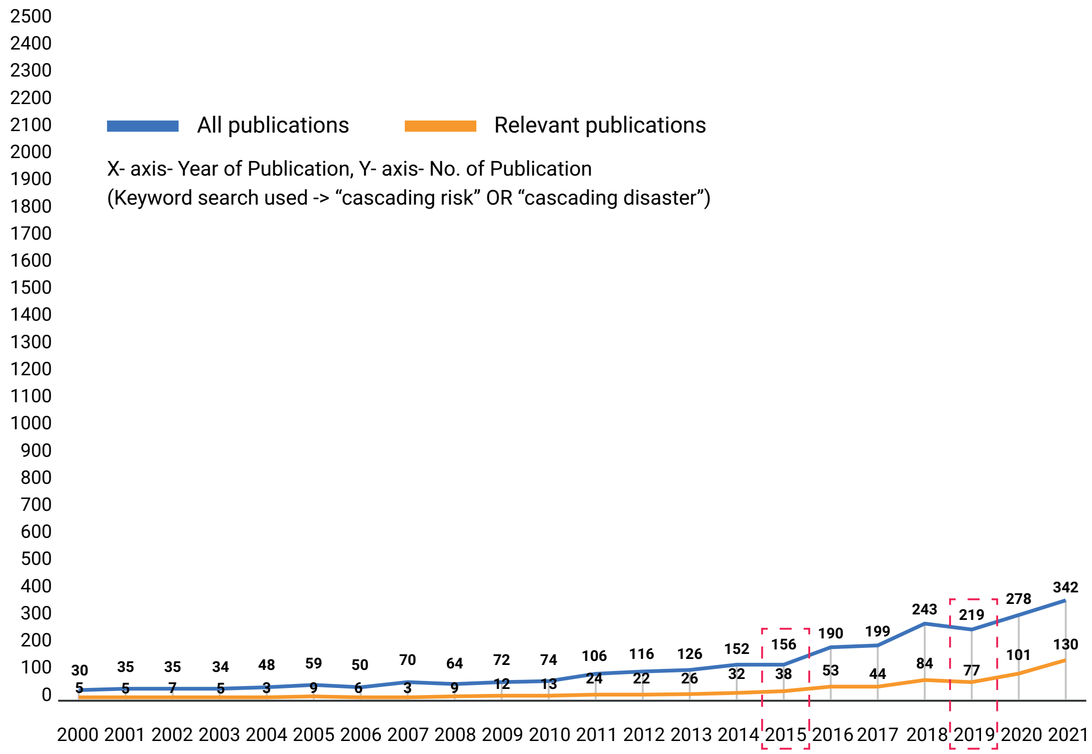


Figure 6 Relevant publications on Cascading Risk/Disaster

(a) Temporal trend of relevant publications on cascading risk/disaster



(b) Types of relevant publications on cascading risk/disaster

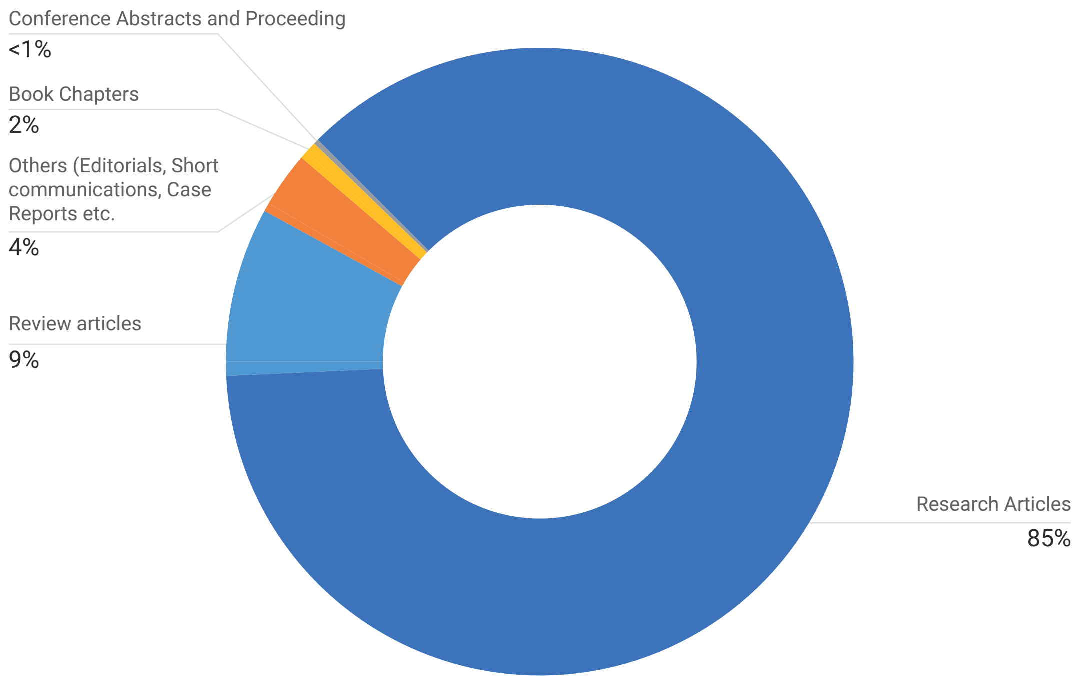
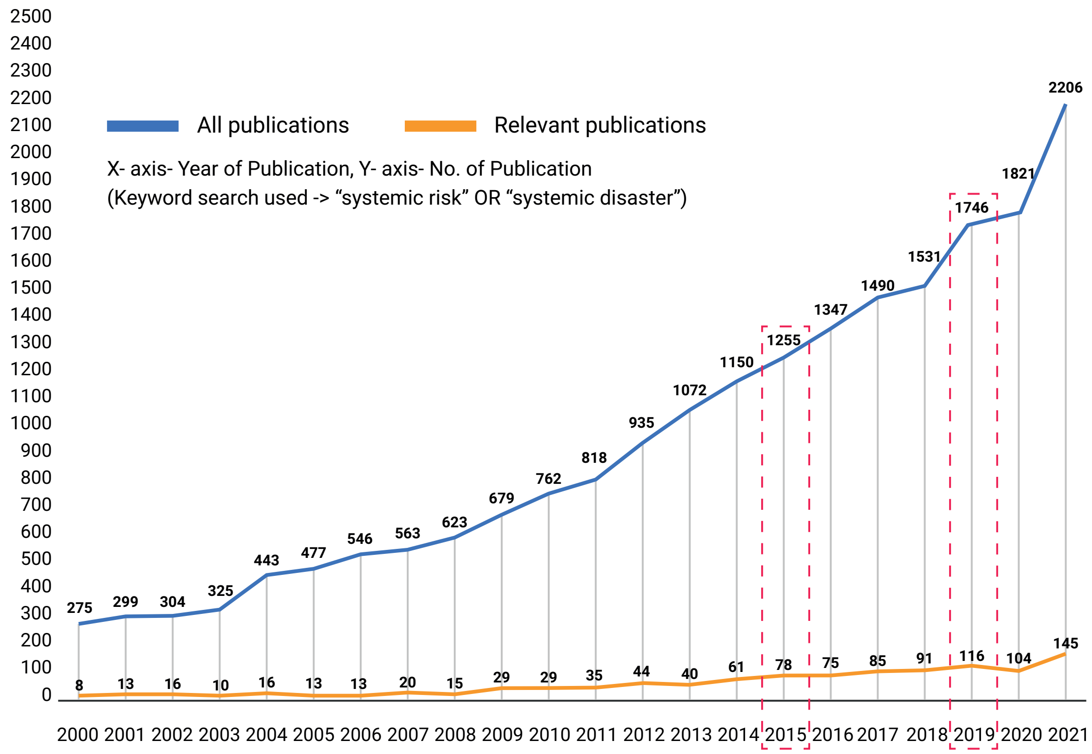
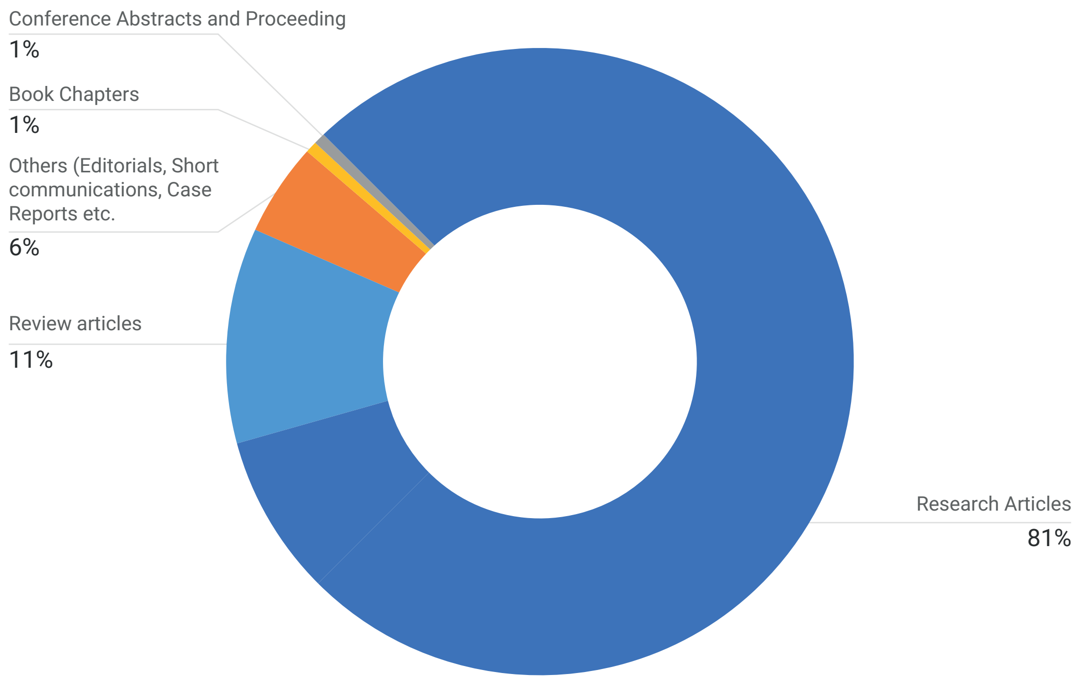


Figure 7 Relevant Publications on Systemic Risk

(a) Temporal trend of relevant publications on systemic risk



(b) Types of relevant publications on systemic risk



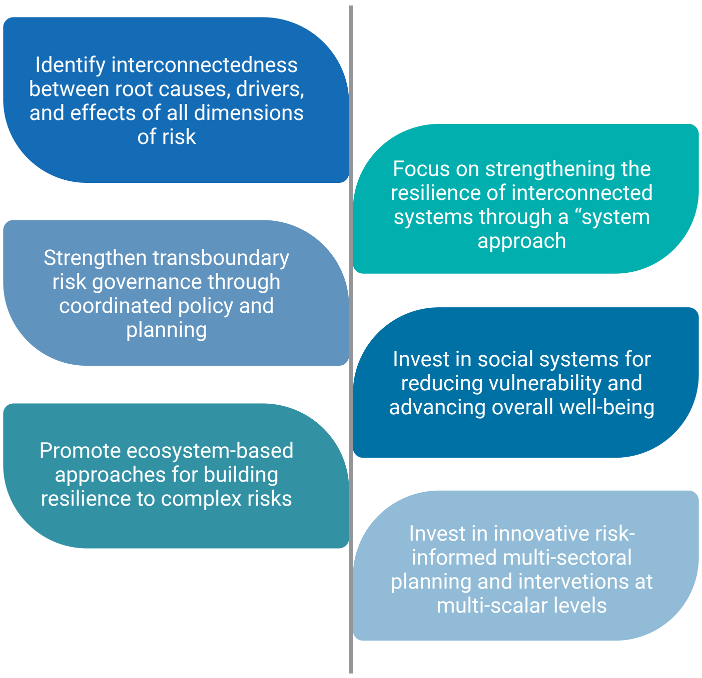
The findings emerging from the literature review suggest that there has been a key positive shift in academic interest concerning compound, cascading and systemic risks. From 2000 to 2021, relevant publications on compound risk increased from 89 to 936; those on cascading risk increased from only 5 to 130; and those on systemic risk increased from only 8 to 145 (Figures 5 to 7). This shift, especially since 2011, could be associated with the discourses concerning cascading and systemic risks after certain disasters, such as the Great East Japan Earthquake and Tsunami of 2011, and the introduction of novel outlooks and frameworks such as the Sendai Framework for Disaster Risk Reduction 2015-30 and the Global Assessment Report on Disaster Risk Reduction 2019, which have invigorated research into these areas. The years 2015 and 2019 show an increase in publications for each of the three risk categories discussed in this study. In addition, in the case of compound risk, the availability of publications has been higher since 2000, in comparison to those on cascading and systemic risks.

While the concepts of compound, cascading and systemic risks are not new to the disaster risk management field, there has been a resurgence of interest due to three factors: (1) the potential of such risks spurring on widespread disruptions to global societies/economies because of the interconnectedness between systems; (2) frequent recurrence of these types of interconnected disasters every year; and (3) each system or stakeholder group, with its own knowledge/approach, engages differently/individually with these hazards (Cutter, 2018).

3. Basic Principles for the Management of Compound, Cascading and Systemic risks

Based on a few case studies from the Asia-Pacific region and a thorough review of the literature, six basic principles for strengthening the management of compound, cascading and systemic risks are suggested below (Figure 8).

Figure 8 Basic Principles for the Management of Compound, Cascading and Systemic Risks



4. Framework for Strengthening the Governance of Compound, Cascading and Systemic risks

Manifestations of compound, cascading and systemic risks underline that the increasing and complex nature of risk is difficult to manage, unless it is addressed using a systems approach. Understanding a system and the various risk patterns it is exposed to calls for a holistic conceptualization and assessment of all dimensions of risk. Such a multi-hazard, multi-dimensional and multi-scalar assessment of risk is the precursor to strengthening the governance of compound, cascading and systemic risks.

The proposed framework (Figure 9) for strengthening risk governance – governance for sustainability and resilience – expands on the Global Risk Assessment Framework 2020-2030 (UNDRR, 2019) to highlight specific considerations required for assessing and managing compound, cascading and systemic risks. These considerations are laid down across hazard, exposure, vulnerability, scale, and systems.

Figure 9 Framework for Strengthening the Governance of Compound, Cascading and Systemic Risks

	HAZARD	EXPOSURE	VULNERABILITY	SCALE	SYSTEM
GRAF 2020-2030 (UNDRR 2019)	EARTHQUAKE VOLCANO TSUNAMI FLOODING DROUGHT FIRE LANDSLIDE BIOLOGICAL CHEMICAL INDUSTRIAL NATECH NUCLEAR RADIOLOGICAL	STRUCTURAL AGRICULTURE BASIC SERVICES HOUSING CRITICAL SYS-TEMS SUBSYSTEMS NATURAL CAPITAL	ECONOMIC SOCIAL ENVIRONMENTAL GOVERNANCE LEGAL SECURITY	GLOBAL REGIONAL NATIONAL SUB-NATIONAL METROPOLITAN LOCAL	HUMAN ECOLOGICAL ECONOMIC POLITICAL CULTURAL FINANCIAL
ASSESSING RISK	Identifying relation between triggering & triggeredhazards	Mapping exposure in spatio-temporal scale	Assessing underlying multi-layered and complex vulnerabilities	Understanding risk & its complexities at all geopolitical scale	Mapping in-terdependencies between systems «Systems Approach»
MANAGING RISK	Identifying relation between triggering & triggeredhazards	Mapping exposure in spatio-temporal scale	Assessing underlying multi-layered and complex vulnerabilities	Understanding risk & its complexities at all geopolitical scale	Mapping in-terdependencies between systems «Systems Approach»

STRENGTHENING THE GOVERNANCE OF COMPOUND, CASCADING, AND SYSTEMIC RISKS

GOVERNANCE OF SUSTAINABILITY AND RESILIENCE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7. YOUTH AND INNOVATION

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1. Introduction

The Co-Chairs' Summary of the 2019 Global Platform for Disaster Risk Reduction stated that "youth and young Professionals (YYPs) are leading the way in disaster risk reduction and climate action. Greater efforts are required to institutionalize their engagement and appropriately draw on their capacities.'. The attention to children and youth has increased since it was stated in the Sendai Framework that "children and youth are agents of change and should be given the space and modalities to contribute to disaster risk reduction"

U-INSPIRE - a platform for youth and young professionals in Asia and the Pacific to leverage SETI for DRR & resilience - aims to address the above-mentioned gaps, especially the urgent need for innovations in DRR, and to connect youth and young professionals to co-create innovations. The term "youth" in this article includes young professionals (up to 40 years old), as defined by U-INSPIRE. U-INSPIRE members' profiles suggest that youth may contribute to science and technology for DRR no matter their professions and disciplines, which range from geosciences and architecture to statistics, with members being students, lecturers/researchers, entrepreneurs, artists, journalists, employees of NGOs, international organizations, government institutions, private institutions and independents.

With existing human capital resources, U-INSPIRE accommodates them by increasing their impact, providing added value, both in terms of quality and outreach to communities and policy-makers, and by initiating collaboration. Based on an early-stage survey of 48 members in October 2019, about 67% of them mentioned that they had collaborated with other members after joining U-INSPIRE, in various forms, such as science communication activities, learning, research, community outreach, etc. (Shidiq et al., 2019). This is a promising sign of U-INSPIRE's aim as a platform to break down silos and build friendships and collaborations instead.

Based on the activities of members from U-INSPIRE country chapters, the major SETI for DRR activities are related but not limited to "dissemination", "research", "school", "preparedness", "science communication" and "education" (Sidiq et al, 2020).

1 U-INSPIRE Alliance
2 UNESCO

Figure 10 Potential Areas of Action for Youth, Young Scientists and Young Professionals in Science, Engineering, Technology and Innovation for DRR

(based on U-INSPIRE Alliance database, 2021)

1. RISK COMMUNICATION, EDUCATION AND COMMUNITY AWARENESS

Myth and hoax buster through Infographics, Videos, Fact sheets, Blogposts, creation of games, art multimedia, knowledge sharing

2. TECHNOLOGY, DESIGN, INNOVATION

COVID19 Monitor, COVID-19 Risk Assessment tool for risk index Health, Exposure, Social behavior & policy, The Importance of Data and Information Management, Low Cost Ventilator, portal for COVID 19 and low-cost sanitize booths, Low-cost Tech, UAV for humanity, Design Innovation, Platform/App development, Emerging Technology (Satellite, IoT, AI)

3. WORKING WITH LOCAL COMMUNITIES ON CONCRETE ACTIONS

On the ground volunteer work as frontlines, assisting less fortunate, participatory hazard & evacuation mapping, safe school assistance

4. RESEARCH AND DISSEMINATION

Research activities and dissemination, articles, books, presentation, Impact of COVID-19 to Tourism, SIR Modeling to determine peak infection time on COVID-19, GIS Based Smart Lockdown Plan, COVID-19 Social Studies, Natural Disasters in times of COVID-19

5. EVIDENCE - BASED POLICY

DRM planning documents, policy-making process

6. SOCIO-ENTERPRENEURSHIP

Cari!, RIKA, Youth Innovation Lab, HRRI, Fly for Humanity, Siagabencana.com, etc

2. DRR Research and Innovation

One-fifth of the students listed as members are postgraduate students. Postgraduate students are the ones who have contributed to research activities and publications (articles in scientific journals, books). For example, a book entitled Retrofitting Techniques for Disaster Resilient Structures - Lessons and Insights was co-written by a 25-year-old master's student with an architect; and the article "An analysis of natural disaster-related information seeking behavior using temporal stages" was authored by a 28-year-old PhD candidate.

Another example of DRR research and innovation conducted by youth and young professionals can be seen in the Confederation of Risk Reduction Professionals (CRRP) in India, which discussed the process of re-inventing community-based disaster risk reduction management in an infographic book called Mili Juli. This collective product is an example of the integration between community participation and research outputs by young professionals. This indicates that YYPs who have a deep interest in DRR can collate, conduct research and innovate to suit their interests and targeted communities.

3. Advancement of Local Actions using Science, Technology, Innovation and Art: Risk Communication, DRR Education and Community Awareness

Youth and young professionals within the U-INSPIRE network have also shown the ability, passion and flexibility to work on the ground level, with the communities on local actions, utilizing science, technology, innovation and art. Local community actions include community-based disaster risk reduction, safe schools, co-developing DRR education materials to increase disaster literacy, DRR education with schools and communities, participatory village watching, developing participatory evacuation maps, evacuation planning and conducting disaster drills. Other examples include assisting in the implementation of the Tsunami Ready program with local communities, using an innovative approach such as the development of Tsunami Ready board games, collecting and preserving local wisdom using technologies such as unmanned aerial vehicle (UAV) mapping, GIS, GPS and apps, and art to humanize science, technology and local knowledge. (e.g., Furqon et al, 2018, predikt.id, ecofun.id, Mili Juli CRRP India). Programs, which are designed to facilitate collaboration between members and other DRR stakeholders in the country, can trigger innovation such as the DRR Hackathon, Disaster Literacy, science communication, the use of digital technology, applications, educationals board games and DRR socio-entrepreneurship.

Several recent examples include but are not limited to:

- saintif.com, a website that answers daily science concerns, created by bachelor students of a Physics department.
- Science videos related to water and geoscience on the YouTube "Geo-Water Channel Indonesia".
- A graphic designer from box-breaker.com has been translating scientific narration on DRR into visual representations that are easier to understand for the general public.
- DRR education through geotourism in the active Lembang Fault, in Bandung city, Indonesia.
- A 24-year-old electrical engineering graduate founded Mari Bertani, an organization that promotes a circular lifestyle through farming. He also invented an automatic waste processor, a waste management device.
- AP-PLAT: Asia-Pacific Climate Change Adaptation Information Platform is an online space where anyone can access information to understand future climate change. AP-PLAT also links local observations and socio-cultural considerations (local adaptation knowledge), and designs specific adaptation measures as one of the key processes.

4. Evidence-Based Policy-Making

Evidence-based policy-making is the process of using high-quality information to inform decisions that are made about government policies. It involves the systematic collection of high-quality data and the analysis of this data with rigorous research methods, which creates the evidence on which decisions can be based.

Policy plays a crucial role in forming the guidelines and principles of a society. There is a paradigm change towards evidence-based policy in DRR. RIKA (Resilience Innovation Knowledge Academy) mentions that, for effective risk-informed decision-making, there should be fact-based knowledge of risk, risk should be known as either acceptable or not, and monitoring and evaluation should be determined.

5. Social Entrepreneurship

In recent years, we have witnessed and observed an increasing number of YYPs who use science and innovation to produce goods and services that disrupt old business models for disaster management activities. To name a few, within the U-INSPIRE network: CARI!, Fly-for-Humanity, RIKA, Predikt!, and Youth Innovation Lab, which operate both as for-profit and social missions. Regardless of the type of business venture, either as a non-profit organization or a start-up, social goals and a more socially-responsible business model are common objectives. One founder stated that "we partially used a for-profit business model, in fact, for sustainability purposes so that our organization would not rely on donors, become dependent, and lose its idealism". For instance, Fly-for-Humanity operates on a not-for-profit basis during emergency response and in other instances, operates for-profit activities during "peace time", such as aerial documentation, survey, and trainings. Another example, CARI!, provides a free and accessible search engine for research on disaster resilience and monthly knowledge syntheses, and at the same time provides tailor-made premium analytics for resilience building, as well as ICT and systems integration. UAV for Humanity is an initiative that focuses on the utilization of Unmanned Aerial Vehicles (UAV) or drones for the sake of humanity, disaster emergency response, and disaster risk reduction.

One challenge in this realm is the thin line between disaster management businesses and humanitarian action. On one hand, the conventional way of thinking of humanitarian action in Asia-Pacific often considers that economic motivation would turn actors into disaster profiteers. On the other hand, business investors often consider disaster-related business unprofitable. Notwithstanding this contradiction, developed countries (Japan, the US) have in fact both for-profit and nonprofit entities. Hence, perhaps what is needed is for disaster management to have its own, or facilitate integration into, a "B-certification" scheme, to label and classify entities with social entrepreneurship values, offering goods and services for resilience building. Furthermore, a dedicated incubation process could be developed so that these entities could learn to balance their social goals (resilience building) with for-profit modalities ensuring their organizational sustainability.

6. Future Thinking on Disaster Risk Reduction and Resilience

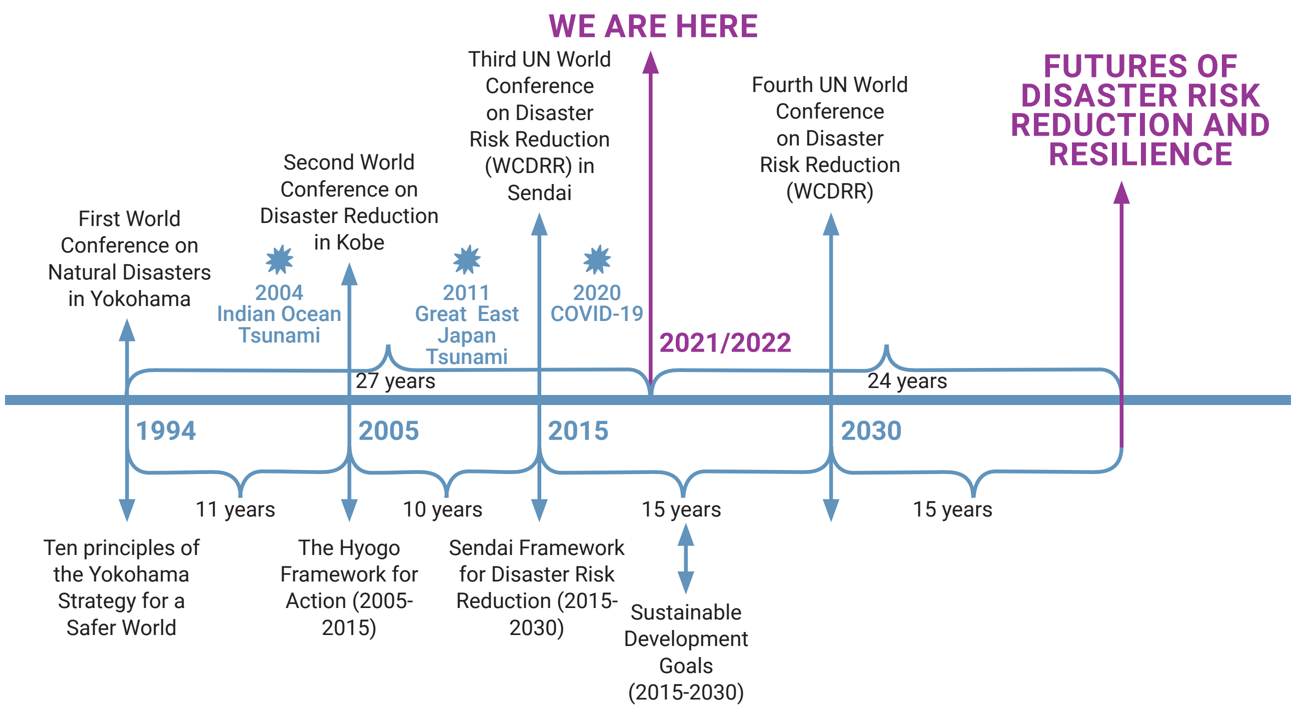
The shocks brought by the COVID-19 pandemic have generated a great deal of reflection, anxiety and action. Natural and climate-induced disasters have also happened during the pandemic. The pandemic now shapes how we respond to disasters, how we view DRR and what resilience means to us. Current DRR strategies and activities are based on the accumulation of everyday perceptions, choices and decisions made in the past. The current COVID-19 pandemic showcases that decisions and actions based on pre-pandemic "normalcy" had never been suitable to face the uncertainty of the future and this type of novelty. Our quest for certainty and repetition (of the past) has created the conditions for a vulnerable and fragile society, facing a plethora of disasters that we were unequipped for. Through the sole scope of preparation, we also limit the learnings we could draw from novel phenomena: unforeseen mutations or novel human behaviour. The only disasters we can foresee are events we know. How do we prepare for something we do not know? The only way to go is agility and resilience, openness to emergence, innovation, in short, futures literacy (Miller, 2015; UNESCO, 2018).

YYPs are future leaders, they will have the responsibility to make choices and decisions that will shape the future we (they) want. They have a key advantage: weaker commitment to the past, which inhibits our ability to use the future more freely. As they become more futures literate, their capacity to be more agile and resilient will also be enhanced.

UNESCO, UNDRR, UNDP Accelerator Lab, and the U-INSPIRE Alliance implemented a series of activities on Futures Thinking on Disaster Risk Reduction and Resilience in 2045. The series of activities consisted of webinars, a Futures Literacy Laboratory on Disaster Risk Reduction (FLL-DRR) and a Let's Talk DRR conversations that were organized throughout 2021 and 2022. The aim of the Futures Thinking on DRR and Resilience program is to leverage the collective intelligence and frontier thinking of youth and young professionals in Asia and the Pacific to challenge, create and negotiate concepts and frameworks for disaster risk reduction and resiliency in 2045.

The year 2045 marks (1) 50 years since the 1st World Conference on DRR; (2) 30 years since the last World Conference on DRR; and (3) current youth and young professionals will be between 41-64 years old and expected to be in leadership positions.

Figure 11 Futures of Disaster Risk Reduction and Resilience



Three FLL-DRR were organized in 2021–2022, engaging more than 120 young professionals in Asia and the Pacific and other regions. Three topics were considered: The Futures of Disaster Governance in 2045, The Futures of Disaster Knowledge in 2045 and The Futures of Human Behaviour and Hazards in 2045. The FLL-DRR became a learning process for young professionals to discuss and share their collective thoughts on the probable futures, the desirable futures, reframing the futures, and they also came up with new questions related to the topics. Following the FLL-DRR, a Let's Talk DRR (LTD) series was held, providing space for youth and young professionals to share their collective thoughts with a wider audience and to have expert perspectives and reflections of their collective thoughts. The three LTDs reached out to more than 600 participants.

Through these series of activities, the capacities of today's young professionals were enhanced and they developed a new skillset for anticipation and better decision-making. Simultaneously, they provided a venue and encouraged youth and young professionals to voice their views and thoughts on DRR and resilience.

7. How to move forward better

Many YYPs find it difficult to cement their SETI careers amidst frequent change, barriers and a culture of insularity in their institutions and careers. Support that youth and young professionals need is prioritized as follows:

- Vertical and horizontal development. Vertical development is to advance ECRs' thinking capability to a more complex, systemic, strategic and independent way. While horizontal development: equip ECRs with personal, technical and political skills to prepare them to become research leaders (CARI! and the Conversation, 2022).
- Greater synergy and collaboration between youth and young professionals' organizations in the region, reducing overlaps, strengthening their voices and also allowing for greater reach and visibility. During the past year, the U-INSPIRE Alliance has continued to engage with other countries that do not have national chapters, to encourage them to set up their own country chapter and connect with the bigger network.
- The need to engage with youth from other regions as well, sharing best practices and experience. In the past, the U-INSPIRE Alliance has engaged with the African Youth Advisory Board (AYAB), CARIDIMA of Caribbean Youth, and the Asia Water Council Young Professionals.
- Greater synergy and collaboration between UNDRR, other UN agencies and youth organizations in the region. The UNESCO Office in Jakarta and the UNDRR Regional Office for Asia and the Pacific have been strong supporters of the U-INSPIRE movement from the beginning. The support of both organizations has allowed the Alliance to expand, become more visible and it has provided many opportunities for the members to be involved in meaningful initiatives. Further involvement of other bodies will continue to strengthen and provide more opportunities. Further engagement could be conducted with other UN bodies such as UNICEF and the United Nations Major Group for Children and Youth, to provide more opportunities for YYP. U-INSPIRE has begun engaging with UNICEF, with U-INSPIRE Malaysia formally working together with UNICEF Malaysia in encouraging YYP involvement in Malaysia.

- During previous years, there has been a strong momentum in youth awareness and advocacy in the region, with more youth and young professionals becoming aware and vocal about their rights for a better world. Rather than suppress the voices of the youth, it is imperative that we leverage the momentum. More can be done to increase awareness amongst youth, including coming up with easy-to-understand materials and resources and easily digestible information.

Externalize capacity building programs that can connect researchers and the market, policy-makers, communities and funders.

Lastly, the Special Representative of the Secretary-General for Disaster Risk Reduction during her special lecture at the Centre for Strategic and International Studies in Indonesia, on 1 February 2022, mentioned the importance of engaging youth and young professionals to ensure and operationalize the Policy and Science Nexus: "All policy decisions for disaster risk reduction and resilience need to be guided be science and evidence. Science and knowledge are not bound to protocol. This is why countries must seek to promote innovation, in disaster risk reduction across the board, especially among the youth. They can bring in innovation that can leapfrog progress towards resilience."

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Part 3: Considerations for the Sendai Framework Midterm Review

The Sendai Framework for Disaster Risk Reduction 2015-2030 acknowledges the key role of S&T and calls for the integration of S&T into the implementation of the four Priorities for Action. It supports scientific and technical work and encourages increased collaboration between academic, scientific and research organizations and networks, and local governments and communities, to enable an interface between science and policy for effective decision-making in DRR. It also facilitates the strengthening of UNDRR's S&T advisory groups to mobilize S&T for DRR.

As we reach the mid-point in the implementation of the Sendai Framework, it is imperative that actions to achieve the outcomes of the S&T Roadmap be accelerated through 2030 and beyond. This will provide more evidence of the critical role of S&T in DRR and allow better uptake by different stakeholders. This report identifies Priority for Action 3 and Priority for Action 4 to have made the least progress among the four Priorities for Action and where work needs to be amplified.

The following reflects on the findings of Part 1 and highlights specific considerations in the thematic chapters of Part 2. It discusses key actions moving forward and makes recommendations for enhanced implementation of actions as input to the Sendai Framework Midterm Review and other global deliberations and processes.

OUTCOMES

Data and knowledge

Interdisciplinary and transdisciplinary approaches are promoted to strengthen the science-policy interface in DRR and CCA. An all-hazard approach, including the consideration of compound, cascading and systemic risks, is advanced to take into account the changing risk landscape. To enable data exchange, sharing and integration for enhanced risk information systems, data governance challenges in many countries are recommended to be addressed.

Dissemination

Science information to be truly useful requires appropriate translation which considers the target user and audience as well as risk perception. Information and knowledge products developed and made available on different platforms should also be considered for translation into the local language for better understanding. More avenues to disseminate information to different stakeholders should be explored.

Monitoring and review

Linking S&T progress reporting to the Sendai Monitor and the Voluntary Commitment System needs to be enhanced. Participatory mechanisms must be identified for improved feedback and action. Transparency and accountability are key to a people-centered approach for the implementation of actions and the achievement of outcomes.

Capacity building

Opportunities to accelerate S&T capabilities for risk-informed development should be encouraged and prioritized. More education, training and learning exchanges on implementing comprehensive risk management, including climate risk and climate change adaptation, are required to build capacities, especially of those that are most vulnerable. Platforms for knowledge transfer and sharing of good practices need to be promoted using various channels and technologies.

CROSS-CUTTING ISSUES

Governance

Accelerating coherence between DRR, CCA and SDGs was highlighted in order to take advantage of the synergies towards common goals. Vertical and horizontal integration in governance, particularly in establishing coherence among national and local plans, was also underscored. Localized actions need to be amplified to leverage subnational government and local community resources and capacities. S&T applications to make risk governance more adaptive to a changing risk landscape are key.

Cooperation

An all-of-society approach to DRR would lead to better participation of stakeholders, especially of civil society, the private sector and of communities at high risk. This would also ensure inclusivity and promote equality so that no one is left behind. Such an approach will make disaster risk management more effective. The role of youth and young professionals in SETI and DRR through networks such as the U-INSPIRE Alliance is underscored to advance the implementation of the Sendai Framework. In recent years, the importance of public-private partnerships is also more recognized, underlining the value of innovative public-private partnership models in DRR. The contribution of citizen science cannot be overemphasized as it empowers individuals and communities to take action in addressing local risks.

Funding

Increased investment in research and development was underscored. Investments in S&T need to be strengthened for application of those with DRR responsibilities towards science-based policy and practice. Diverse and continuous funding from different sources must be explored.

Technology and Innovation

Investing in new and emerging technologies is crucial to address climate and disaster risks. Innovation is required not only in terms of technology but also in reviewing processes, methodologies, tools and partnership models, among others, that benefit risk reduction actions. Frontier technologies provide promising solutions, but traditional and local knowledge must not be forgotten and instead be integrated into science-based solutions.

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